

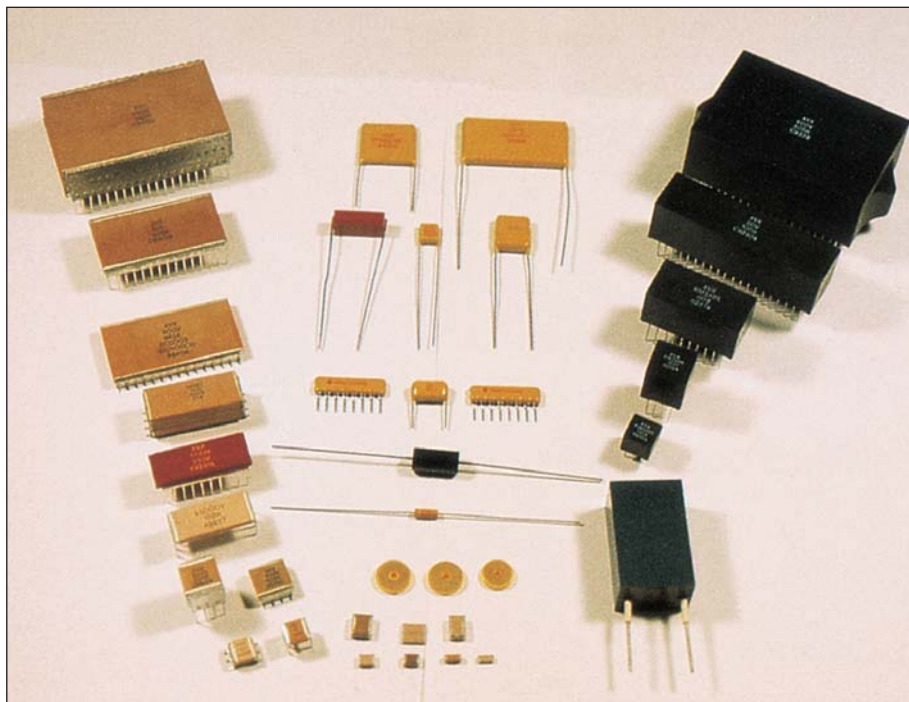


**AVX**  
**SMPS Caps/High Voltage Caps**  
**Tip & Ring/Cap Arrays/Discoïdals**  
**Advanced Applications**

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# Application Specific MLCs

## Problem Solving at the Leading Edge



As the world's leading manufacturer and innovator in application specific multilayer ceramic (ASMLC) capacitors, AVX offers a unique technological and production capability to the field. AVX actively pursues and satisfies the high reliability and custom needs of a variety of governmental and industrial customers. Successful involvement in missile programs, extensive work in ultra-high reliability telecommunications and sophisticated capacitor design applications – all have established AVX as the source for

advanced and high reliability ASMLC capacitors. **Advanced Products are ISO9001 certified organizations for design and manufacturing of MLC capacitors.**

AVX Advanced Application Capacitors are organized around three distinct functions:

- Application Specific Development Laboratories
- Advanced Manufacturing Facilities
- Quality Control

***For designs or applications not listed please consult Advanced Products.***

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International Space Station



Defense / Military



Telecommunications  
Undersea Cable Repeater

# Application Specific MLCs



## Problem Solving at the Leading Edge

### APPLICATION SPECIFIC DEVELOPMENT LABORATORIES

Initially, AVX technical personnel communicate with customers to learn the requirements that the new capacitor must satisfy. The personnel involved are well-versed in material, manufacturing and electronic application technologies. They study the overall application and the environment in which the part will function. Programs are begun for selection of appropriate ceramic formulations, metal systems and designs. These programs yield a detailed technology profile from which mechanical design and process specifications follow.

### ADVANCED MANUFACTURING FACILITIES

The ability and reputation of AVX in high reliability MLCs is due in part to the company's complete control over all phases of the production process. This includes powder processing, tape casting and/or wet build-up, green MLC assembly and final capacitor assembly/packaging. Recent renovations at AVX have upgraded green MLC assembly areas to certified clean room levels.

A favorite feature with many customers of AVX is our ability to work with customers in solving special packaging

requirements. This includes special lead configurations and multiple chip packaging that simplifies the mounting of specialty capacitors. To the customer, the total capability of AVX assures a high level of consistent control at all steps of production.

### QUALITY CONTROL

The Q. A. organization is an integral part of manufacturing. Quality Control tests the product of each manufacturing process, detects flaws or variations from the narrow acceptable standard and isolates the cause of the deviation. Corrective action can then be taken to return the process to within its predetermined control levels.

Quality Assurance has large and well-equipped laboratories where statistical samples are evaluated and tested to determine failure rates, characterize products and assure compliance with specification. Both destructive and non-destructive testing are used, including advanced ultrasonic inspection equipment for non-destructive inspection of an entire production quantity.

Put the experience, technology and facilities of the leading company in multilayer ceramics to work for you. No other source offers the unique combination of capability and commitment to advanced application specific components.



# SMPS Capacitors

## SMPS Capacitor Applications



### FOREWORD

High speed switch mode power supplies place high demands on the capacitors used in the input or output filters of Resonant DC-DC or Pulse Modulated DC-DC converters. AVX Corporation has developed several multilayer ceramic (MLC) capacitor styles for these switcher applications. These capacitors have been extensively tested and characterized and found to have almost ideal performances to meet the stringent requirements of these applications.

### Input Filter Capacitor

The Input Filter capacitor is required to perform two functions: To supply an unrestricted burst of current to the power supply switch circuitry and to not only do it without generating any noise, but to help suppress noise generated in the switch circuitry. It is, in effect, a very large decoupling capacitor. It must have very low ESL, capabilities for very high  $dv/dt$ , as well as  $di/dt$  and it must have a very low ESR to eliminate power loss.

The distance from the primary DC source, as well as the type of capacitor used in this source (usually electrolytics), presents a very high inductance to the input of the Switcher. The MLC input capacitor, with its excellent ESL and ESR characteristics, is located physically close to the switch circuitry. Repetitive peak currents, inherent with the Switcher design, require a high ripple capability, as well as high surge capability for transients, both induced and conducted from other sources. MLCs have both these capabilities.

### Output Filter Capacitor

The output from the switching circuit of a Switcher consists of current on and off. From an elevated DC reference, this current is an AC ripple additive on the DC. In order to smooth this ripple effect, a filter circuit (usually inductive input) is built to allow a storage of energy to take place during the rising ripple portion and to allow a discharge of energy during the falling ripple portion.

The ESR and ESL of the capacitor contribute to the net ripple effect. The output filter capacitor is chosen for ESR, and with previous types of capacitors, multiples were used in an attempt to lower the net ESR. The MLC offers ESRs well below the minimum allowable to lower noise levels, thus eliminating the need for multiple units.

### Other MLC Capacitors for SMPS Applications

AVX also manufactures coupling, decoupling, resonant and snubber capacitors for SMPS applications. Contact AVX for Application Specific S.M.P.S. capacitor requirements.

|                             |                     |
|-----------------------------|---------------------|
| Olean, NY, USA              | 716-372-6611        |
| Coleraine, Northern Ireland | ++44(0) 28703 44188 |
| St. Apollinaire, France     | ++33(0) 38071 7400  |

# SMPS Capacitors

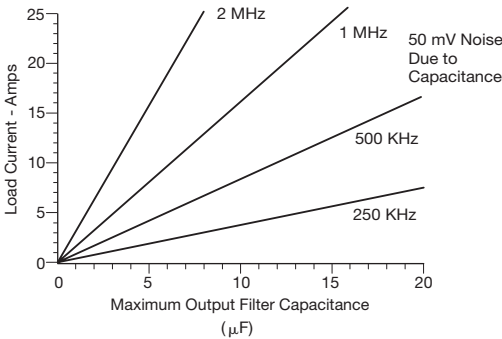


## Capacitor Selection and Performance

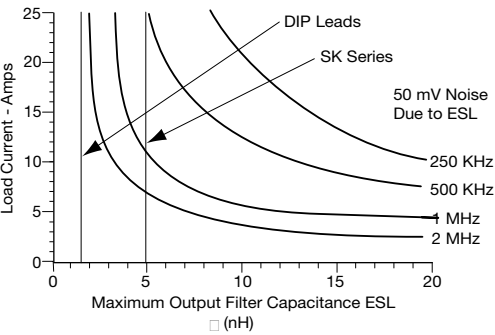
### ASMLC CAPACITOR SELECTION

#### SMPS Design Information (SM, CH, CV, RH and SK Styles)

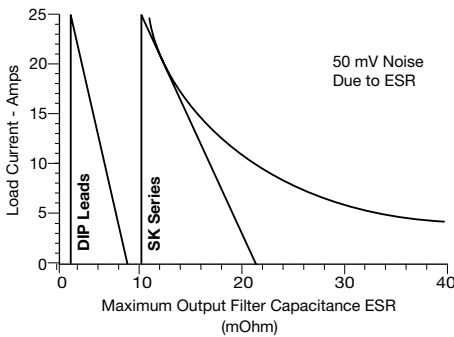
**Absolute Maximum Output Capacitance**  
Assuming no ESL and no ESR



**Absolute Maximum Capacitance ESL**  
Assuming no ESR - Capacitive Induced Ripple



**Absolute Maximum Capacitance ESR**  
Assuming no ESL - Capacitive Induced Ripple



### ASMLC CAPACITOR PERFORMANCE

**Capacitance as Measured from dv/dt Slope**  
200 mA/ns Current Pulse  
Measurement starts after inductive ring decay



### AC Ripple Capability

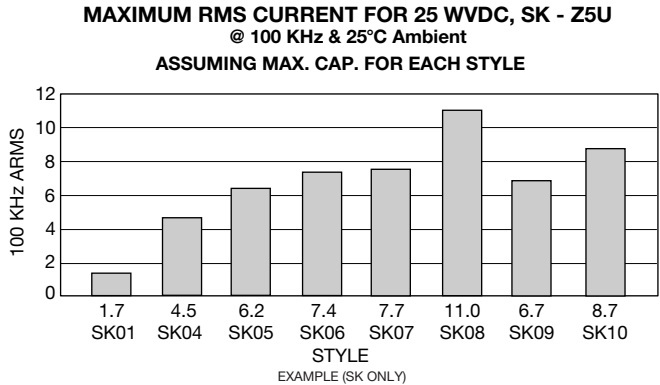
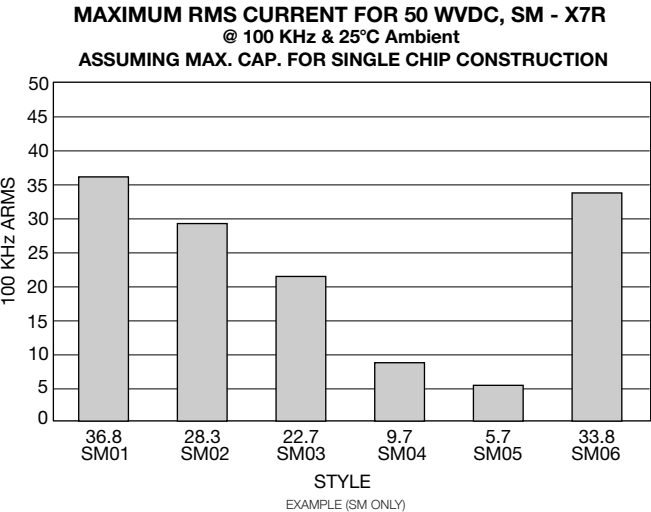
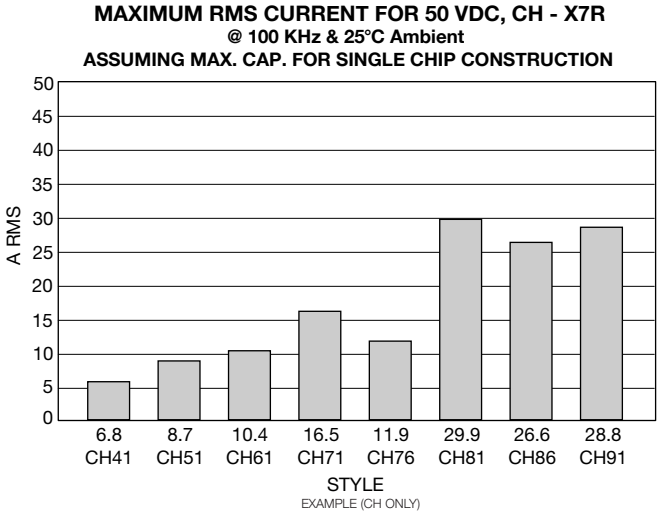
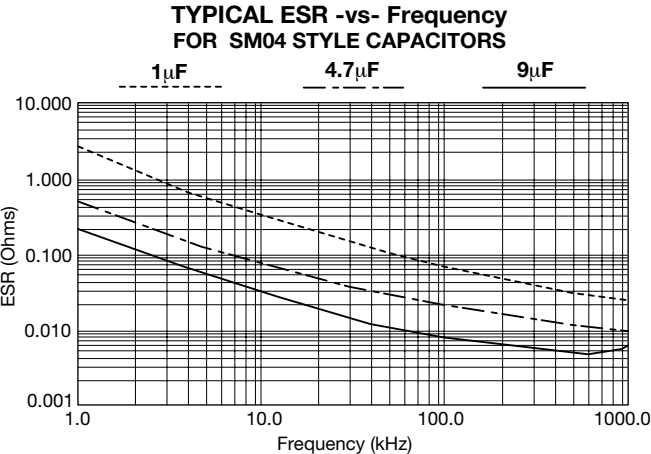
Due to the wide range of product offering in this catalog, the AC ripple capabilities for switch mode power supply capacitors and high voltage capacitors are provided in the form of IBM compatible software package called SpiCalci. It is available free from AVX and can be downloaded for free from AVX website: [www.avx.com](http://www.avx.com).



SpiCalci program will provide answers to most of the design engineers' questions on critical parameters for their specific applications:

- Equivalent Series Resistance  
- *function of frequency and temperature*
- Equivalent Series Inductance  
- *function of design*
- Self Resonant Frequency  
 $f = 1 / (2 \times \pi \sqrt{L \times C})$
- Thermal Characteristics  
- *function of design*
- AC Ripple Capabilities  
- *function of frequency, temperature and design*

### Examples of Product Performance



# SMPS Capacitors

## Application Information on SupraCap®

### SUPRACAP® - LARGE CAPACITANCE VALUE MLCs

High speed switch mode power supplies require extremely low equivalent series resistance (ESR) and equivalent series inductance (ESL) capacitors for input and output filtering. These requirements are beyond the practical limits of electrolytic capacitors, both aluminum and tantalums, but are readily met by multilayer ceramic (MLCs) capacitors (Figure 1).

Theoretical SMPS's output filter capacitor values are in the range of 6-10  $\mu\text{F}/\text{amp}$  at 40KHz and drop to less than 1  $\mu\text{F}/\text{amp}$  at 1MHz. Most electrolytic applications use 10 to 100 times the theoretical value in order to obtain lower ESR from paralleling many capacitors. This is not necessary with SupraCap® MLC capacitors which inherently have ESRs in the range of milliohms. These extremely low values of ESR mean low ripple voltage and less self-heating of the capacitor.

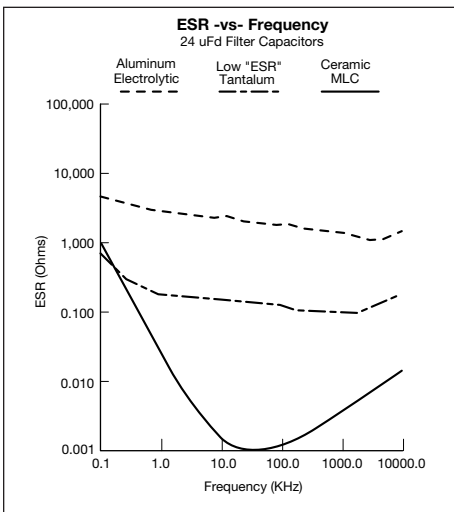
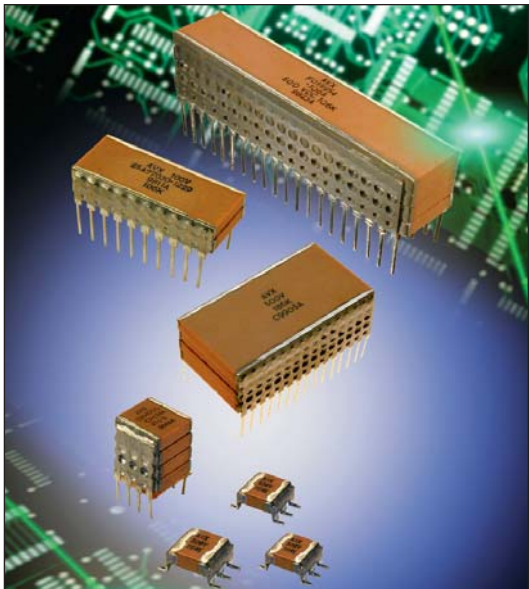


Figure 1



Output noise spikes are reduced by lowering the filter capacitance self-inductance. The ripple current is a triangle wave form with constant  $di/dt$  except when it changes polarity, then the  $di/dt$  is very high. The noise voltage generated by the filter capacitor is

$$V_{\text{Noise}} = L_{\text{Capacitor}} di/dt$$

AVX SupraCap® devices have inductance value less than 3nH.

Figure 2 compares a 5.6  $\mu\text{F}$  MLC to a 5.6  $\mu\text{F}$  tantalum which was specially designed for low ESR and ESL. When subjected to a  $di/dt$  of 200 mA/ns the tantalum shows an ESR of 165 m $\Omega$  and an ESL of 18nH versus the MLC's 4 m $\Omega$  and 0.3 nH. These performance differences allow considerable reduction in size and weight of the filter capacitor.

Additionally, MLCs are compatible with surface mount technology reflow and assembly techniques which is the desirable assembly for conversion frequencies exceeding 1 MHz. Electrolytic capacitors (both aluminum and tantalum) are not compatible with normal vapor phase (VPS) or infrared (IR) reflow temperatures (205-215°C) due to electrolyte and structural problems. AVX SupraCap® devices are supplied with lead frames for either thru-hole or surface mount assembly. The lead frames act as stress relief for differences in coefficients of expansion between the large ceramic chip ( $\approx 10$  ppm/°C) and the PC boards.

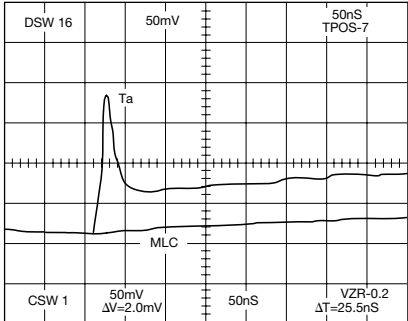
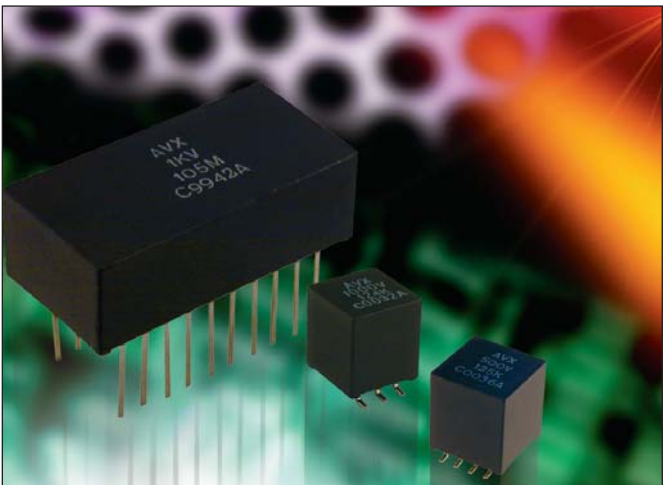


Figure 2



# SMPS Stacked MLC Capacitors



U.S. Preferred Styles

## (SM Style) Technical Information on SMPS Capacitors

### ELECTRICAL SPECIFICATIONS

#### Temperature Coefficient

C0G: A Temperature Coefficient -  $0 \pm 30$  ppm/°C, -55° to +125°C

X7R: C Temperature Coefficient -  $\pm 15\%$ , -55° to +125°C

Z5U: E Temperature Coefficient - +22, -56%, +10° to +85°C

#### Capacitance Test (MIL-STD-202 Method 305)

C0G: 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

X7R: 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

Z5U: 25°C, 0.5 Vrms max (open circuit voltage) at 1KHz

#### Dissipation Factor 25°C

C0G: 0.15% Max @ 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

X7R: 2.5% Max @ 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

Z5U: 3.0% Max @ 25°C, 0.5 Vrms max (open circuit voltage) at 1KHz

#### Insulation Resistance 25°C (MIL-STD-202 Method 302)

C0G and X7R: 100K M $\Omega$  or 1000 M $\Omega$ - $\mu$ F, whichever is less.

Z5U: 10K M $\Omega$  or 1000 M $\Omega$ - $\mu$ F, whichever is less.

#### Insulation Resistance 125°C (MIL-STD-202 Method 302)

C0G and X7R: 10K M $\Omega$  or 100 M $\Omega$ - $\mu$ F, whichever is less.

Z5U: 1K M $\Omega$  or 100 M $\Omega$ - $\mu$ F, whichever is less.

#### Dielectric Withstanding Voltage 25°C (Flash Test)

C0G and X7R: 250% rated voltage for 5 seconds with 50 mA max charging current. (500 Volt units @ 750 VDC)

Z5U: 200% rated voltage for 5 seconds with 50 mA max charging current.

#### Life Test (1000 hrs)

C0G and X7R: 200% rated voltage at +125°C. (500 Volt units @ 600 VDC)

Z5U: 150% rated voltage at +85°C

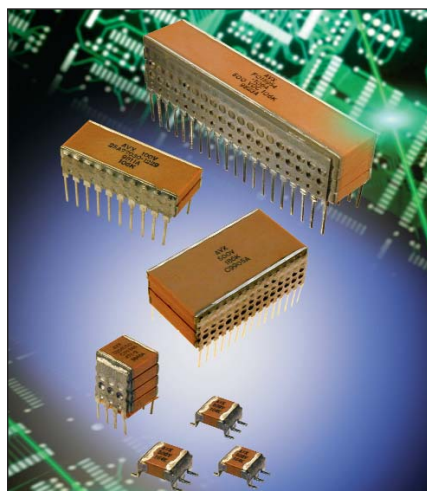
#### Moisture Resistance (MIL-STD-202 Method 106)

C0G, X7R, Z5U: Ten cycles with no voltage applied.

#### Thermal Shock (MIL-STD-202 Method 107, Condition A)

#### Immersion Cycling (MIL-STD-202 Method 104, Condition B)

#### Resistance To Solder Heat (MIL-STD-202, Method 210, Condition B, for 20 seconds)



### Typical ESR (m $\Omega$ )

#### 24 $\mu$ F Performance

|              | Aluminum Electrolytic | Tantalum | MLC |
|--------------|-----------------------|----------|-----|
| ESR @ 50KHz  | 2,100                 | 140      | 1   |
| ESR @ 100KHz | 2,000                 | 125      | 1   |
| ESR @ 500KHz | 1,600                 | 105      | 2.5 |
| ESR @ 1MHz   | 1,500                 | 105      | 5   |
| ESR @ 5MHz   | 1,200                 | 140      | 10  |
| ESR @ 10MHz  | 1,700                 | 190      | 14  |

### HOW TO ORDER

#### AVX Styles: SM-1, SM-2, SM-3, SM-4, SM-5, SM-6

| SM0            | 1                         | 7                                                   | C                                                     | 106                                                                                                                                                                                                        | M                                                                                                                                                                                                     | A                                      | N                                                                            | 650                                                                                                      |
|----------------|---------------------------|-----------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| AVX Style Size | Size See dimensions chart | Voltage 50V = 5<br>100V = 1<br>200V = 2<br>500V = 7 | Temperature Coefficient C0G = A<br>X7R = C<br>Z5U = E | Capacitance Code (2 significant digits + no. of zeros)<br>10 pF = 100<br>100 pF = 101<br>1,000 pF = 102<br>22,000 pF = 223<br>220,000 pF = 224<br>1 $\mu$ F = 105<br>10 $\mu$ F = 106<br>100 $\mu$ F = 107 | Capacitance Tolerance C0G: J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>X7R: K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = +80, -20%<br>Z5U: M = $\pm 20\%$<br>Z = +80, -20%<br>P = GMV (+100, -0%) | Test Level A = Standard<br>B = Hi-Rel* | Termination N = Straight Lead<br>J = Leads formed in<br>L = Leads formed out | Height Max Dimension "A"<br>120 = 0.120"<br>240 = 0.240"<br>360 = 0.360"<br>480 = 0.480"<br>650 = 0.650" |

Note: Capacitors with X7R and Z5U dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations.

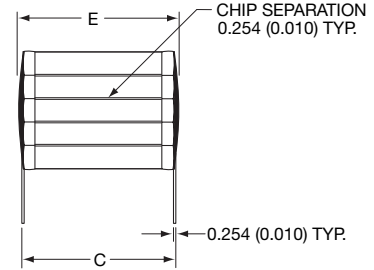
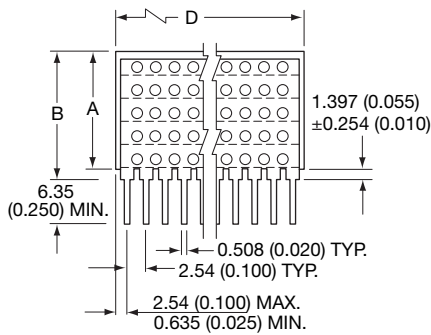
\*Hi-Rel screening for C0G and X7R only. Screening consists of 100% Group A (B Level), Subgroup 1 per MIL-PRF-49470.

# SMPS Stacked MLC Capacitors

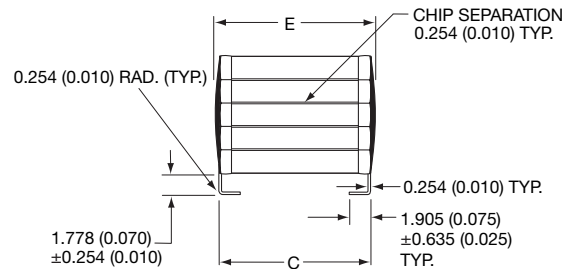
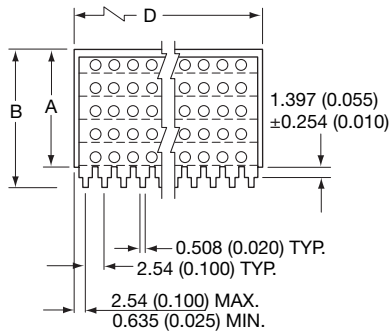
(SM Style) Surface Mount and Thru-Hole Styles (SM0, SM5)



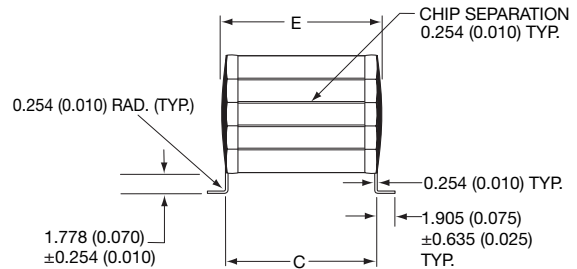
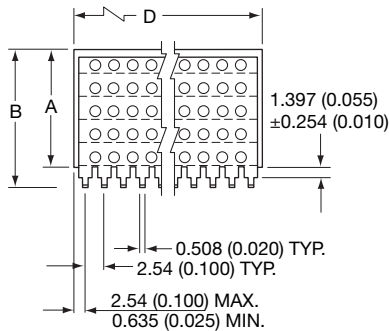
U.S. Preferred Styles



## “N” STYLE LEADS



## “J” STYLE LEADS



## “L” STYLE LEADS

## DIMENSIONS

millimeters (inches)

| Style | A (max.)                              | B (max.)                                                        | C ±.635 (±0.025) | D ±.635 (±0.025) | E (max.)     | No. of Leads per side |
|-------|---------------------------------------|-----------------------------------------------------------------|------------------|------------------|--------------|-----------------------|
| SM-1  | See page 10 for maximum “A” Dimension | For “N” Style Leads, “B” Dimension = “A” Dimension Plus 0.065”. | 11.4 (0.450)     | 52.1 (2.050)     | 12.7 (0.500) | 20                    |
| SM-2  |                                       |                                                                 | 20.3 (0.800)     | 38.4 (1.510)     | 22.1 (0.870) | 15                    |
| SM-3  |                                       |                                                                 | 11.4 (0.450)     | 26.7 (1.050)     | 12.7 (0.500) | 10                    |
| SM-4  |                                       | For “J” & “L” Leads, “B” Dimension = “A” Dimension Plus 0.080”  | 10.2 (0.400)     | 10.2 (0.400)     | 11.2 (0.440) | 4                     |
| SM-5  |                                       |                                                                 | 6.35 (0.250)     | 6.35 (0.250)     | 7.62 (0.300) | 3                     |
| SM-6  |                                       |                                                                 | 31.8 (1.250)     | 52.1 (2.050)     | 34.3 (1.350) | 20                    |

Note: For SM5 add 0.127 (0.005) to max. and nominal dimensions A, B, D, & E



# SMPS Stacked MLC Capacitors

(SM Style)



U.S. Preferred Styles

## Max Capacitance (μF) Available Versus Style with Height (A) of 0.120" - 3.05mm

| AVX<br>STYLE | SM01 _____ AN120 |      |      |      | SM02 _____ AN120 |      |      |      | SM03 _____ AN120 |      |      |      | SM04 _____ AN120 |      |      |      | SM05 _____ AN120 |      |      |      | SM06 _____ AN120 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 1.0              | .70  | .40  | .18  | 1.2              | 1.0  | .60  | .26  | .47              | .40  | .20  | .09  | .16              | .13  | .07  | .02  | .05              | .04  | .02  | .01  | 3.2              | 2.4  | 1.3  | .50  |
| X7R          | 27               | 12   | 7.0  | 2.6  | 41               | 18   | 11   | 4.0  | 18               | 6.0  | 3.6  | 1.3  | 7.5              | 1.8  | 1.1  | .40  | 2.8              | .68  | .40  | .16  | 80               | 40   | 24   | 9.4  |
| Z5U          | 84               | 32   | 12   | --   | 110              | 46   | 34   | --   | 40               | 15   | 6.0  | --   | 12               | 4.6  | 3.0  | --   | 4.6              | 1.8  | .72  | --   | 260              | 140  | 92   | --   |

## Max Capacitance (μF) Available Versus Style with Height (A) of 0.240" - 6.10mm

| AVX<br>STYLE | SM01 _____ AN240 |      |      |      | SM02 _____ AN240 |      |      |      | SM03 _____ AN240 |      |      |      | SM04 _____ AN240 |      |      |      | SM05 _____ AN240 |      |      |      | SM06 _____ AN240 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 2.0              | 1.4  | .80  | .36  | 2.4              | 2.0  | 1.2  | .52  | 1.0              | .80  | .40  | .18  | .32              | .26  | .14  | .05  | .10              | .08  | .05  | .02  | 6.4              | 4.8  | 2.6  | 1.0  |
| X7R          | 54               | 24   | 14   | 5.2  | 82               | 36   | 22   | 8.0  | 36               | 12   | 7.2  | 2.6  | 15               | 3.6  | 2.2  | .80  | 5.6              | 1.3  | .80  | .32  | 160              | 80   | 48   | 18   |
| Z5U          | 160              | 64   | 24   | --   | 230              | 92   | 68   | --   | 80               | 30   | 12   | --   | 24               | 9.2  | 6.0  | --   | 9.2              | 3.6  | 1.4  | --   | 520              | 280  | 180  | --   |

## Max Capacitance (μF) Available Versus Style with Height (A) of 0.360" - 9.14mm

| AVX<br>STYLE | SM01 _____ AN360 |      |      |      | SM02 _____ AN360 |      |      |      | SM03 _____ AN360 |      |      |      | SM04 _____ AN360 |      |      |      | SM05 _____ AN360 |      |      |      | SM06 _____ AN360 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 3.0              | 2.1  | 1.2  | .54  | 3.6              | 3.0  | 1.8  | .78  | 1.5              | 1.2  | .60  | .27  | .48              | .39  | .21  | .07  | .15              | .12  | .07  | .03  | 9.6              | 7.2  | 3.9  | 1.5  |
| X7R          | 82               | 36   | 21   | 7.8  | 120              | 54   | 33   | 12   | 54               | 18   | 10   | 3.9  | 22               | 5.4  | 3.3  | 1.2  | 8.2              | 2.0  | 1.2  | .48  | 240              | 120  | 72   | 28   |
| Z5U          | 250              | 96   | 36   | --   | 350              | 130  | 100  | --   | 120              | 45   | 18   | --   | 36               | 13   | 9.0  | --   | 13               | 5.4  | 2.1  | --   | 780              | 430  | 270  | --   |

## Max Capacitance (μF) Available Versus Style with Height (A) of 0.480" - 12.2mm

| AVX<br>STYLE | SM01 _____ AN480 |      |      |      | SM02 _____ AN480 |      |      |      | SM03 _____ AN480 |      |      |      | SM04 _____ AN480 |      |      |      | SM05 _____ AN480 |      |      |      | SM06 _____ AN480 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 4.0              | 2.8  | 1.6  | .72  | 4.8              | 4.0  | 2.2  | 1.0  | 2.0              | 1.6  | .80  | .36  | .64              | .52  | .28  | .10  | .20              | .16  | .10  | .04  | 12               | 9.6  | 5.2  | 2.0  |
| X7R          | 110              | 48   | 28   | 10   | 160              | 72   | 44   | 16   | 72               | 24   | 14   | 5.2  | 30               | 7.2  | 4.4  | 1.6  | 10               | 2.7  | 1.6  | .64  | 320              | 160  | 96   | 37   |
| Z5U          | 330              | 120  | 48   | --   | 470              | 180  | 130  | --   | 160              | 60   | 24   | --   | 48               | 18   | 12   | --   | 18               | 7.2  | 2.8  | --   | 1000             | 570  | 360  | --   |

## Max Capacitance (μF) Available Versus Style with Height (A) of 0.650" - 16.5mm

| AVX<br>STYLE | SM01 _____ AN650 |      |      |      | SM02 _____ AN650 |      |      |      | SM03 _____ AN650 |      |      |      | SM04 _____ AN650 |      |      |      | SM05 _____ AN650 |      |      |      | SM06 _____ AN650 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 5.0              | 3.5  | 2.0  | .90  | 6.0              | 5.0  | 3.0  | 1.3  | 2.5              | 2.0  | 1.0  | .45  | .80              | .65  | .35  | .12  | .25              | .20  | .12  | .05  | 16               | 12   | 6.5  | 2.5  |
| X7R          | 130              | 60   | 35   | 13   | 200              | 90   | 55   | 20   | 90               | 30   | 18   | 6.5  | 36               | 9.0  | 5.5  | 2.0  | 12               | 3.4  | 2.0  | .80  | 400              | 200  | 120  | 47   |
| Z5U          | 420              | 160  | 60   | --   | 590              | 230  | 170  | --   | 200              | 75   | 30   | --   | 60               | 23   | 15   | --   | 23               | 9.0  | 3.6  | --   | 1300             | 720  | 460  | --   |

# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles MIL-PRF-49470



U.S. Preferred Styles

## AVX IS QUALIFIED TO MIL-PRF-49470/1 AND MIL-PRF-49470/2

The SMPS capacitors are designed for high current, high-power and high-temperature applications. These capacitors have very low ESR (Equivalent Series Resistance) and ESL (Equivalent Series Inductance). SMPS Series capacitors offer design and component engineers a proven technology specifically designed for programs requiring high reliability performance in harsh environments.

MIL-PRF-49470 SMPS Series capacitors are primarily used in input/output filters of high-power and high-voltage power supplies as well as in bus filters and DC snubbers for high power inverters and other high-current applications. These capacitors are available with through-hole and surface mount leads. The operating temperature is -55°C to +125°C. The MIL-PRF-49470 capacitors are preferred over the DSCC

drawing 87106 capacitors. MIL-PRF-49470 specification was created to produce a robust replacement for DSCC 87106. MIL-PRF-49470 offers two product levels.

Level "B" is the standard reliability. Level "T" is the high reliability suitable for space application.

AVX is qualified to supply MIL-PRF-49470/1 parts. These are unencapsulated ceramic dielectric, switch mode power supply capacitors. AVX is also qualified to supply MIL-PRF-49470/2 parts. These are encapsulated ceramic dielectric, switch mode power supply capacitors.

### PLEASE CONTACT THE DSCC WEBSITE

[\[http://www.dscclia.mil/Programs/MilSpec/DocSearch.asp\]](http://www.dscclia.mil/Programs/MilSpec/DocSearch.asp) for details on testing, electrical, mechanical and part number options.

### PLEASE CONTACT THE DSCC WEBSITE

[\[http://www.dscclia.mil/Programs/QmlQpl/\]](http://www.dscclia.mil/Programs/QmlQpl/) for the latest QPL (Qualified Products List).

## HOW TO ORDER



For "T" level parts, replace the "M" in the pin with "T" (for example M49470R01474KCN becomes T49470R01474KCN) MIL-PRF-49470 contains additional capacitors that are not available in 87106, such as additional lead configurations and lower profile parts.

On the pages to follow is the general dimensional outline along with a cross reference from 87106 parts to MIL-PRF-49470 parts.

# SMPS Stacked MLC Capacitors

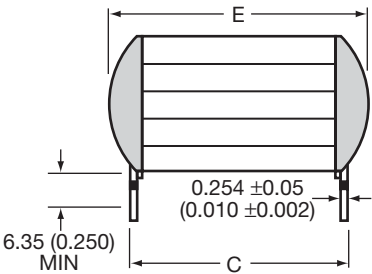
(SM Style) SM Military Styles MIL-PRF-49470/1



U.S. Preferred Styles

## MIL-PRF-49470/1

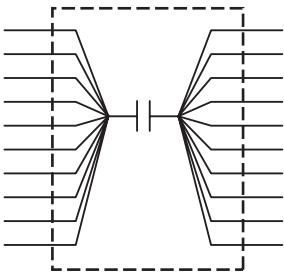
MIL-PRF-49470/1 - capacitor, fixed, ceramic dielectric, switch mode power supply (general purpose and temperature stable), standard reliability and high reliability unencapsulated, Style PS01.



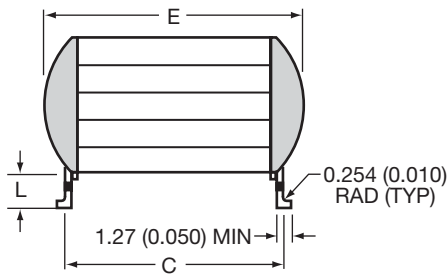
LEAD STYLE N AND A



LEAD STYLE J AND C



CIRCUIT DIAGRAM



LEAD STYLE L AND B

## DIMENSIONS:

millimeters (inches)

| Case Code | C $\pm 0.635$ ( $\pm 0.025$ ) | D            |              | E (max.)     | Number of Leads per side |
|-----------|-------------------------------|--------------|--------------|--------------|--------------------------|
|           |                               | Min.         | Max.         |              |                          |
| 1         | 11.4 (0.450)                  | 49.5 (1.950) | 52.7 (2.075) | 12.7 (0.500) | 20                       |
| 2         | 20.3 (0.800)                  | 36.8 (1.450) | 40.0 (1.535) | 22.1 (0.870) | 15                       |
| 3         | 11.4 (0.450)                  | 24.1 (0.950) | 27.3 (1.075) | 12.7 (0.500) | 10                       |
| 4         | 10.2 (0.400)                  | 8.89 (0.350) | 10.8 (0.425) | 11.2 (0.440) | 4                        |
| 5         | 6.35 (0.250)                  | 6.20 (0.224) | 6.97 (0.275) | 7.62 (0.300) | 3                        |
| 6         | 31.8 (1.250)                  | 49.5 (1.950) | 52.7 (2.075) | 34.3 (1.350) | 20                       |

### NOTES:

1. Dimensions are in millimeters (inches)
2. Unless otherwise specified, tolerances are 0.254 ( $\pm 0.010$ ).
3. Lead frame configuration is shown as typical above the seating plane.
4. See table I of MIL-PRF-49470/1 for specific maximum A dimension. For maximum B dimension, add 1.65 (0.065) to the appropriate A dimension. For all lead styles, the number of chips is determined by the capacitance and voltage rating.
5. For case code 5, dimensions shall be 2.54 (0.100) maximum and 0.305 (0.012) minimum.
6. Lead alignment within pin rows shall be within  $\pm 0.10$  (0.005).

# SMPS Stacked MLC Capacitors

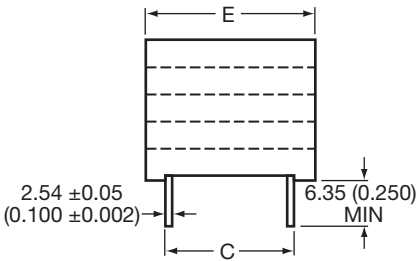
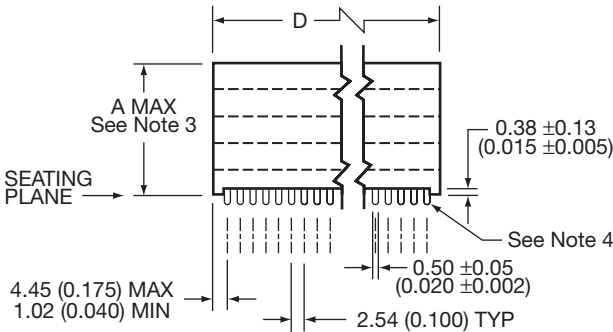
(SM Style) SM Military Styles MIL-PRF-49470/2



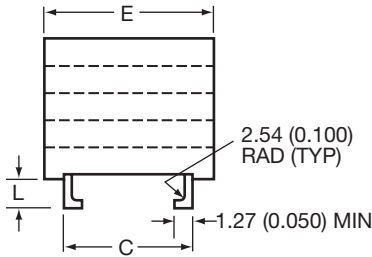
U.S. Preferred Styles

## MIL-PRF-49470/2

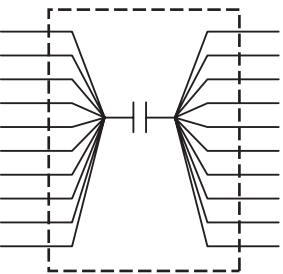
MIL-PRF-49470/2 - capacitor, fixed, ceramic dielectric, switch mode power supply (general purpose and temperature stable), standard reliability and high reliability encapsulated, Style PS02.



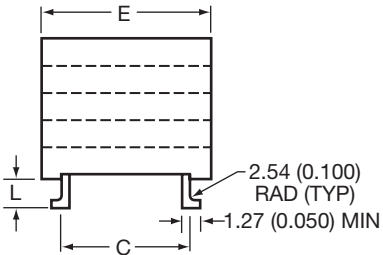
LEAD STYLE N AND A



LEAD STYLE J AND C



CIRCUIT DIAGRAM



LEAD STYLE L AND B

## DIMENSIONS:

millimeters (inches)

| Case Code | C $\pm 0.635$ ( $\pm 0.025$ ) | D $\pm 0.635$ ( $\pm 0.025$ ) | E (max)      | Number of Leads per side |
|-----------|-------------------------------|-------------------------------|--------------|--------------------------|
| 1         | 11.4 (0.450)                  | 54.7 (2.155)                  | 14.7 (0.580) | 20                       |
| 2         | 20.3 (0.800)                  | 41.0 (1.615)                  | 24.1 (0.950) | 15                       |
| 3         | 11.4 (0.450)                  | 29.3 (1.155)                  | 14.7 (0.580) | 10                       |
| 4         | 10.2 (0.400)                  | 12.3 (0.485)                  | 12.3 (0.485) | 4                        |
| 5         | 6.35 (0.250)                  | 9.02 (0.355)                  | 9.02 (0.355) | 3                        |
| 6         | 31.8 (1.250)                  | 54.7 (2.155)                  | 36.3 (1.430) | 20                       |

### NOTES:

1. Dimensions are in millimeters (inches)
2. Unless otherwise specified, tolerances are 0.254 ( $\pm 0.001$ ).
3. See table I of MIL-PRF-49470/2 for specific maximum A dimension. For all lead styles, the number of chips is determined by the capacitance and voltage rating.
4. Lead alignment within pin rows shall be within  $\pm 0.10$  (0.004).



# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles MIL-PRF-49470



U.S. Preferred Styles

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
| 1      | M49470X01105KAN   | SM055C105KHN120 | 1.0      | ±10% | 5         | 50         |
| 2      | M49470X01105MAN   | SM055C105MHN120 | 1.0      | ±20% | 5         | 50         |
| 3      | M49470X01125KAN   | SM055C125KHN120 | 1.2      | ±10% | 5         | 50         |
| 4      | M49470X01125MAN   | SM055C125MHN120 | 1.2      | ±20% | 5         | 50         |
| 5      | M49470X01155KAN   | SM055C155KHN240 | 1.5      | ±10% | 5         | 50         |
| 6      | M49470X01155MAN   | SM055C155MHN240 | 1.5      | ±20% | 5         | 50         |
| 7      | M49470X01185KAN   | SM055C185KHN240 | 1.8      | ±10% | 5         | 50         |
| 8      | M49470X01185MAN   | SM055C185MHN240 | 1.8      | ±20% | 5         | 50         |
| 9      | M49470X01225KAN   | SM055C225KHN240 | 2.2      | ±10% | 5         | 50         |
| 10     | M49470X01225MAN   | SM055C225MHN240 | 2.2      | ±20% | 5         | 50         |
| 11     | M49470X01275KAN   | SM055C275KHN360 | 2.7      | ±10% | 5         | 50         |
| 12     | M49470X01275MAN   | SM055C275MHN360 | 2.7      | ±20% | 5         | 50         |
| 13     | M49470X01335KAN   | SM055C335KHN360 | 3.3      | ±10% | 5         | 50         |
| 14     | M49470X01335MAN   | SM055C335MHN360 | 3.3      | ±20% | 5         | 50         |
| 15     | M49470X01395KAN   | SM055C395KHN480 | 3.9      | ±10% | 5         | 50         |
| 16     | M49470X01395MAN   | SM055C395MHN480 | 3.9      | ±20% | 5         | 50         |
| 17     | M49470X01475KAN   | SM055C475KHN480 | 4.7      | ±10% | 5         | 50         |
| 18     | M49470X01475MAN   | SM055C475MHN480 | 4.7      | ±20% | 5         | 50         |
|        | M49470X01475KAA   | SM045C475KHN240 | 4.7      | ±10% | 4         | 50         |
|        | M49470X01475MAA   | SM045C475MHN240 | 4.7      | ±20% | 4         | 50         |
| 19     | M49470X01565KAN   | SM055C565KHN650 | 5.6      | ±10% | 5         | 50         |
| 20     | M49470X01565MAN   | SM055C565MHN650 | 5.6      | ±20% | 5         | 50         |
|        | M49470X01565KAA   | SM045C565KHN240 | 5.6      | ±10% | 4         | 50         |
|        | M49470X01565MAA   | SM045C565MHN240 | 5.6      | ±20% | 4         | 50         |
| 21     | M49470X01825KAN   | SM045C825KHN360 | 8.2      | ±10% | 4         | 50         |
| 22     | M49470X01825MAN   | SM045C825MHN360 | 8.2      | ±20% | 4         | 50         |
| 23     | M49470X01106KAN   | SM045C106KHN480 | 10       | ±10% | 4         | 50         |
| 24     | M49470X01106MAN   | SM045C106MHN480 | 10       | ±20% | 4         | 50         |
| 25     | M49470X01126KAN   | SM045C126KHN480 | 12       | ±10% | 4         | 50         |
| 26     | M49470X01126MAN   | SM045C126MHN480 | 12       | ±20% | 4         | 50         |
| 27     | M49470X01156KAN   | SM045C156KHN650 | 15       | ±10% | 4         | 50         |
| 28     | M49470X01156MAN   | SM045C156MHN650 | 15       | ±20% | 4         | 50         |
|        | M49470X01156KAA   | SM035C156KHN240 | 15       | ±10% | 3         | 50         |
|        | M49470X01156MAA   | SM035C156MHN240 | 15       | ±20% | 3         | 50         |
| 29     | M49470X01186KAN   | SM035C186KHN240 | 18       | ±10% | 3         | 50         |
| 30     | M49470X01186MAN   | SM035C186MHN240 | 18       | ±20% | 3         | 50         |
| 31     | M49470X01226KAN   | SM035C226KHN360 | 22       | ±10% | 3         | 50         |
| 32     | M49470X01226MAN   | SM035C226MHN360 | 22       | ±20% | 3         | 50         |
| 33     | M49470X01276KAN   | SM035C276KHN360 | 27       | ±10% | 3         | 50         |
| 34     | M49470X01276MAN   | SM035C276MHN360 | 27       | ±20% | 3         | 50         |
| 35     | M49470X01336KAN   | SM035C336KHN360 | 33       | ±10% | 3         | 50         |
| 36     | M49470X01336MAN   | SM035C336MHN360 | 33       | ±20% | 3         | 50         |
| 37     | M49470X01396KAN   | SM035C396KHN480 | 39       | ±10% | 3         | 50         |
| 38     | M49470X01396MAN   | SM035C396MHN480 | 39       | ±20% | 3         | 50         |
| 39     | M49470X01476KAN   | SM035C476KHN650 | 47       | ±10% | 3         | 50         |
| 40     | M49470X01476MAN   | SM035C476MHN650 | 47       | ±20% | 3         | 50         |
|        | M49470X01476KAA   | SM025C476KHN240 | 47       | ±10% | 2         | 50         |
|        | M49470X01476MAA   | SM025C476MHN240 | 47       | ±20% | 2         | 50         |
| 41     | M49470X01686KAN   | SM015C686KHN480 | 68       | ±10% | 1         | 50         |
| 42     | M49470X01686MAN   | SM015C686MHN480 | 68       | ±20% | 1         | 50         |
|        | M49470X01686KAA   | SM025C686KHN360 | 68       | ±10% | 2         | 50         |
|        | M49470X01686MAA   | SM025C686MHN360 | 68       | ±20% | 2         | 50         |
| 43     | M49470X01826KAN   | SM015C826KHN480 | 82       | ±10% | 1         | 50         |
| 44     | M49470X01826MAN   | SM015C826MHN480 | 82       | ±20% | 1         | 50         |
|        | M49470X01826KAA   | SM025C826KHN360 | 82       | ±10% | 2         | 50         |
|        | M49470X01826MAA   | SM025C826MHN360 | 82       | ±20% | 2         | 50         |
| 45     | M49470X01107KAN   | SM015C107KHN650 | 100      | ±10% | 1         | 50         |
| 46     | M49470X01107MAN   | SM015C107MHN650 | 100      | ±20% | 1         | 50         |
|        | M49470X01107KAA   | SM025C107KHN480 | 100      | ±10% | 2         | 50         |
|        | M49470X01107MAA   | SM025C107MHN480 | 100      | ±20% | 2         | 50         |
| 47     | M49470X01157KAN   | SM025C157KHN650 | 150      | ±10% | 2         | 50         |
| 48     | M49470X01157MAN   | SM025C157MHN650 | 150      | ±20% | 2         | 50         |

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
| 49     | M49470X01187KAN   | SM065C187KHN480 | 180      | ±10% | 6         | 50         |
| 50     | M49470X01187MAN   | SM065C187MHN480 | 180      | ±20% | 6         | 50         |
| 51     | M49470X01227KAN   | SM065C227KHN480 | 220      | ±10% | 6         | 50         |
| 52     | M49470X01227MAN   | SM065C227MHN480 | 220      | ±20% | 6         | 50         |
| 53     | M49470X01277KAN   | SM065C277KHN650 | 270      | ±10% | 6         | 50         |
| 54     | M49470X01277MAN   | SM065C277MHN650 | 270      | ±20% | 6         | 50         |
| 55     | M49470X01684KBN   | SM051C684KHN120 | 0.68     | ±10% | 5         | 100        |
| 56     | M49470X01684MBN   | SM051C684MHN120 | 0.68     | ±20% | 5         | 100        |
| 57     | M49470X01824KBN   | SM051C824KHN240 | 0.82     | ±10% | 5         | 100        |
| 58     | M49470X01824MBN   | SM051C824MHN240 | 0.82     | ±20% | 5         | 100        |
| 59     | M49470X01105KBN   | SM051C105KHN240 | 1.0      | ±10% | 5         | 100        |
| 60     | M49470X01105MBN   | SM051C105MHN240 | 1.0      | ±20% | 5         | 100        |
| 61     | M49470X01125KBN   | SM051C125KHN240 | 1.2      | ±10% | 5         | 100        |
| 62     | M49470X01125MBN   | SM051C125MHN240 | 1.2      | ±20% | 5         | 100        |
| 63     | M49470X01155KBN   | SM051C155KHN360 | 1.5      | ±10% | 5         | 100        |
| 64     | M49470X01155MBN   | SM051C155MHN360 | 1.5      | ±20% | 5         | 100        |
| 65     | M49470X01185KBN   | SM051C185KHN360 | 1.8      | ±10% | 5         | 100        |
| 66     | M49470X01185MBN   | SM051C185MHN360 | 1.8      | ±20% | 5         | 100        |
| 67     | M49470X01225KBN   | SM051C225KHN480 | 2.2      | ±10% | 5         | 100        |
| 68     | M49470X01225MBN   | SM051C225MHN480 | 2.2      | ±20% | 5         | 100        |
|        | M49470X01225KBA   | SM041C225KHN240 | 2.2      | ±10% | 4         | 100        |
|        | M49470X01225MBA   | SM041C225MHN240 | 2.2      | ±20% | 4         | 100        |
| 69     | M49470X01275KBN   | SM051C275KHN480 | 2.7      | ±10% | 5         | 100        |
| 70     | M49470X01275MBN   | SM051C275MHN480 | 2.7      | ±20% | 5         | 100        |
| 71     | M49470X01335KBN   | SM051C335KHN650 | 3.3      | ±10% | 5         | 100        |
| 72     | M49470X01335MBN   | SM051C335MHN650 | 3.3      | ±20% | 5         | 100        |
|        | M49470X01335KBA   | SM041C335KHN240 | 3.3      | ±10% | 4         | 100        |
|        | M49470X01335MBA   | SM041C335MHN240 | 3.3      | ±20% | 4         | 100        |
| 73     | M49470X01395KBN   | SM041C395KHN360 | 3.9      | ±10% | 4         | 100        |
| 74     | M49470X01395MBN   | SM041C395MHN360 | 3.9      | ±20% | 4         | 100        |
| 75     | M49470X01475KBN   | SM041C475KHN360 | 4.7      | ±10% | 4         | 100        |
| 76     | M49470X01475MBN   | SM041C475MHN360 | 4.7      | ±20% | 4         | 100        |
| 77     | M49470X01565KBN   | SM041C565KHN480 | 5.6      | ±10% | 4         | 100        |
| 78     | M49470X01565MBN   | SM041C565MHN480 | 5.6      | ±20% | 4         | 100        |
| 79     | M49470X01685KBN   | SM041C685KHN480 | 6.8      | ±10% | 4         | 100        |
| 80     | M49470X01685MBN   | SM041C685MHN480 | 6.8      | ±20% | 4         | 100        |
| 81     | M49470X01825KBN   | SM041C825KHN650 | 8.2      | ±10% | 4         | 100        |
| 82     | M49470X01825MBN   | SM041C825MHN650 | 8.2      | ±20% | 4         | 100        |
|        | M49470X01825KBA   | SM031C825KHN240 | 8.2      | ±10% | 3         | 100        |
|        | M49470X01825MBA   | SM031C825MHN240 | 8.2      | ±20% | 3         | 100        |
| 83     | M49470X01126KBN   | SM031C126KHN240 | 12       | ±10% | 3         | 100        |
| 84     | M49470X01126MBN   | SM031C126MHN240 | 12       | ±20% | 3         | 100        |
| 85     | M49470X01156KBN   | SM031C156KHN360 | 15       | ±10% | 3         | 100        |
| 86     | M49470X01156MBN   | SM031C156MHN360 | 15       | ±20% | 3         | 100        |
| 87     | M49470X01186KBN   | SM031C186KHN360 | 18       | ±10% | 3         | 100        |
| 88     | M49470X01186MBN   | SM031C186MHN360 | 18       | ±20% | 3         | 100        |
| 89     | M49470X01226KBN   | SM031C226KHN480 | 22       | ±10% | 3         | 100        |
| 90     | M49470X01226MBN   | SM031C226MHN480 | 22       | ±20% | 3         | 100        |
| 91     | M49470X01276KBN   | SM031C276KHN650 | 27       | ±10% | 3         | 100        |
| 92     | M49470X01276MBN   | SM031C276MHN650 | 27       | ±20% | 3         | 100        |
|        | M49470X01276KBA   | SM021C276KHN240 | 27       | ±10% | 2         | 100        |
|        | M49470X01276MBA   | SM021C276MHN240 | 27       | ±20% | 2         | 100        |
| 93     | M49470X01336KBN   | SM011C336KHN360 | 33       | ±10% | 1         | 100        |
| 94     | M49470X01336MBN   | SM011C336MHN360 | 33       | ±20% | 1         | 100        |
|        | M49470X01336KBA   | SM021C336KHN240 | 33       | ±10% | 2         | 100        |
|        | M49470X01336MBA   | SM021C336MHN240 | 33       | ±20% | 2         | 100        |
| 95     | M49470X01396KBN   | SM011C396KHN480 | 39       | ±10% | 1         | 100        |
| 96     | M49470X01396MBN   | SM011C396MHN480 | 39       | ±20% | 1         | 100        |
|        | M49470X01396KBA   | SM021C396KHN360 | 39       | ±10% | 2         | 100        |
|        | M49470X01396MBA   | SM021C396MHN360 | 39       | ±20% | 2         | 100        |
| 97     | M49470X01476KBN   | SM011C476KHN480 | 47       | ±10% | 1         | 100        |
| 98     | M49470X01476MBN   | SM011C476MHN480 | 47       | ±20% | 1         | 100        |

# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles MIL-PRF-49470



U.S. Preferred Styles

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
|        | M49470X01476KBA   | SM021C476KHN360 | 47       | ±10% | 2         | 100        |
|        | M49470X01476MBA   | SM021C476MHN360 | 47       | ±20% | 2         | 100        |
| 99     | M49470X01566KBN   | SM011C566KHN650 | 56       | ±10% | 1         | 100        |
| 100    | M49470X01566MBN   | SM011C566MHN650 | 56       | ±20% | 1         | 100        |
| 101    | M49470X01686KBN   | SM021C686KHN480 | 68       | ±10% | 2         | 100        |
| 102    | M49470X01686MBN   | SM021C686MHN480 | 68       | ±20% | 2         | 100        |
| 103    | M49470X01826KBN   | SM021C826KHN650 | 82       | ±10% | 2         | 100        |
| 104    | M49470X01826MBN   | SM021C826MHN650 | 82       | ±20% | 2         | 100        |
| 105    | M49470X01107KBN   | SM061C107KHN360 | 100      | ±10% | 6         | 100        |
| 106    | M49470X01107MBN   | SM061C107MHN360 | 100      | ±20% | 6         | 100        |
| 107    | M49470X01127KBN   | SM061C127KHN360 | 120      | ±10% | 6         | 100        |
| 108    | M49470X01127MBN   | SM061C127MHN360 | 120      | ±20% | 6         | 100        |
| 109    | M49470X01157KBN   | SM061C157KHN480 | 150      | ±10% | 6         | 100        |
| 110    | M49470X01157MBN   | SM061C157MHN480 | 150      | ±20% | 6         | 100        |
| 111    | M49470X01187KBN   | SM061C187KHN650 | 180      | ±10% | 6         | 100        |
| 112    | M49470X01187MBN   | SM061C187MHN650 | 180      | ±20% | 6         | 100        |
| 113    | M49470R01474KCN   | SM052C474KHN240 | 0.47     | ±10% | 5         | 200        |
| 114    | M49470R01474MCN   | SM052C474MHN240 | 0.47     | ±20% | 5         | 200        |
| 115    | M49470R01564KCN   | SM052C564KHN240 | 0.56     | ±10% | 5         | 200        |
| 116    | M49470R01564MCN   | SM052C564MHN240 | 0.56     | ±20% | 5         | 200        |
| 117    | M49470R01684KCN   | SM052C684KHN360 | 0.68     | ±10% | 5         | 200        |
| 118    | M49470R01684MCN   | SM052C684MHN360 | 0.68     | ±20% | 5         | 200        |
| 119    | M49470R01824KCN   | SM052C824KHN360 | 0.82     | ±10% | 5         | 200        |
| 120    | M49470R01824MCN   | SM052C824MHN360 | 0.82     | ±20% | 5         | 200        |
| 121    | M49470R01105KCN   | SM052C105KHN480 | 1.0      | ±10% | 5         | 200        |
| 122    | M49470R01105MCN   | SM052C105MHN480 | 1.0      | ±20% | 5         | 200        |
|        | M49470R01105KCA   | SM042C105KHN120 | 1.0      | ±10% | 4         | 200        |
|        | M49470R01105MCA   | SM042C105MHN120 | 1.0      | ±20% | 4         | 200        |
| 123    | M49470R01125KCN   | SM052C125KHN480 | 1.2      | ±10% | 5         | 200        |
| 124    | M49470R01125MCN   | SM052C125MHN480 | 1.2      | ±20% | 5         | 200        |
|        | M49470R01125KCA   | SM042C125KHN240 | 1.2      | ±10% | 4         | 200        |
|        | M49470R01125MCA   | SM042C125MHN240 | 1.2      | ±20% | 4         | 200        |
| 125    | M49470R01155KCN   | SM052C155KHN650 | 1.5      | ±10% | 5         | 200        |
| 126    | M49470R01155MCN   | SM052C155MHN650 | 1.5      | ±20% | 5         | 200        |
|        | M49470R01155KCA   | SM042C155KHN240 | 1.5      | ±10% | 4         | 200        |
|        | M49470R01155MCA   | SM042C155MHN240 | 1.5      | ±20% | 4         | 200        |
| 127    | M49470R01185KCN   | SM042C185KHN360 | 1.8      | ±10% | 4         | 200        |
| 128    | M49470R01185MCN   | SM042C185MHN360 | 1.8      | ±20% | 4         | 200        |
| 129    | M49470R01225KCN   | SM042C225KHN360 | 2.2      | ±10% | 4         | 200        |
| 130    | M49470R01225MCN   | SM042C225MHN360 | 2.2      | ±20% | 4         | 200        |
| 131    | M49470R01275KCN   | SM042C275KHN480 | 2.7      | ±10% | 4         | 200        |
| 132    | M49470R01275MCN   | SM042C275MHN480 | 2.7      | ±20% | 4         | 200        |
| 133    | M49470R01335KCN   | SM042C335KHN480 | 3.3      | ±10% | 4         | 200        |
| 134    | M49470R01335MCN   | SM042C335MHN480 | 3.3      | ±20% | 4         | 200        |
| 135    | M49470R01395KCN   | SM042C395KHN650 | 3.9      | ±10% | 4         | 200        |
| 136    | M49470R01395MCN   | SM042C395MHN650 | 3.9      | ±20% | 4         | 200        |
|        | M49470R01395KCA   | SM032C395KHN240 | 3.9      | ±10% | 3         | 200        |
|        | M49470R01395MCA   | SM032C395MHN240 | 3.9      | ±20% | 3         | 200        |
| 137    | M49470R01475KCN   | SM032C475KHN240 | 4.7      | ±10% | 3         | 200        |
| 138    | M49470R01475MCN   | SM032C475MHN240 | 4.7      | ±20% | 3         | 200        |
| 139    | M49470R01565KCN   | SM032C565KHN240 | 5.6      | ±10% | 3         | 200        |
| 140    | M49470R01565MCN   | SM032C565MHN240 | 5.6      | ±20% | 3         | 200        |
| 141    | M49470R01685KCN   | SM032C685KHN360 | 6.8      | ±10% | 3         | 200        |
| 142    | M49470R01685MCN   | SM032C685MHN360 | 6.8      | ±20% | 3         | 200        |
| 143    | M49470R01825KCN   | SM032C825KHN360 | 8.2      | ±10% | 3         | 200        |
| 144    | M49470R01825MCN   | SM032C825MHN360 | 8.2      | ±20% | 3         | 200        |
| 145    | M49470R01106KCN   | SM032C106KHN480 | 10       | ±10% | 3         | 200        |
| 146    | M49470R01106MCN   | SM032C106MHN480 | 10       | ±20% | 3         | 200        |
| 147    | M49470R01126KCN   | SM032C126KHN650 | 12       | ±10% | 3         | 200        |
| 148    | M49470R01126MCN   | SM032C126MHN650 | 12       | ±20% | 3         | 200        |
|        | M49470R01126KCA   | SM022C126KHN240 | 12       | ±10% | 2         | 200        |
|        | M49470R01126MCA   | SM022C126MHN240 | 12       | ±20% | 2         | 200        |

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
| 149    | M49470R01156KCN   | SM012C156KHN360 | 15       | ±10% | 1         | 200        |
| 150    | M49470R01156MCN   | SM012C156MHN360 | 15       | ±20% | 1         | 200        |
|        | M49470R01156KCA   | SM022C156KHN240 | 15       | ±10% | 2         | 200        |
|        | M49470R01156MCA   | SM022C156MHN240 | 15       | ±20% | 2         | 200        |
| 151    | M49470R01186KCN   | SM012C186KHN480 | 18       | ±10% | 1         | 200        |
| 152    | M49470R01186MCN   | SM012C186MHN480 | 18       | ±20% | 1         | 200        |
|        | M49470R01186KCA   | SM022C186KHN360 | 18       | ±10% | 2         | 200        |
|        | M49470R01186MCA   | SM022C186MHN360 | 18       | ±20% | 2         | 200        |
| 153    | M49470R01226KCN   | SM012C226KHN650 | 22       | ±10% | 1         | 200        |
| 154    | M49470R01226MCN   | SM012C226MHN650 | 22       | ±20% | 1         | 200        |
|        | M49470R01226KCA   | SM022C226KHN360 | 22       | ±10% | 2         | 200        |
|        | M49470R01226MCA   | SM022C226MHN360 | 22       | ±20% | 2         | 200        |
| 155    | M49470R01276KCN   | SM012C276KHN650 | 27       | ±10% | 1         | 200        |
| 156    | M49470R01276MCN   | SM012C276MHN650 | 27       | ±20% | 1         | 200        |
|        | M49470R01276KCA   | SM022C276KHN480 | 27       | ±10% | 2         | 200        |
|        | M49470R01276MCA   | SM022C276MHN480 | 27       | ±20% | 2         | 200        |
| 157    | M49470R01336KCN   | SM022C336KHN480 | 33       | ±10% | 2         | 200        |
| 158    | M49470R01336MCN   | SM022C336MHN480 | 33       | ±20% | 2         | 200        |
| 159    | M49470R01396KCN   | SM022C396KHN650 | 39       | ±10% | 2         | 200        |
| 160    | M49470R01396MCN   | SM022C396MHN650 | 39       | ±20% | 2         | 200        |
| 161    | M49470R01476KCN   | SM062C476KHN240 | 47       | ±10% | 6         | 200        |
| 162    | M49470R01476MCN   | SM062C476MHN240 | 47       | ±20% | 6         | 200        |
| 163    | M49470R01566KCN   | SM062C566KHN360 | 56       | ±10% | 6         | 200        |
| 164    | M49470R01566MCN   | SM062C566MHN360 | 56       | ±20% | 6         | 200        |
| 165    | M49470R01686KCN   | SM062C686KHN360 | 68       | ±10% | 6         | 200        |
| 166    | M49470R01686MCN   | SM062C686MHN360 | 68       | ±20% | 6         | 200        |
| 167    | M49470R01826KCN   | SM062C826KHN480 | 82       | ±10% | 6         | 200        |
| 168    | M49470R01826MCN   | SM062C826MHN480 | 82       | ±20% | 6         | 200        |
| 169    | M49470R01107KCN   | SM062C107KHN650 | 100      | ±10% | 6         | 200        |
| 170    | M49470R01107MCN   | SM062C107MHN650 | 100      | ±20% | 6         | 200        |
| 171    | M49470R01127KCN   | SM062C127KHN650 | 120      | ±10% | 6         | 200        |
| 172    | M49470R01127MCN   | SM062C127MHN650 | 120      | ±20% | 6         | 200        |
| 173    | M49470Q01154KEN   | SM057C154KHN120 | 0.15     | ±10% | 5         | 500        |
| 174    | M49470Q01154MEN   | SM057C154MHN120 | 0.15     | ±20% | 5         | 500        |
| 175    | M49470Q01184KEN   | SM057C184KHN240 | 0.18     | ±10% | 5         | 500        |
| 176    | M49470Q01184MEN   | SM057C184MHN240 | 0.18     | ±20% | 5         | 500        |
| 177    | M49470Q01224KEN   | SM057C224KHN240 | 0.22     | ±10% | 5         | 500        |
| 178    | M49470Q01224MEN   | SM057C224MHN240 | 0.22     | ±20% | 5         | 500        |
| 179    | M49470Q01274KEN   | SM057C274KHN240 | 0.27     | ±10% | 5         | 500        |
| 180    | M49470Q01274MEN   | SM057C274MHN240 | 0.27     | ±20% | 5         | 500        |
| 181    | M49470Q01334KEN   | SM057C334KHN360 | 0.33     | ±10% | 5         | 500        |
| 182    | M49470Q01334MEN   | SM057C334MHN360 | 0.33     | ±20% | 5         | 500        |
| 183    | M49470Q01394KEN   | SM057C394KHN360 | 0.39     | ±10% | 5         | 500        |
| 184    | M49470Q01394MEN   | SM057C394MHN360 | 0.39     | ±20% | 5         | 500        |
| 185    | M49470Q01474KEN   | SM057C474KHN360 | 0.47     | ±10% | 5         | 500        |
| 186    | M49470Q01474MEN   | SM057C474MHN360 | 0.47     | ±20% | 5         | 500        |
| 187    | M49470Q01564KEN   | SM057C564KHN480 | 0.56     | ±10% | 5         | 500        |
| 188    | M49470Q01564MEN   | SM057C564MHN480 | 0.56     | ±20% | 5         | 500        |
|        | M49470Q01564KEA   | SM047C564KHN240 | 0.56     | ±10% | 4         | 500        |
|        | M49470Q01564MEA   | SM047C564MHN240 | 0.56     | ±20% | 4         | 500        |
| 189    | M49470Q01684KEN   | SM057C684KHN650 | 0.68     | ±10% | 5         | 500        |
| 190    | M49470Q01684MEN   | SM057C684MHN650 | 0.68     | ±20% | 5         | 500        |
|        | M49470Q01684KEA   | SM047C684KHN360 | 0.68     | ±10% | 4         | 500        |
|        | M49470Q01684MEA   | SM047C684MHN360 | 0.68     | ±20% | 4         | 500        |
| 191    | M49470Q01105KEN   | SM047C105KHN360 | 1.0      | ±10% | 4         | 500        |
| 192    | M49470Q01105MEN   | SM047C105MHN360 | 1.0      | ±20% | 4         | 500        |
| 193    | M49470Q01125KEN   | SM047C125KHN360 | 1.2      | ±10% | 4         | 500        |
| 194    | M49470Q01125MEN   | SM047C125MHN360 | 1.2      | ±20% | 4         | 500        |
| 195    | M49470Q01155KEN   | SM047C155KHN480 | 1.5      | ±10% | 4         | 500        |
| 196    | M49470Q01155MEN   | SM047C155MHN480 | 1.5      | ±20% | 4         | 500        |
| 197    | M49470Q01185KEN   | SM047C185KHN650 | 1.8      | ±10% | 4         | 500        |
| 198    | M49470Q01185MEN   | SM047C185MHN650 | 1.8      | ±20% | 4         | 500        |



# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles MIL-PRF-49470



U.S. Preferred Styles

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
|        | M49470Q01185KEA   | SM037C185KHN240 | 1.8      | ±10% | 3         | 500        |
|        | M49470Q01185MEA   | SM037C185MHN240 | 1.8      | ±20% | 3         | 500        |
| 199    | M49470Q01275KEN   | SM037C275KHN360 | 2.7      | ±10% | 3         | 500        |
| 200    | M49470Q01275MEN   | SM037C275MHN360 | 2.7      | ±20% | 3         | 500        |
| 201    | M49470Q01335KEN   | SM037C335KHN360 | 3.3      | ±10% | 3         | 500        |
| 202    | M49470Q01335MEN   | SM037C335MHN360 | 3.3      | ±20% | 3         | 500        |
| 203    | M49470Q01395KEN   | SM037C395KHN360 | 3.9      | ±10% | 3         | 500        |
| 204    | M49470Q01395MEN   | SM037C395MHN360 | 3.9      | ±20% | 3         | 500        |
| 205    | M49470Q01475KEN   | SM037C475KHN480 | 4.7      | ±10% | 3         | 500        |
| 206    | M49470Q01475MEN   | SM037C475MHN480 | 4.7      | ±20% | 3         | 500        |
| 207    | M49470Q01565KEN   | SM037C565KHN650 | 5.6      | ±10% | 3         | 500        |
| 208    | M49470Q01565MEN   | SM037C565MHN650 | 5.6      | ±20% | 3         | 500        |
|        | M49470Q01565KEA   | SM027C565KHN240 | 5.6      | ±10% | 2         | 500        |
|        | M49470Q01565MEA   | SM027C565MHN240 | 5.6      | ±20% | 2         | 500        |
| 209    | M49470Q01825KEN   | SM017C825KHN480 | 8.2      | ±10% | 1         | 500        |
| 210    | M49470Q01825MEN   | SM017C825MHN480 | 8.2      | ±20% | 1         | 500        |
|        | M49470Q01825KEA   | SM027C825KHN360 | 8.2      | ±10% | 2         | 500        |
|        | M49470Q01825MEA   | SM027C825MHN360 | 8.2      | ±20% | 2         | 500        |
| 211    | M49470Q01106KEN   | SM017C106KHN480 | 10       | ±10% | 1         | 500        |
| 212    | M49470Q01106MEN   | SM017C106MHN480 | 10       | ±20% | 1         | 500        |
|        | M49470Q01106KEA   | SM027C106KHN360 | 10       | ±10% | 2         | 500        |
|        | M49470Q01106MEA   | SM027C106MHN360 | 10       | ±20% | 2         | 500        |
| 213    | M49470Q01126KEN   | SM017C126KHN650 | 12       | ±10% | 1         | 500        |
| 214    | M49470Q01126MEN   | SM017C126MHN650 | 12       | ±20% | 1         | 500        |
|        | M49470Q01126KEA   | SM027C126KHN480 | 12       | ±10% | 2         | 500        |
|        | M49470Q01126MEA   | SM027C126MHN480 | 12       | ±20% | 2         | 500        |
| 215    | M49470Q01186KEN   | SM027C186KHN650 | 18       | ±10% | 2         | 500        |
| 216    | M49470Q01186MEN   | SM027C186MHN650 | 18       | ±20% | 2         | 500        |
| 217    | M49470Q01276KEN   | SM067C276KHN360 | 27       | ±10% | 6         | 500        |
| 218    | M49470Q01276MEN   | SM067C276MHN360 | 27       | ±20% | 6         | 500        |
| 219    | M49470Q01336KEN   | SM067C336KHN480 | 33       | ±10% | 6         | 500        |
| 220    | M49470Q01336MEN   | SM067C336MHN480 | 33       | ±20% | 6         | 500        |
| 221    | M49470Q01396KEN   | SM067C396KHN650 | 39       | ±10% | 6         | 500        |
| 222    | M49470Q01396MEN   | SM067C396MHN650 | 39       | ±20% | 6         | 500        |
| 223    | M49470X01685KAN   | SM045C685KHN360 | 6.8      | ±10% | 4         | 50         |
| 224    | M49470X01685MAN   | SM045C685MHN360 | 6.8      | ±20% | 4         | 50         |
| 225    | M49470X01566KAN   | SM015C566KHN360 | 56       | ±10% | 1         | 50         |
| 226    | M49470X01566MAN   | SM015C566MHN360 | 56       | ±20% | 1         | 50         |
|        | M49470X01566KAA   | SM025C566KHN240 | 56       | ±10% | 2         | 50         |
|        | M49470X01566MAA   | SM025C566MHN240 | 56       | ±20% | 2         | 50         |
| 227    | M49470X01127KAN   | SM025C127KHN480 | 120      | ±10% | 2         | 50         |
| 228    | M49470X01127MAN   | SM025C127MHN480 | 120      | ±20% | 2         | 50         |
| 229    | M49470X01106KBN   | SM031C106KHN240 | 10       | ±10% | 3         | 100        |
| 230    | M49470X01106MBN   | SM031C106MHN240 | 10       | ±20% | 3         | 100        |
| 231    | M49470Q01824KEN   | SM047C824KHN360 | 0.82     | ±10% | 4         | 500        |
| 232    | M49470Q01824MEN   | SM047C824MHN360 | 0.82     | ±20% | 4         | 500        |
| 233    | M49470Q01225KEN   | SM037C225KHN240 | 2.2      | ±10% | 3         | 500        |
| 234    | M49470Q01225MEN   | SM037C225MHN240 | 2.2      | ±20% | 3         | 500        |
| 235    | M49470Q01685KEN   | SM017C685KHN480 | 6.8      | ±10% | 1         | 500        |
| 236    | M49470Q01685MEN   | SM017C685MHN480 | 6.8      | ±20% | 1         | 500        |
|        | M49470Q01685KEA   | SM027C685KHN240 | 6.8      | ±10% | 2         | 500        |
|        | M49470Q01685MEA   | SM027C685MHN240 | 6.8      | ±20% | 2         | 500        |
| 237    | M49470Q01156KEN   | SM027C156KHN650 | 15       | ±10% | 2         | 500        |
| 238    | M49470Q01156MEN   | SM027C156MHN650 | 15       | ±20% | 2         | 500        |
| 239    | M49470Q01226KEN   | SM067C226KHN360 | 22       | ±10% | 6         | 500        |
| 240    | M49470Q01226MEN   | SM067C226MHN360 | 22       | ±20% | 6         | 500        |
| 241    | M49470X01105KAJ   | SM055C105KHJ120 | 1.0      | ±10% | 5         | 50         |
| 242    | M49470X01105MAJ   | SM055C105MHJ120 | 1.0      | ±20% | 5         | 50         |
| 243    | M49470X01125KAJ   | SM055C125KHJ120 | 1.2      | ±10% | 5         | 50         |
| 244    | M49470X01125MAJ   | SM055C125MHJ120 | 1.2      | ±20% | 5         | 50         |
| 245    | M49470X01155KAJ   | SM055C155KHJ240 | 1.5      | ±10% | 5         | 50         |
| 246    | M49470X01155MAJ   | SM055C155MHJ240 | 1.5      | ±20% | 5         | 50         |

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
| 247    | M49470X01185KAJ   | SM055C185KHJ240 | 1.8      | ±10% | 5         | 50         |
| 248    | M49470X01185MAJ   | SM055C185MHJ240 | 1.8      | ±20% | 5         | 50         |
| 249    | M49470X01225KAJ   | SM055C225KHJ240 | 2.2      | ±10% | 5         | 50         |
| 250    | M49470X01225MAJ   | SM055C225MHJ240 | 2.2      | ±20% | 5         | 50         |
| 251    | M49470X01275KAJ   | SM055C275KHJ360 | 2.7      | ±10% | 5         | 50         |
| 252    | M49470X01275MAJ   | SM055C275MHJ360 | 2.7      | ±20% | 5         | 50         |
| 253    | M49470X01335KAJ   | SM055C335KHJ360 | 3.3      | ±10% | 5         | 50         |
| 254    | M49470X01335MAJ   | SM055C335MHJ360 | 3.3      | ±20% | 5         | 50         |
| 255    | M49470X01395KAJ   | SM055C395KHJ480 | 3.9      | ±10% | 5         | 50         |
| 256    | M49470X01395MAJ   | SM055C395MHJ480 | 3.9      | ±20% | 5         | 50         |
| 257    | M49470X01475KAJ   | SM055C475KHJ480 | 4.7      | ±10% | 5         | 50         |
| 258    | M49470X01475MAJ   | SM055C475MHJ480 | 4.7      | ±20% | 5         | 50         |
|        | M49470X01475KAC   | SM045C475KHJ240 | 4.7      | ±10% | 4         | 50         |
|        | M49470X01475MAC   | SM045C475MHJ240 | 4.7      | ±20% | 4         | 50         |
| 259    | M49470X01565KAJ   | SM055C565KHJ650 | 5.6      | ±10% | 5         | 50         |
| 260    | M49470X01565MAJ   | SM055C565MHJ650 | 5.6      | ±20% | 5         | 50         |
|        | M49470X01565KAC   | SM045C565KHJ240 | 5.6      | ±10% | 4         | 50         |
|        | M49470X01565MAC   | SM045C565MHJ240 | 5.6      | ±10% | 4         | 50         |
| 261    | M49470X01685KAJ   | SM045C685KHJ360 | 6.8      | ±10% | 4         | 50         |
| 262    | M49470X01685MAJ   | SM045C685MHJ360 | 6.8      | ±20% | 4         | 50         |
| 263    | M49470X01825KAJ   | SM045C825KHJ360 | 8.2      | ±10% | 4         | 50         |
| 264    | M49470X01825MAJ   | SM045C825MHJ360 | 8.2      | ±20% | 4         | 50         |
| 265    | M49470X01106KAJ   | SM045C106KHJ480 | 10       | ±10% | 4         | 50         |
| 266    | M49470X01106MAJ   | SM045C106MHJ480 | 10       | ±20% | 4         | 50         |
| 267    | M49470X01126KAJ   | SM045C126KHJ480 | 12       | ±10% | 4         | 50         |
| 268    | M49470X01126MAJ   | SM045C126MHJ480 | 12       | ±20% | 4         | 50         |
| 269    | M49470X01156KAJ   | SM045C156KHJ650 | 15       | ±10% | 4         | 50         |
| 270    | M49470X01156MAJ   | SM045C156MHJ650 | 15       | ±20% | 4         | 50         |
|        | M49470X01156KAC   | SM035C156KHJ240 | 15       | ±10% | 3         | 50         |
|        | M49470X01156MAC   | SM035C156MHJ240 | 15       | ±20% | 3         | 50         |
| 271    | M49470X01186KAJ   | SM035C186KHJ240 | 18       | ±10% | 3         | 50         |
| 272    | M49470X01186MAJ   | SM035C186MHJ240 | 18       | ±20% | 3         | 50         |
| 273    | M49470X01226KAJ   | SM035C226KHJ360 | 22       | ±10% | 3         | 50         |
| 274    | M49470X01226MAJ   | SM035C226MHJ360 | 22       | ±20% | 3         | 50         |
| 275    | M49470X01276KAJ   | SM035C276KHJ360 | 27       | ±10% | 3         | 50         |
| 276    | M49470X01276MAJ   | SM035C276MHJ360 | 27       | ±20% | 3         | 50         |
| 277    | M49470X01336KAJ   | SM035C336KHJ360 | 33       | ±10% | 3         | 50         |
| 278    | M49470X01336MAJ   | SM035C336MHJ360 | 33       | ±20% | 3         | 50         |
| 279    | M49470X01396KAJ   | SM035C396KHJ480 | 39       | ±10% | 3         | 50         |
| 280    | M49470X01396MAJ   | SM035C396MHJ480 | 39       | ±20% | 3         | 50         |
| 281    | M49470X01476KAJ   | SM035C476KHJ650 | 47       | ±10% | 3         | 50         |
| 282    | M49470X01476MAJ   | SM035C476MHJ650 | 47       | ±20% | 3         | 50         |
|        | M49470X01476KAC   | SM025C476KHJ240 | 47       | ±10% | 2         | 50         |
|        | M49470X01476MAC   | SM025C476MHJ240 | 47       | ±20% | 2         | 50         |
| 283    | M49470X01566KAJ   | SM015C566KHJ360 | 56       | ±10% | 1         | 50         |
| 284    | M49470X01566MAJ   | SM015C566MHJ360 | 56       | ±20% | 1         | 50         |
|        | M49470X01566KAC   | SM025C566KHJ240 | 56       | ±10% | 2         | 50         |
|        | M49470X01566MAC   | SM025C566MHJ240 | 56       | ±20% | 2         | 50         |
| 285    | M49470X01686KAJ   | SM015C686KHJ480 | 68       | ±10% | 1         | 50         |
| 286    | M49470X01686MAJ   | SM015C686MHJ480 | 68       | ±20% | 1         | 50         |
|        | M49470X01686KAC   | SM025C686KHJ360 | 68       | ±10% | 2         | 50         |
|        | M49470X01686MAC   | SM025C686MHJ360 | 68       | ±20% | 2         | 50         |
| 287    | M49470X01826KAJ   | SM015C826KHJ480 | 82       | ±10% | 1         | 50         |
| 288    | M49470X01826MAJ   | SM015C826MHJ480 | 82       | ±20% | 1         | 50         |
|        | M49470X01826KAC   | SM025C826KHJ360 | 82       | ±10% | 2         | 50         |
|        | M49470X01826MAC   | SM025C826MHJ360 | 82       | ±20% | 2         | 50         |
| 289    | M49470X01107KAJ   | SM015C107KHJ650 | 100      | ±10% | 1         | 50         |
| 290    | M49470X01107MAJ   | SM015C107MHJ650 | 100      | ±20% | 1         | 50         |
|        | M49470X01107KAC   | SM025C107KHJ480 | 100      | ±10% | 2         | 50         |
|        | M49470X01107MAC   | SM025C107MHJ480 | 100      | ±20% | 2         | 50         |
| 291    | M49470X01127KAJ   | SM025C127KHJ480 | 120      | ±10% | 2         | 50         |
| 292    | M49470X01127MAJ   | SM025C127MHJ480 | 120      | ±20% | 2         | 50         |

# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles MIL-PRF-49470



U.S. Preferred Styles

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
| 293    | M49470X01157KAJ   | SM025C157KHJ650 | 150      | ±10% | 2         | 50         |
| 294    | M49470X01157MAJ   | SM025C157MHJ650 | 150      | ±20% | 2         | 50         |
| 295    | M49470X01187KAJ   | SM065C187KHJ480 | 180      | ±10% | 6         | 50         |
| 296    | M49470X01187MAJ   | SM065C187MHJ480 | 180      | ±20% | 6         | 50         |
| 297    | M49470X01227KAJ   | SM065C227KHJ480 | 220      | ±10% | 6         | 50         |
| 298    | M49470X01227MAJ   | SM065C227MHJ480 | 220      | ±20% | 6         | 50         |
| 299    | M49470X01277KAJ   | SM065C277KHJ650 | 270      | ±10% | 6         | 50         |
| 300    | M49470X01277MAJ   | SM065C277MHJ650 | 270      | ±20% | 6         | 50         |
| 301    | M49470X01684KBJ   | SM051C684KHJ120 | 0.68     | ±10% | 5         | 100        |
| 302    | M49470X01684MBJ   | SM051C684MHJ120 | 0.68     | ±20% | 5         | 100        |
| 303    | M49470X01824KBJ   | SM051C824KHJ240 | 0.82     | ±10% | 5         | 100        |
| 304    | M49470X01824MBJ   | SM051C824MHJ240 | 0.82     | ±20% | 5         | 100        |
| 305    | M49470X01105KBJ   | SM051C105KHJ240 | 1.0      | ±10% | 5         | 100        |
| 306    | M49470X01105MBJ   | SM051C105MHJ240 | 1.0      | ±20% | 5         | 100        |
| 307    | M49470X01125KBJ   | SM051C125KHJ240 | 1.2      | ±10% | 5         | 100        |
| 308    | M49470X01125MBJ   | SM051C125MHJ240 | 1.2      | ±20% | 5         | 100        |
| 309    | M49470X01155KBJ   | SM051C155KHJ360 | 1.5      | ±10% | 5         | 100        |
| 310    | M49470X01155MBJ   | SM051C155MHJ360 | 1.5      | ±20% | 5         | 100        |
| 311    | M49470X01185KBJ   | SM051C185KHJ360 | 1.8      | ±10% | 5         | 100        |
| 312    | M49470X01185MBJ   | SM051C185MHJ360 | 1.8      | ±20% | 5         | 100        |
| 313    | M49470X01225KBJ   | SM051C225KHJ480 | 2.2      | ±10% | 5         | 100        |
| 314    | M49470X01225MBJ   | SM051C225MHJ480 | 2.2      | ±20% | 5         | 100        |
|        | M49470X01225KBC   | SM041C225KHJ240 | 2.2      | ±10% | 4         | 100        |
|        | M49470X01225MBC   | SM041C225MHJ240 | 2.2      | ±20% | 4         | 100        |
| 315    | M49470X01275KBJ   | SM051C275KHJ480 | 2.7      | ±10% | 5         | 100        |
| 316    | M49470X01275MBJ   | SM051C275MHJ480 | 2.7      | ±20% | 5         | 100        |
| 317    | M49470X01335KBJ   | SM051C335KHJ650 | 3.3      | ±10% | 5         | 100        |
| 318    | M49470X01335MBJ   | SM051C335MHJ650 | 3.3      | ±20% | 5         | 100        |
|        | M49470X01335KBC   | SM041C335KHJ240 | 3.3      | ±10% | 4         | 100        |
|        | M49470X01335MBC   | SM041C335MHJ240 | 3.3      | ±20% | 4         | 100        |
| 319    | M49470X01395KBJ   | SM041C395KHJ360 | 3.9      | ±10% | 4         | 100        |
| 320    | M49470X01395MBJ   | SM041C395MHJ360 | 3.9      | ±20% | 4         | 100        |
| 321    | M49470X01475KBJ   | SM041C475KHJ360 | 4.7      | ±10% | 4         | 100        |
| 322    | M49470X01475MBJ   | SM041C475MHJ360 | 4.7      | ±20% | 4         | 100        |
| 323    | M49470X01565KBJ   | SM041C565KHJ480 | 5.6      | ±10% | 4         | 100        |
| 324    | M49470X01565MBJ   | SM041C565MHJ480 | 5.6      | ±20% | 4         | 100        |
| 325    | M49470X01685KBJ   | SM041C685KHJ480 | 6.8      | ±10% | 4         | 100        |
| 326    | M49470X01685MBJ   | SM041C685MHJ480 | 6.8      | ±20% | 4         | 100        |
| 327    | M49470X01825KBJ   | SM041C825KHJ650 | 8.2      | ±10% | 4         | 100        |
| 328    | M49470X01825MBJ   | SM041C825MHJ650 | 8.2      | ±20% | 4         | 100        |
|        | M49470X01825KBC   | SM031C825KHJ240 | 8.2      | ±10% | 3         | 100        |
|        | M49470X01825MBC   | SM031C825MHJ240 | 8.2      | ±20% | 3         | 100        |
| 329    | M49470X01106KBJ   | SM031C106KHJ240 | 10       | ±10% | 3         | 100        |
| 330    | M49470X01106MBJ   | SM031C106MHJ240 | 10       | ±20% | 3         | 100        |
| 331    | M49470X01126KBJ   | SM031C126KHJ240 | 12       | ±10% | 3         | 100        |
| 332    | M49470X01126MBJ   | SM031C126MHJ240 | 12       | ±20% | 3         | 100        |
| 333    | M49470X01156KBJ   | SM031C156KHJ360 | 15       | ±10% | 3         | 100        |
| 334    | M49470X01156MBJ   | SM031C156MHJ360 | 15       | ±20% | 3         | 100        |
| 335    | M49470X01186KBJ   | SM031C186KHJ360 | 18       | ±10% | 3         | 100        |
| 336    | M49470X01186MBJ   | SM031C186MHJ360 | 18       | ±20% | 3         | 100        |
| 337    | M49470X01226KBJ   | SM031C226KHJ480 | 22       | ±10% | 3         | 100        |
| 338    | M49470X01226MBJ   | SM031C226MHJ480 | 22       | ±20% | 3         | 100        |
| 339    | M49470X01276KBJ   | SM031C276KHJ650 | 27       | ±10% | 3         | 100        |
| 340    | M49470X01276MBJ   | SM031C276MHJ650 | 27       | ±20% | 3         | 100        |
|        | M49470X01276KBC   | SM021C276KHJ240 | 27       | ±10% | 2         | 100        |
|        | M49470X01276MBC   | SM021C276MHJ240 | 27       | ±20% | 2         | 100        |
| 341    | M49470X01336KBJ   | SM011C336KHJ360 | 33       | ±10% | 1         | 100        |
| 342    | M49470X01336MBJ   | SM011C336MHJ360 | 33       | ±20% | 1         | 100        |
|        | M49470X01336KBC   | SM021C336KHJ240 | 33       | ±10% | 2         | 100        |
|        | M49470X01336MBC   | SM021C336MHJ240 | 33       | ±20% | 2         | 100        |
| 343    | M49470X01396KBJ   | SM011C396KHJ480 | 39       | ±10% | 1         | 100        |
| 344    | M49470X01396MBJ   | SM011C396MHJ480 | 39       | ±20% | 1         | 100        |

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
|        | M49470X01396KBC   | SM021C396KHJ360 | 39       | ±10% | 2         | 100        |
|        | M49470X01396MBC   | SM021C396MHJ360 | 39       | ±20% | 2         | 100        |
| 345    | M49470X01476KBJ   | SM011C476KHJ480 | 47       | ±10% | 1         | 100        |
| 346    | M49470X01476MBJ   | SM011C476MHJ480 | 47       | ±20% | 1         | 100        |
|        | M49470X01476KBC   | SM021C476KHJ360 | 47       | ±10% | 2         | 100        |
|        | M49470X01476MBC   | SM021C476MHJ360 | 47       | ±20% | 2         | 100        |
| 347    | M49470X01566KBJ   | SM011C566KHJ650 | 56       | ±10% | 1         | 100        |
| 348    | M49470X01566MBJ   | SM011C566MHJ650 | 56       | ±20% | 1         | 100        |
| 349    | M49470X01686KBJ   | SM021C686KHJ480 | 68       | ±10% | 2         | 100        |
| 350    | M49470X01686MBJ   | SM021C686MHJ480 | 68       | ±20% | 2         | 100        |
| 351    | M49470X01826KBJ   | SM021C826KHJ650 | 82       | ±10% | 2         | 100        |
| 352    | M49470X01826MBJ   | SM021C826MHJ650 | 82       | ±20% | 2         | 100        |
| 353    | M49470X01107KBJ   | SM061C107KHJ360 | 100      | ±10% | 6         | 100        |
| 354    | M49470X01107MBJ   | SM061C107MHJ360 | 100      | ±20% | 6         | 100        |
| 355    | M49470X01127KBJ   | SM061C127KHJ360 | 120      | ±10% | 6         | 100        |
| 356    | M49470X01127MBJ   | SM061C127MHJ360 | 120      | ±20% | 6         | 100        |
| 357    | M49470X01157KBJ   | SM061C157KHJ480 | 150      | ±10% | 6         | 100        |
| 358    | M49470X01157MBJ   | SM061C157MHJ480 | 150      | ±20% | 6         | 100        |
| 359    | M49470X01187KBJ   | SM061C187KHJ650 | 180      | ±10% | 6         | 100        |
| 360    | M49470X01187MBJ   | SM061C187MHJ650 | 180      | ±20% | 6         | 100        |
| 361    | M49470R01474KCJ   | SM052C474KHJ240 | 0.47     | ±10% | 5         | 200        |
| 362    | M49470R01474MCJ   | SM052C474MHJ240 | 0.47     | ±20% | 5         | 200        |
| 363    | M49470R01564KCJ   | SM052C564KHJ240 | 0.56     | ±10% | 5         | 200        |
| 364    | M49470R01564MCJ   | SM052C564MHJ240 | 0.56     | ±20% | 5         | 200        |
| 365    | M49470R01684KCJ   | SM052C684KHJ360 | 0.68     | ±10% | 5         | 200        |
| 366    | M49470R01684MCJ   | SM052C684MHJ360 | 0.68     | ±20% | 5         | 200        |
| 367    | M49470R01824KCJ   | SM052C824KHJ360 | 0.82     | ±10% | 5         | 200        |
| 368    | M49470R01824MCJ   | SM052C824MHJ360 | 0.82     | ±20% | 5         | 200        |
| 369    | M49470R01105KCJ   | SM052C105KHJ480 | 1.0      | ±10% | 5         | 200        |
| 370    | M49470R01105MCJ   | SM052C105MHJ480 | 1.0      | ±20% | 5         | 200        |
|        | M49470R01105KCC   | SM042C105KHJ120 | 1.0      | ±10% | 4         | 200        |
|        | M49470R01105MCC   | SM042C105MHJ120 | 1.0      | ±20% | 4         | 200        |
| 371    | M49470R01125KCJ   | SM052C125KHJ480 | 1.2      | ±10% | 5         | 200        |
| 372    | M49470R01125MCJ   | SM052C125MHJ480 | 1.2      | ±20% | 5         | 200        |
|        | M49470R01125KCC   | SM042C125KHJ240 | 1.2      | ±10% | 4         | 200        |
|        | M49470R01125MCC   | SM042C125MHJ240 | 1.2      | ±20% | 4         | 200        |
| 373    | M49470R01155KCJ   | SM052C155KHJ650 | 1.5      | ±10% | 5         | 200        |
| 374    | M49470R01155MCJ   | SM052C155MHJ650 | 1.5      | ±20% | 5         | 200        |
|        | M49470R01155KCC   | SM042C155KHJ230 | 1.5      | ±10% | 4         | 200        |
|        | M49470R01155MCC   | SM042C155MHJ230 | 1.5      | ±20% | 4         | 200        |
| 375    | M49470R01185KCJ   | SM042C185KHJ360 | 1.8      | ±10% | 4         | 200        |
| 376    | M49470R01185MCJ   | SM042C185MHJ360 | 1.8      | ±20% | 4         | 200        |
| 377    | M49470R01225KCJ   | SM042C225KHJ360 | 2.2      | ±10% | 4         | 200        |
| 378    | M49470R01225MCJ   | SM042C225MHJ360 | 2.2      | ±20% | 4         | 200        |
| 379    | M49470R01275KCJ   | SM042C275KHJ480 | 2.7      | ±10% | 4         | 200        |
| 380    | M49470R01275MCJ   | SM042C275MHJ480 | 2.7      | ±20% | 4         | 200        |
| 381    | M49470R01335KCJ   | SM042C335KHJ480 | 3.3      | ±10% | 4         | 200        |
| 382    | M49470R01335MCJ   | SM042C335MHJ480 | 3.3      | ±20% | 4         | 200        |
| 383    | M49470R01395KCJ   | SM042C395KHJ650 | 3.9      | ±10% | 4         | 200        |
| 384    | M49470R01395MCJ   | SM042C395MHJ650 | 3.9      | ±20% | 4         | 200        |
|        | M49470R01395KCC   | SM032C395KHJ240 | 3.9      | ±10% | 3         | 200        |
|        | M49470R01395MCC   | SM032C395MHJ240 | 3.9      | ±20% | 3         | 200        |
| 385    | M49470R01475KCJ   | SM032C475KHJ240 | 4.7      | ±10% | 3         | 200        |
| 386    | M49470R01475MCJ   | SM032C475MHJ240 | 4.7      | ±20% | 3         | 200        |
| 387    | M49470R01565KCJ   | SM032C565KHJ240 | 5.6      | ±10% | 3         | 200        |
| 388    | M49470R01565MCJ   | SM032C565MHJ240 | 5.6      | ±20% | 3         | 200        |
| 389    | M49470R01685KCJ   | SM032C685KHJ360 | 6.8      | ±10% | 3         | 200        |
| 390    | M49470R01685MCJ   | SM032C685MHJ360 | 6.8      | ±20% | 3         | 200        |
| 391    | M49470R01825KCJ   | SM032C825KHJ360 | 8.2      | ±10% | 3         | 200        |
| 392    | M49470R01825MCJ   | SM032C825MHJ360 | 8.2      | ±20% | 3         | 200        |
| 393    | M49470R01106KCJ   | SM032C106KHJ480 | 10       | ±10% | 3         | 200        |
| 394    | M49470R01106MCJ   | SM032C106MHJ480 | 10       | ±20% | 3         | 200        |



# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles MIL-PRF-49470



U.S. Preferred Styles

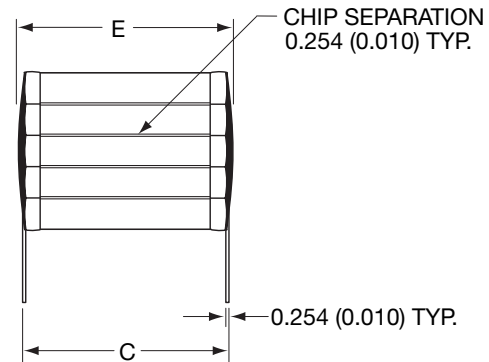
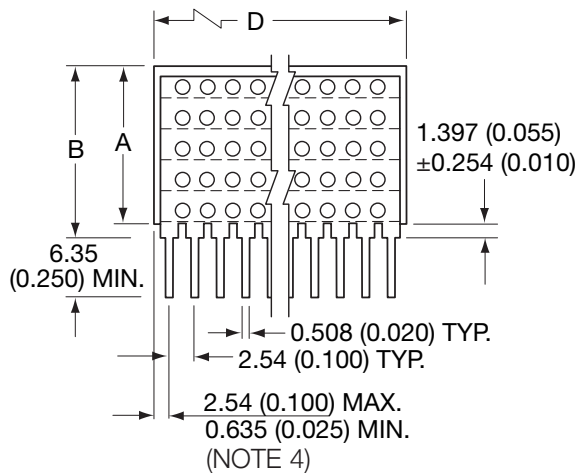
| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
| 395    | M49470R01126KCJ   | SM032C126KHJ650 | 12       | ±10% | 3         | 200        |
| 396    | M49470R01126MCJ   | SM032C126MHJ650 | 12       | ±20% | 3         | 200        |
|        | M49470R01126KCC   | SM022C126KHJ240 | 12       | ±10% | 2         | 200        |
|        | M49470R01126MCC   | SM022C126MHJ240 | 12       | ±20% | 2         | 200        |
| 397    | M49470R01156KCJ   | SM012C156KHJ360 | 15       | ±10% | 1         | 200        |
| 398    | M49470R01156MCJ   | SM012C156MHJ360 | 15       | ±20% | 1         | 200        |
|        | M49470R01156KCC   | SM022C156KHJ240 | 15       | ±10% | 2         | 200        |
|        | M49470R01156MCC   | SM022C156MHJ240 | 15       | ±20% | 2         | 200        |
| 399    | M49470R01186KCJ   | SM012C186KHJ480 | 18       | ±10% | 1         | 200        |
| 400    | M49470R01186MCJ   | SM012C186MHJ480 | 18       | ±20% | 1         | 200        |
|        | M49470R01186KCC   | SM022C186KHJ360 | 18       | ±10% | 2         | 200        |
|        | M49470R01186MCC   | SM022C186MHJ360 | 18       | ±20% | 2         | 200        |
| 401    | M49470R01226KCJ   | SM012C226KHJ650 | 22       | ±10% | 1         | 200        |
| 402    | M49470R01226MCJ   | SM012C226MHJ650 | 22       | ±20% | 1         | 200        |
|        | M49470R01226KCC   | SM022C226KHJ360 | 22       | ±10% | 2         | 200        |
|        | M49470R01226MCC   | SM022C226MHJ360 | 22       | ±20% | 2         | 200        |
| 403    | M49470R01276KCJ   | SM012C276KHJ650 | 27       | ±10% | 1         | 200        |
| 404    | M49470R01276MCJ   | SM012C276MHJ650 | 27       | ±20% | 1         | 200        |
|        | M49470R01276KCC   | SM022C276KHJ480 | 27       | ±10% | 2         | 200        |
|        | M49470R01276MCC   | SM022C276MHJ480 | 27       | ±20% | 2         | 200        |
| 405    | M49470R01336KCJ   | SM022C336KHJ480 | 33       | ±10% | 2         | 200        |
| 406    | M49470R01336MCJ   | SM022C336MHJ480 | 33       | ±20% | 2         | 200        |
| 407    | M49470R01396KCJ   | SM022C396KHJ650 | 39       | ±10% | 2         | 200        |
| 408    | M49470R01396MCJ   | SM022C396MHJ650 | 39       | ±20% | 2         | 200        |
| 409    | M49470R01476KCJ   | SM062C476KHJ240 | 47       | ±10% | 6         | 200        |
| 410    | M49470R01476MCJ   | SM062C476MHJ240 | 47       | ±20% | 6         | 200        |
| 411    | M49470R01566KCJ   | SM062C566KHJ360 | 56       | ±10% | 6         | 200        |
| 412    | M49470R01566MCJ   | SM062C566MHJ360 | 56       | ±20% | 6         | 200        |
| 413    | M49470R01686KCJ   | SM062C686KHJ360 | 68       | ±10% | 6         | 200        |
| 414    | M49470R01686MCJ   | SM062C686MHJ360 | 68       | ±20% | 6         | 200        |
| 415    | M49470R01826KCJ   | SM062C826KHJ480 | 82       | ±10% | 6         | 200        |
| 416    | M49470R01826MCJ   | SM062C826MHJ480 | 82       | ±20% | 6         | 200        |
| 417    | M49470R01107KCJ   | SM062C107KHJ650 | 100      | ±10% | 6         | 200        |
| 418    | M49470R01107MCJ   | SM062C107MHJ650 | 100      | ±20% | 6         | 200        |
| 419    | M49470R01127KCJ   | SM062C127KHJ650 | 120      | ±10% | 6         | 200        |
| 420    | M49470R01127MCJ   | SM062C127MHJ650 | 120      | ±20% | 6         | 200        |
| 421    | M49470Q01154KEJ   | SM057C154KHJ120 | 0.15     | ±10% | 5         | 500        |
| 422    | M49470Q01154MEJ   | SM057C154MHJ120 | 0.15     | ±20% | 5         | 500        |
| 423    | M49470Q01184KEJ   | SM057C184KHJ240 | 0.18     | ±10% | 5         | 500        |
| 424    | M49470Q01184MEJ   | SM057C184MHJ240 | 0.18     | ±20% | 5         | 500        |
| 425    | M49470Q01224KEJ   | SM057C224KHJ240 | 0.22     | ±10% | 5         | 500        |
| 426    | M49470Q01224MEJ   | SM057C224MHJ240 | 0.22     | ±20% | 5         | 500        |
| 427    | M49470Q01274KEJ   | SM057C274KHJ240 | 0.27     | ±10% | 5         | 500        |
| 428    | M49470Q01274MEJ   | SM057C274MHJ240 | 0.27     | ±20% | 5         | 500        |
| 429    | M49470Q01334KEJ   | SM057C334KHJ360 | 0.33     | ±10% | 5         | 500        |
| 430    | M49470Q01334MEJ   | SM057C334MHJ360 | 0.33     | ±20% | 5         | 500        |
| 431    | M49470Q01394KEJ   | SM057C394KHJ360 | 0.39     | ±10% | 5         | 500        |
| 432    | M49470Q01394MEJ   | SM057C394MHJ360 | 0.39     | ±20% | 5         | 500        |
| 433    | M49470Q01474KEJ   | SM057C474KHJ360 | 0.47     | ±10% | 5         | 500        |
| 434    | M49470Q01474MEJ   | SM057C474MHJ360 | 0.47     | ±20% | 5         | 500        |
| 435    | M49470Q01564KEJ   | SM057C564KHJ480 | 0.56     | ±10% | 5         | 500        |
| 436    | M49470Q01564MEJ   | SM057C564MHJ480 | 0.56     | ±20% | 5         | 500        |
|        | M49470Q01564KEC   | SM047C564KHJ240 | 0.56     | ±10% | 4         | 500        |
|        | M49470Q01564MEC   | SM047C564MHJ240 | 0.56     | ±20% | 4         | 500        |
| 437    | M49470Q01684KEJ   | SM057C684KHJ650 | 0.68     | ±10% | 5         | 500        |
| 438    | M49470Q01684MEJ   | SM057C684MHJ650 | 0.68     | ±20% | 5         | 500        |
|        | M49470Q01684KEC   | SM047C684KHJ240 | 0.68     | ±10% | 4         | 500        |
|        | M49470Q01684MEC   | SM047C684MHJ240 | 0.68     | ±20% | 4         | 500        |
| 439    | M49470Q01824KEJ   | SM047C824KHJ360 | 0.82     | ±10% | 4         | 500        |
| 440    | M49470Q01824MEJ   | SM047C824MHJ360 | 0.82     | ±20% | 4         | 500        |
| 441    | M49470Q01105KEJ   | SM047C105KHJ360 | 1.0      | ±10% | 4         | 500        |
| 442    | M49470Q01105MEJ   | SM047C105MHJ360 | 1.0      | ±20% | 4         | 500        |

| 87106- | MIL-PRF-49470 PIN | AVX PART NUMBER | CAP (μF) | TOL  | CASE CODE | VOLT (VDC) |
|--------|-------------------|-----------------|----------|------|-----------|------------|
| 443    | M49470Q01125KEJ   | SM047C125KHJ360 | 1.2      | ±10% | 4         | 500        |
| 444    | M49470Q01125MEJ   | SM047C125MHJ360 | 1.2      | ±20% | 4         | 500        |
| 445    | M49470Q01155KEJ   | SM047C155KHJ480 | 1.5      | ±10% | 4         | 500        |
| 446    | M49470Q01155MEJ   | SM047C155MHJ480 | 1.5      | ±20% | 4         | 500        |
| 447    | M49470Q01185KEJ   | SM047C185KHJ650 | 1.8      | ±10% | 4         | 500        |
| 448    | M49470Q01185MEJ   | SM047C185MHJ650 | 1.8      | ±20% | 4         | 500        |
|        | M49470Q01185KEC   | SM037C185KHJ240 | 1.8      | ±10% | 3         | 500        |
|        | M49470Q01185MEC   | SM037C185MHJ240 | 1.8      | ±20% | 3         | 500        |
| 449    | M49470Q01225KEJ   | SM037C225KHJ240 | 2.2      | ±10% | 3         | 500        |
| 450    | M49470Q01225MEJ   | SM037C225MHJ240 | 2.2      | ±20% | 3         | 500        |
| 451    | M49470Q01275KEJ   | SM037C275KHJ360 | 2.7      | ±10% | 3         | 500        |
| 452    | M49470Q01275MEJ   | SM037C275MHJ360 | 2.7      | ±20% | 3         | 500        |
| 453    | M49470Q01335KEJ   | SM037C335KHJ360 | 3.3      | ±10% | 3         | 500        |
| 454    | M49470Q01335MEJ   | SM037C335MHJ360 | 3.3      | ±20% | 3         | 500        |
| 455    | M49470Q01395KEJ   | SM037C395KHJ360 | 3.9      | ±10% | 3         | 500        |
| 456    | M49470Q01395MEJ   | SM037C395MHJ360 | 3.9      | ±20% | 3         | 500        |
| 457    | M49470Q01475KEJ   | SM037C475KHJ480 | 4.7      | ±10% | 3         | 500        |
| 458    | M49470Q01475MEJ   | SM037C475MHJ480 | 4.7      | ±20% | 3         | 500        |
| 459    | M49470Q01565KEJ   | SM037C565KHJ650 | 5.6      | ±10% | 3         | 500        |
| 460    | M49470Q01565MEJ   | SM037C565MHJ650 | 5.6      | ±20% | 3         | 500        |
|        | M49470Q01565KEC   | SM027C565KHJ240 | 5.6      | ±10% | 2         | 500        |
|        | M49470Q01565MEC   | SM027C565MHJ240 | 5.6      | ±20% | 2         | 500        |
| 461    | M49470Q01685KEJ   | SM017C685KHJ480 | 6.8      | ±10% | 1         | 500        |
| 462    | M49470Q01685MEJ   | SM017C685MHJ480 | 6.8      | ±20% | 1         | 500        |
|        | M49470Q01685KEC   | SM027C685KHJ240 | 6.8      | ±10% | 2         | 500        |
|        | M49470Q01685MEC   | SM027C685MHJ240 | 6.8      | ±20% | 2         | 500        |
| 463    | M49470Q01825KEJ   | SM017C825KHJ480 | 8.2      | ±10% | 1         | 500        |
| 464    | M49470Q01825MEJ   | SM017C825MHJ480 | 8.2      | ±20% | 1         | 500        |
|        | M49470Q01825KEC   | SM027C825KHJ360 | 8.2      | ±10% | 2         | 500        |
|        | M49470Q01825MEC   | SM027C825MHJ360 | 8.2      | ±20% | 2         | 500        |
| 465    | M49470Q01106KEJ   | SM017C106KHJ480 | 10       | ±10% | 1         | 500        |
| 466    | M49470Q01106MEJ   | SM017C106MHJ480 | 10       | ±20% | 1         | 500        |
|        | M49470Q01106KEC   | SM027C106KHJ360 | 10       | ±10% | 2         | 500        |
|        | M49470Q01106MEC   | SM027C106MHJ360 | 10       | ±20% | 2         | 500        |
| 467    | M49470Q01126KEJ   | SM017C126KHJ650 | 12       | ±10% | 1         | 500        |
| 468    | M49470Q01126MEJ   | SM017C126MHJ650 | 12       | ±20% | 1         | 500        |
|        | M49470Q01126KEC   | SM027C126KHJ480 | 12       | ±10% | 2         | 500        |
|        | M49470Q01126MEC   | SM027C126MHJ480 | 12       | ±20% | 2         | 500        |
| 469    | M49470Q01156KEJ   | SM027C156KHJ650 | 15       | ±10% | 2         | 500        |
| 470    | M49470Q01156MEJ   | SM027C156MHJ650 | 15       | ±20% | 2         | 500        |
| 471    | M49470Q01186KEJ   | SM027C186KHJ650 | 18       | ±10% | 2         | 500        |
| 472    | M49470Q01186MEJ   | SM027C186MHJ650 | 18       | ±20% | 2         | 500        |
| 473    | M49470Q01226KEJ   | SM067C226KHJ360 | 22       | ±10% | 6         | 500        |
| 474    | M49470Q01226MEJ   | SM067C226MHJ360 | 22       | ±20% | 6         | 500        |
| 475    | M49470Q01276KEJ   | SM067C276KHJ360 | 27       | ±10% | 6         | 500        |
| 476    | M49470Q01276MEJ   | SM067C276MHJ360 | 27       | ±20% | 6         | 500        |
| 477    | M49470Q01336KEJ   | SM067C336KHJ480 | 33       | ±10% | 6         | 500        |
| 478    | M49470Q01336MEJ   | SM067C336MHJ480 | 33       | ±20% | 6         | 500        |
| 479    | M49470Q01396KEJ   | SM067C396KHJ650 | 39       | ±10% | 6         | 500        |
| 480    | M49470Q01396MEJ   | SM067C396MHJ650 | 39       | ±20% | 6         | 500        |

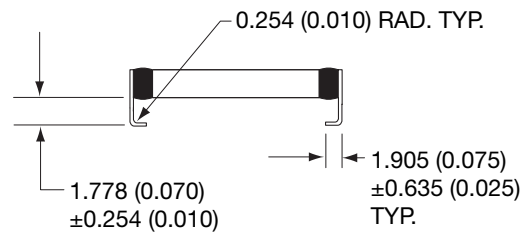
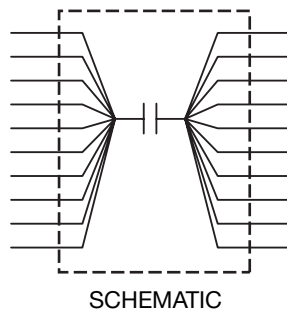
# SMPS Stacked MLC Capacitors



(SM Style) SM Military Styles DSCC Dwg. #87106 & #88011 U.S. Preferred Styles



**“N” STYLE LEADS**



**“J” STYLE LEADS**

## DIMENSIONS

millimeters (inches)

| Case Code | A (max.)<br>(See Note 2) | B (max.)<br>(See Note 2) | C ±.635 (±0.025) | D ±.635 (±0.025) | E (max.)     | No. of Leads per side |
|-----------|--------------------------|--------------------------|------------------|------------------|--------------|-----------------------|
| 1         | 16.5 (0.650)             | 18.2 (0.715)             | 11.4 (0.450)     | 52.1 (2.050)     | 12.7 (0.500) | 20                    |
| 2         | 16.5 (0.650)             | 18.2 (0.715)             | 20.3 (0.800)     | 38.4 (1.510)     | 22.1 (0.870) | 15                    |
| 3         | 16.5 (0.650)             | 18.2 (0.715)             | 11.4 (0.450)     | 26.7 (1.050)     | 12.7 (0.500) | 10                    |
| 4         | 16.5 (0.650)             | 18.2 (0.715)             | 10.2 (0.400)     | 10.2 (0.400)     | 11.2 (0.440) | 4                     |
| 5         | 16.5 (0.650)             | 18.2 (0.715)             | 6.35 (0.250)     | 6.35 (0.250)     | 7.62 (0.300) | 3                     |
| 6         | 16.5 (0.650)             | 18.2 (0.715)             | 31.8 (1.250)     | 52.1 (2.050)     | 34.3 (1.350) | 20                    |

### NOTES:

1. Unless otherwise specified, tolerances 0.254 (±0.010).
2. “A” dimensions are maximum (see tables on pages 22 thru 25 for specific part number dimensions).
3. “N” straight leads; “J” leads formed in.
4. For case code 5, dimensions shall be 2.54 (0.100) maximum, 0.305 (0.012) minimum.



# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles DSCC Dwg. #87106 & #88011



U.S. Preferred Styles

## Ordering Information

**Part Number:** The complete part number shall be as follows:

X7R: 87106                      XXX

                      
Drawing number

                      
Dash number  
(see list)

**Ordering Data.** The contract or purchase order should specify the following:

- Complete part number.
- Requirements for delivery of one copy of the quality conformance inspection data with each shipment of parts by the manufacturer.
- Whether the manufacturer performs the group B tests, or provides certification of compliance with group B requirements.
- Requirements for notification of change of products to acquiring activity, if applicable.
- Requirements for packaging and packing.

## Source of Supply.

                      
Vendor CAGE  
number

96095

                      
Vendor name  
and address

Olean Advanced Products  
A Division of AVX Corporation  
1695 Seneca Avenue  
Olean, NY 14760

## Performance Characteristics

**Operating Temperature Range.** The operating temperature range shall be -55°C to +125°C.

## Electrical Characteristics.

Rated Voltage. See tables on pages 22, 23, 24 & 25.

**Capacitance.** Measured in accordance with method 305 of MIL-STD-202 (1KHz at 1.0Vrms, open circuit voltage, at +25°C).

**Dissipation Factor (+25°C).** X7R: Dissipation factor shall be 2.5 percent maximum (measured under the same conditions as capacitance.) C0G: Dissipation factor shall be 0.15 percent maximum.

## Temperature Coefficient.

| DSCC Dwg.                     | Bias = 0 volt | Bias = rated voltage |
|-------------------------------|---------------|----------------------|
| 88011 All Voltages            | 0±30 ppm/°C   | 0±30 ppm/°C          |
| 87106 50 WVDC<br>and 100 WVDC | ±15%          | +15, -25%            |
| 87106 200 WVDC                | ±15%          | +15, -40%            |
| 87106 500 WVDC                | ±15%          | +15, -50%            |

## Insulation Resistance.

At +25°C, rated voltage: 100K MΩ or 1,000 MΩ-μF, whichever is less.

At +125°C, rated voltage: 10K MΩ or 100 MΩ-μF, whichever is less.

**Dielectric Withstanding Voltage.** Dielectric withstanding voltage shall be 250 percent of rated voltage except 500V rated parts at 150 percent of rated voltage.

**Capacitance Tolerance.** J = ±5 percent, K = ±10 percent, M = ±20 percent.

**Solderability of Terminals.** In accordance with MIL-PRF-49470.

**Resistance to Soldering Heat.** In accordance with MIL-STD-202, method 210, condition B, for 20 seconds.

**Shock.** In accordance with MIL-PRF-49470.

**Immersion Cycling.** In accordance with MIL-PRF-49470.

**Moisture Resistance.** In accordance with MIL-PRF-49470.

**Life.** Life shall be 200 percent of rated voltage except 500V rated parts at 120 percent of rated voltage applied at +125°C for 1,000 hours.

**Thermal Shock.** MIL-STD-202, method 107, test condition A, except high temperature is +125°C.

**Voltage Conditioning.** In accordance with MIL-PRF-49470, except 500V rated parts at 120 percent of rated voltage at +125°C.

**Terminal Strength.** MIL-STD-202, method 211, condition B, except that each lead shall be bent away from the body 90 degrees from the original position and back, two bends.

**Marking.** Marking shall be in accordance with MIL-STD-1285, except the part number shall be as specified in paragraph 1.2 of 87106, or 88011 with the manufacturer's name or code and date code minimum, except case sizes 4 and 5 shall be marked with coded cap and tolerance minimum. Full marking shall be included on the package.

# SMPS Stacked MLC Capacitors

(SM Style) DSCC #87106 and #88011



U.S. Preferred Styles

**Table II. Group A inspection.**

| Inspection                                                                                                                                                                                   | Requirement paragraph of MIL-PRF-49470          | Test method paragraph of MIL-PRF-49470 | Sampling procedure       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|----------------------------------------|--------------------------|
| <b>Subgroup 1</b><br>Thermal shock and voltage conditioning <u>1/</u>                                                                                                                        | 3.9                                             | 4.8.5                                  | 100% inspection          |
| <b>Subgroup 2</b><br>Visual and mechanical examination:<br>Material<br>Physical dimensions<br>Interface requirements<br>(other than physical dimensions)<br>Marking <u>2/</u><br>Workmanship | 3.4<br>3.1<br>3.5 and 3.5.1<br><br>3.28<br>3.30 | 4.8.4                                  | 13 samples<br>0 failures |

1/ Post checks are required (see paragraph 3.9 of MIL-PRF-49470).

2/ Marking defects are based on visual examination only. Any subsequent electrical defects shall not be used as a basis for determining marking defects.

**Table III. Group B inspection. 1/**

| Inspection                                                                                                                                       | Requirement paragraph of MIL-PRF-49470 | Test method paragraph of MIL-PRF-49470  | Number of sample units to be inspected | Number of defectives permitted <u>2/</u> |             |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----------------------------------------|----------------------------------------|------------------------------------------|-------------|--|
| <b>Subgroup 1 <u>3/</u></b><br>Temperature coefficient<br>Resistance to solvents <u>5/</u> <u>6/</u><br>Immersion<br>Terminal strength <u>5/</u> | <u>4/</u><br>3.23<br>3.18<br>3.24      | <u>4/</u><br>4.8.20<br>4.8.15<br>4.8.10 | 12                                     | 1                                        | <u>6/</u> 1 |  |
| <b>Subgroup 2</b><br>Resistance to soldering heat<br>Moisture resistance                                                                         | 3.20<br>3.21                           | 4.8.17<br>4.8.18                        | 12                                     | 1                                        |             |  |
| <b>Subgroup 3</b><br>Marking legibility<br>(laser marking only)                                                                                  | 3.28.1                                 | 4.8.4.1                                 | 6                                      | 1                                        |             |  |
| <b>Subgroup 4</b><br>Solderability                                                                                                               | 3.15                                   | 4.8.12                                  | 3                                      | 0                                        |             |  |
| <b>Subgroup 5</b><br>Life                                                                                                                        | 3.26                                   | 4.8.22                                  | 5 minimum<br>per case code             | 0                                        |             |  |

1/ Unless otherwise specified herein, when necessary, mounting of group B samples shall be at the discretion of the manufacturer.

2/ A sample unit having one or more defects shall be charged as a single defective.

3/ Order of tests is at discretion of manufacturer.

4/ See 3.2.3 of DSCC 87106.

5/ Sample size shall be 3 pieces with zero defectives permitted.

6/ Total of one defect allowed for combination of subgroup 1, subgroup 2, and subgroup 3 inspections.



# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles DSCC Dwg. #87106 (X7R)



U.S. Preferred Styles

## Electrical characteristics

| DSCC Dwg. 87106- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| <b>50V</b>       |                 |           |           |            |                              |
| 001              | 1.0             | K         | 5         | N          | 3.05 (0.120)                 |
| 002              | 1.0             | M         | 5         | N          | 3.05 (0.120)                 |
| 241              | 1.0             | K         | 5         | J          | 3.05 (0.120)                 |
| 242              | 1.0             | M         | 5         | J          | 3.05 (0.120)                 |
| 003              | 1.2             | K         | 5         | N          | 3.05 (0.120)                 |
| 004              | 1.2             | M         | 5         | N          | 3.05 (0.120)                 |
| 243              | 1.2             | K         | 5         | J          | 3.05 (0.120)                 |
| 244              | 1.2             | M         | 5         | J          | 3.05 (0.120)                 |
| 005              | 1.5             | K         | 5         | N          | 6.10 (0.240)                 |
| 006              | 1.5             | M         | 5         | N          | 6.10 (0.240)                 |
| 245              | 1.5             | K         | 5         | J          | 6.10 (0.240)                 |
| 246              | 1.5             | M         | 5         | J          | 6.10 (0.240)                 |
| 007              | 1.8             | K         | 5         | N          | 6.10 (0.240)                 |
| 008              | 1.8             | M         | 5         | N          | 6.10 (0.240)                 |
| 247              | 1.8             | K         | 5         | J          | 6.10 (0.240)                 |
| 248              | 1.8             | M         | 5         | J          | 6.10 (0.240)                 |
| 009              | 2.2             | K         | 5         | N          | 6.10 (0.240)                 |
| 010              | 2.2             | M         | 5         | N          | 6.10 (0.240)                 |
| 249              | 2.2             | K         | 5         | J          | 6.10 (0.240)                 |
| 250              | 2.2             | M         | 5         | J          | 6.10 (0.240)                 |
| 011              | 2.7             | K         | 5         | N          | 9.14 (0.360)                 |
| 012              | 2.7             | M         | 5         | N          | 9.14 (0.360)                 |
| 251              | 2.7             | K         | 5         | J          | 9.14 (0.360)                 |
| 252              | 2.7             | M         | 5         | J          | 9.14 (0.360)                 |
| 013              | 3.3             | K         | 5         | N          | 9.14 (0.360)                 |
| 014              | 3.3             | M         | 5         | N          | 9.14 (0.360)                 |
| 253              | 3.3             | K         | 5         | J          | 9.14 (0.360)                 |
| 254              | 3.3             | M         | 5         | J          | 9.14 (0.360)                 |
| 015              | 3.9             | K         | 5         | N          | 12.2 (0.480)                 |
| 016              | 3.9             | M         | 5         | N          | 12.2 (0.480)                 |
| 255              | 3.9             | K         | 5         | J          | 12.2 (0.480)                 |
| 256              | 3.9             | M         | 5         | J          | 12.2 (0.480)                 |
| 017              | 4.7             | K         | 5         | N          | 12.2 (0.480)                 |
| 018              | 4.7             | M         | 5         | N          | 12.2 (0.480)                 |
| 257              | 4.7             | K         | 5         | J          | 12.2 (0.480)                 |
| 258              | 4.7             | M         | 5         | J          | 12.2 (0.480)                 |
| 019              | 5.6             | K         | 5         | N          | 16.5 (0.650)                 |
| 020              | 5.6             | M         | 5         | N          | 16.5 (0.650)                 |
| 259              | 5.6             | K         | 5         | J          | 16.5 (0.650)                 |
| 260              | 5.6             | M         | 5         | J          | 16.5 (0.650)                 |
| 223              | 6.8             | K         | 4         | N          | 9.14 (0.360)                 |
| 224              | 6.8             | M         | 4         | N          | 9.14 (0.360)                 |
| 261              | 6.8             | K         | 4         | J          | 9.14 (0.360)                 |
| 262              | 6.8             | M         | 4         | J          | 9.14 (0.360)                 |
| 021              | 8.2             | K         | 4         | N          | 9.14 (0.360)                 |
| 022              | 8.2             | M         | 4         | N          | 9.14 (0.360)                 |
| 263              | 8.2             | K         | 4         | J          | 9.14 (0.360)                 |
| 264              | 8.2             | M         | 4         | J          | 9.14 (0.360)                 |
| 023              | 10              | K         | 4         | N          | 12.2 (0.480)                 |
| 024              | 10              | M         | 4         | N          | 12.2 (0.480)                 |
| 265              | 10              | K         | 4         | J          | 12.2 (0.480)                 |
| 266              | 10              | M         | 4         | J          | 12.2 (0.480)                 |
| 025              | 12              | K         | 4         | N          | 12.2 (0.480)                 |
| 026              | 12              | M         | 4         | N          | 12.2 (0.480)                 |
| 267              | 12              | K         | 4         | J          | 12.2 (0.480)                 |
| 268              | 12              | M         | 4         | J          | 12.2 (0.480)                 |
| 027              | 15              | K         | 4         | N          | 16.5 (0.650)                 |
| 028              | 15              | M         | 4         | N          | 16.5 (0.650)                 |
| 269              | 15              | K         | 4         | J          | 16.5 (0.650)                 |
| 270              | 15              | M         | 4         | J          | 16.5 (0.650)                 |
| 029              | 18              | K         | 3         | N          | 6.10 (0.240)                 |
| 030              | 18              | M         | 3         | N          | 6.10 (0.240)                 |
| 271              | 18              | K         | 3         | J          | 6.10 (0.240)                 |

| DSCC Dwg. 87106- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| <b>50V</b>       |                 |           |           |            |                              |
| 272              | 18              | M         | 3         | J          | 6.10 (0.240)                 |
| 272              | 18              | M         | 3         | J          | 6.10 (0.240)                 |
| 031              | 22              | K         | 3         | N          | 9.14 (0.360)                 |
| 032              | 22              | M         | 3         | N          | 9.14 (0.360)                 |
| 273              | 22              | K         | 3         | J          | 9.14 (0.360)                 |
| 274              | 22              | M         | 3         | J          | 9.14 (0.360)                 |
| 033              | 27              | K         | 3         | N          | 9.14 (0.360)                 |
| 034              | 27              | M         | 3         | N          | 9.14 (0.360)                 |
| 275              | 27              | K         | 3         | J          | 9.14 (0.360)                 |
| 276              | 27              | M         | 3         | J          | 9.14 (0.360)                 |
| 035              | 33              | K         | 3         | N          | 9.14 (0.360)                 |
| 036              | 33              | M         | 3         | N          | 9.14 (0.360)                 |
| 277              | 33              | K         | 3         | J          | 9.14 (0.360)                 |
| 278              | 33              | M         | 3         | J          | 9.14 (0.360)                 |
| 037              | 39              | K         | 3         | N          | 12.2 (0.480)                 |
| 038              | 39              | M         | 3         | N          | 12.2 (0.480)                 |
| 279              | 39              | K         | 3         | J          | 12.2 (0.480)                 |
| 280              | 39              | M         | 3         | J          | 12.2 (0.480)                 |
| 039              | 47              | K         | 3         | N          | 16.5 (0.650)                 |
| 040              | 47              | M         | 3         | N          | 16.5 (0.650)                 |
| 281              | 47              | K         | 3         | J          | 16.5 (0.650)                 |
| 282              | 47              | M         | 3         | J          | 16.5 (0.650)                 |
| 225              | 56              | K         | 1         | N          | 9.14 (0.360)                 |
| 226              | 56              | M         | 1         | N          | 9.14 (0.360)                 |
| 283              | 56              | K         | 1         | J          | 9.14 (0.360)                 |
| 284              | 56              | M         | 1         | J          | 9.14 (0.360)                 |
| 041              | 68              | K         | 1         | N          | 12.2 (0.480)                 |
| 042              | 68              | M         | 1         | N          | 12.2 (0.480)                 |
| 285              | 68              | K         | 1         | J          | 12.2 (0.480)                 |
| 286              | 68              | M         | 1         | J          | 12.2 (0.480)                 |
| 043              | 82              | K         | 1         | N          | 12.2 (0.480)                 |
| 044              | 82              | M         | 1         | N          | 12.2 (0.480)                 |
| 287              | 82              | K         | 1         | J          | 12.2 (0.480)                 |
| 288              | 82              | M         | 1         | J          | 12.2 (0.480)                 |
| 045              | 100             | K         | 1         | N          | 16.5 (0.650)                 |
| 046              | 100             | M         | 1         | N          | 16.5 (0.650)                 |
| 289              | 100             | K         | 1         | J          | 16.5 (0.650)                 |
| 290              | 100             | M         | 1         | J          | 16.5 (0.650)                 |
| 227              | 120             | K         | 2         | N          | 12.2 (0.480)                 |
| 228              | 120             | M         | 2         | N          | 12.2 (0.480)                 |
| 291              | 120             | K         | 2         | J          | 12.2 (0.480)                 |
| 292              | 120             | M         | 2         | J          | 12.2 (0.480)                 |
| 047              | 150             | K         | 2         | N          | 16.5 (0.650)                 |
| 048              | 150             | M         | 2         | N          | 16.5 (0.650)                 |
| 293              | 150             | K         | 2         | J          | 16.5 (0.650)                 |
| 294              | 150             | M         | 2         | J          | 16.5 (0.650)                 |
| 049              | 180             | K         | 6         | N          | 12.2 (0.480)                 |
| 050              | 180             | M         | 6         | N          | 12.2 (0.480)                 |
| 295              | 180             | K         | 6         | J          | 12.2 (0.480)                 |
| 296              | 180             | M         | 6         | J          | 12.2 (0.480)                 |
| 051              | 220             | K         | 6         | N          | 12.2 (0.480)                 |
| 052              | 220             | M         | 6         | N          | 12.2 (0.480)                 |
| 297              | 220             | K         | 6         | J          | 12.2 (0.480)                 |
| 298              | 220             | M         | 6         | J          | 12.2 (0.480)                 |
| 053              | 270             | K         | 6         | N          | 16.5 (0.650)                 |
| 054              | 270             | M         | 6         | N          | 16.5 (0.650)                 |
| 299              | 270             | K         | 6         | J          | 16.5 (0.650)                 |
| 300              | 270             | M         | 6         | J          | 16.5 (0.650)                 |

| DSCC Dwg. 87106- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| <b>100V</b>      |                 |           |           |            |                              |
| 055              | .68             | K         | 5         | N          | 3.05 (0.120)                 |
| 056              | .68             | M         | 5         | N          | 3.05 (0.120)                 |
| 301              | .68             | K         | 5         | J          | 3.05 (0.120)                 |
| 302              | .68             | M         | 5         | J          | 3.05 (0.120)                 |
| 057              | .82             | K         | 5         | N          | 6.10 (0.240)                 |
| 058              | .82             | M         | 5         | N          | 6.10 (0.240)                 |
| 303              | .82             | K         | 5         | J          | 6.10 (0.240)                 |
| 304              | .82             | M         | 5         | J          | 6.10 (0.240)                 |
| 059              | 1.0             | K         | 5         | N          | 6.10 (0.240)                 |
| 060              | 1.0             | M         | 5         | N          | 6.10 (0.240)                 |
| 305              | 1.0             | K         | 5         | J          | 6.10 (0.240)                 |
| 306              | 1.0             | M         | 5         | J          | 6.10 (0.240)                 |
| 061              | 1.2             | K         | 5         | N          | 6.10 (0.240)                 |
| 062              | 1.2             | M         | 5         | N          | 6.10 (0.240)                 |
| 307              | 1.2             | K         | 5         | J          | 6.10 (0.240)                 |
| 308              | 1.2             | M         | 5         | J          | 6.10 (0.240)                 |
| 063              | 1.5             | K         | 5         | N          | 9.14 (0.360)                 |
| 064              | 1.5             | M         | 5         | N          | 9.14 (0.360)                 |
| 309              | 1.5             | K         | 5         | J          | 9.14 (0.360)                 |
| 310              | 1.5             | M         | 5         | J          | 9.14 (0.360)                 |
| 065              | 1.8             | K         | 5         | N          | 9.14 (0.360)                 |
| 066              | 1.8             | M         | 5         | N          | 9.14 (0.360)                 |
| 311              | 1.8             | K         | 5         | J          | 9.14 (0.360)                 |
| 312              | 1.8             | M         | 5         | J          | 9.14 (0.360)                 |
| 067              | 2.2             | K         | 5         | N          | 12.2 (0.480)                 |
| 068              | 2.2             | M         | 5         | N          | 12.2 (0.480)                 |
| 313              | 2.2             | K         | 5         | J          | 12.2 (0.480)                 |
| 314              | 2.2             | M         | 5         | J          | 12.2 (0.480)                 |
| 069              | 2.7             | K         | 5         | N          | 12.2 (0.480)                 |
| 070              | 2.7             | M         | 5         | N          | 12.2 (0.480)                 |
| 315              | 2.7             | K         | 5         | J          | 12.2 (0.480)                 |
| 316              | 2.7             | M         | 5         | J          | 12.2 (0.480)                 |
| 071              | 3.3             | K         | 5         | N          | 16.5 (0.650)                 |
| 072              | 3.3             | M         | 5         | N          | 16.5 (0.650)                 |
| 317              | 3.3             | K         | 5         | J          | 16.5 (0.650)                 |
| 318              | 3.3             | M         | 5         | J          | 16.5 (0.650)                 |
| 073              | 3.9             | K         | 4         | N          | 9.14 (0.360)                 |
| 074              | 3.9             | M         | 4         | N          | 9.14 (0.360)                 |
| 319              | 3.9             | K         | 4         | J          | 9.14 (0.360)                 |
| 320              | 3.9             | M         | 4         | J          | 9.14 (0.360)                 |
| 075              | 4.7             | K         | 4         | N          | 9.14 (0.360)                 |
| 076              | 4.7             | M         | 4         | N          | 9.14 (0.360)                 |
| 321              | 4.7             | K         | 4         | J          | 9.14 (0.360)                 |
| 322              | 4.7             | M         | 4         | J          | 9.14 (0.360)                 |
| 077              | 5.6             | K         | 4         | N          | 12.2 (0.480)                 |
| 078              | 5.6             | M         | 4         | N          | 12.2 (0.480)                 |
| 323              | 5.6             | K         | 4         | J          | 12.2 (0.480)                 |
| 324              | 5.6             | M         | 4         | J          | 12.2 (0.480)                 |
| 079              | 6.8             | K         | 4         | N          | 12.2 (0.480)                 |
| 080              | 6.8             | M         | 4         | N          | 12.2 (0.480)                 |
| 325              | 6.8             | K         | 4         | J          | 12.2 (0.480)                 |
| 326              | 6.8             | M         | 4         | J          | 12.2 (0.480)                 |
| 081              | 8.2             | K         | 4         | N          | 16.5 (0.650)                 |
| 082              | 8.2             | M         | 4         | N          | 16.5 (0.650)                 |
| 327              | 8.2             | K         | 4         | J          | 16.5 (0.650)                 |
| 328              | 8.2             | M         | 4         | J          | 16.5 (0.650)                 |
| 229              | 10              | K         | 3         | N          | 6.10 (0.240)                 |
| 230              | 10              | M         | 3         | N          | 6.10 (0.240)                 |
| 329              | 10              | K         | 3         | J          | 6.10 (0.240)                 |
| 330              | 10              | M         | 3         | J          | 6.10 (0.240)                 |
| 083              | 12              | K         | 3         | N          | 6.10 (0.240)                 |
| 084              | 12              | M         | 3         | N          | 6.10 (0.240)                 |
| 331              | 12              | K         | 3         | J          | 6.10 (0.240)                 |
| 332              | 12              | M         | 3         | J          | 6.10 (0.240)                 |

# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles DSCC Dwg. #87106 (X7R)



U.S. Preferred Styles

## Electrical characteristics

| DSCC Dwg. 87106- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| <b>100V</b>      |                 |           |           |            |                              |
| 085              | 15              | K         | 3         | N          | 9.14 (0.360)                 |
| 086              | 15              | M         | 3         | N          | 9.14 (0.360)                 |
| 333              | 15              | K         | 3         | J          | 9.14 (0.360)                 |
| 334              | 15              | M         | 3         | J          | 9.14 (0.360)                 |
| 087              | 18              | K         | 3         | N          | 9.14 (0.360)                 |
| 088              | 18              | M         | 3         | N          | 9.14 (0.360)                 |
| 335              | 18              | K         | 3         | J          | 9.14 (0.360)                 |
| 336              | 18              | M         | 3         | J          | 9.14 (0.360)                 |
| 089              | 22              | K         | 3         | N          | 12.2 (0.480)                 |
| 090              | 22              | M         | 3         | N          | 12.2 (0.480)                 |
| 337              | 22              | M         | 3         | K          | 12.2 (0.480)                 |
| 338              | 22              | M         | 3         | J          | 12.2 (0.480)                 |
| 091              | 27              | K         | 3         | N          | 16.5 (0.650)                 |
| 092              | 27              | M         | 3         | N          | 16.5 (0.650)                 |
| 339              | 27              | K         | 3         | J          | 16.5 (0.650)                 |
| 340              | 27              | M         | 3         | J          | 16.5 (0.650)                 |
| 093              | 33              | K         | 1         | N          | 9.14 (0.360)                 |
| 094              | 33              | M         | 1         | N          | 9.14 (0.360)                 |
| 341              | 33              | K         | 1         | J          | 9.14 (0.360)                 |
| 342              | 33              | M         | 1         | J          | 9.14 (0.360)                 |
| 095              | 39              | K         | 1         | N          | 12.2 (0.480)                 |
| 096              | 39              | M         | 1         | N          | 12.2 (0.480)                 |
| 343              | 39              | K         | 1         | J          | 12.2 (0.480)                 |
| 344              | 39              | M         | 1         | J          | 12.2 (0.480)                 |
| 097              | 47              | K         | 1         | N          | 12.2 (0.480)                 |
| 098              | 47              | M         | 1         | N          | 12.2 (0.480)                 |
| 345              | 47              | K         | 1         | J          | 12.2 (0.480)                 |
| 346              | 47              | M         | 1         | J          | 12.2 (0.480)                 |
| 099              | 56              | K         | 1         | N          | 16.5 (0.650)                 |
| 100              | 56              | M         | 1         | N          | 16.5 (0.650)                 |
| 347              | 56              | K         | 1         | J          | 16.5 (0.650)                 |
| 348              | 56              | M         | 1         | J          | 16.5 (0.650)                 |
| 101              | 68              | K         | 2         | N          | 12.2 (0.480)                 |
| 102              | 68              | M         | 2         | N          | 12.2 (0.480)                 |
| 349              | 68              | K         | 2         | J          | 12.2 (0.480)                 |
| 350              | 68              | M         | 2         | J          | 12.2 (0.480)                 |
| 103              | 82              | K         | 2         | N          | 16.5 (0.650)                 |
| 104              | 82              | M         | 2         | N          | 16.5 (0.650)                 |
| 351              | 82              | K         | 2         | J          | 16.5 (0.650)                 |
| 352              | 82              | M         | 2         | J          | 16.5 (0.650)                 |
| 105              | 100             | K         | 6         | N          | 9.14 (0.360)                 |
| 106              | 100             | M         | 6         | N          | 9.14 (0.360)                 |
| 353              | 100             | K         | 6         | J          | 9.14 (0.360)                 |
| 354              | 100             | M         | 6         | J          | 9.14 (0.360)                 |
| 107              | 120             | K         | 6         | N          | 9.14 (0.360)                 |
| 108              | 120             | M         | 6         | N          | 9.14 (0.360)                 |
| 355              | 120             | K         | 6         | J          | 9.14 (0.360)                 |
| 356              | 120             | M         | 6         | J          | 9.14 (0.360)                 |
| 109              | 150             | K         | 6         | N          | 12.2 (0.480)                 |
| 110              | 150             | M         | 6         | N          | 12.2 (0.480)                 |
| 357              | 150             | K         | 6         | J          | 12.2 (0.480)                 |
| 358              | 150             | M         | 6         | J          | 12.2 (0.480)                 |
| 111              | 180             | K         | 6         | N          | 16.5 (0.650)                 |
| 112              | 180             | M         | 6         | N          | 16.5 (0.650)                 |
| 359              | 180             | K         | 6         | J          | 16.5 (0.650)                 |
| 360              | 180             | M         | 6         | J          | 16.5 (0.650)                 |

| DSCC Dwg. 87106- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| <b>200V</b>      |                 |           |           |            |                              |
| 113              | .47             | K         | 5         | N          | 6.10 (0.240)                 |
| 114              | .47             | M         | 5         | N          | 6.10 (0.240)                 |
| 361              | .47             | K         | 5         | J          | 6.10 (0.240)                 |
| 362              | .47             | M         | 5         | J          | 6.10 (0.240)                 |
| 115              | .56             | K         | 5         | N          | 6.10 (0.240)                 |
| 116              | .56             | M         | 5         | N          | 6.10 (0.240)                 |
| 363              | .56             | K         | 5         | J          | 6.10 (0.240)                 |
| 364              | .56             | M         | 5         | J          | 6.10 (0.240)                 |
| 117              | .68             | K         | 5         | N          | 9.14 (0.360)                 |
| 118              | .68             | M         | 5         | N          | 9.14 (0.360)                 |
| 365              | .68             | K         | 5         | J          | 9.14 (0.360)                 |
| 366              | .68             | M         | 5         | J          | 9.14 (0.360)                 |
| 119              | .82             | K         | 5         | N          | 9.14 (0.360)                 |
| 120              | .82             | M         | 5         | N          | 9.14 (0.360)                 |
| 367              | .82             | M         | 5         | J          | 9.14 (0.360)                 |
| 368              | .82             | M         | 5         | J          | 9.14 (0.360)                 |
| 121              | 1.0             | K         | 5         | N          | 12.2 (0.480)                 |
| 122              | 1.0             | M         | 5         | N          | 12.2 (0.480)                 |
| 369              | 1.0             | K         | 5         | J          | 12.2 (0.480)                 |
| 370              | 1.0             | M         | 5         | J          | 12.2 (0.480)                 |
| 123              | 1.2             | K         | 5         | N          | 12.2 (0.480)                 |
| 124              | 1.2             | M         | 5         | N          | 12.2 (0.480)                 |
| 371              | 1.2             | K         | 5         | J          | 12.2 (0.480)                 |
| 372              | 1.2             | M         | 5         | J          | 12.2 (0.480)                 |
| 125              | 1.5             | K         | 5         | N          | 16.5 (0.650)                 |
| 126              | 1.5             | M         | 5         | N          | 16.5 (0.650)                 |
| 373              | 1.5             | K         | 5         | J          | 16.5 (0.650)                 |
| 374              | 1.5             | M         | 5         | J          | 16.5 (0.650)                 |
| 127              | 1.8             | K         | 4         | N          | 9.14 (0.360)                 |
| 128              | 1.8             | M         | 4         | N          | 9.14 (0.360)                 |
| 375              | 1.8             | K         | 4         | J          | 9.14 (0.360)                 |
| 376              | 1.8             | M         | 4         | J          | 9.14 (0.360)                 |
| 129              | 2.2             | K         | 4         | N          | 9.14 (0.360)                 |
| 130              | 2.2             | M         | 4         | N          | 9.14 (0.360)                 |
| 377              | 2.2             | K         | 4         | J          | 9.14 (0.360)                 |
| 378              | 2.2             | M         | 4         | J          | 9.14 (0.360)                 |
| 131              | 2.7             | K         | 4         | N          | 12.2 (0.480)                 |
| 132              | 2.7             | M         | 4         | N          | 12.2 (0.480)                 |
| 379              | 2.7             | K         | 4         | J          | 12.2 (0.480)                 |
| 380              | 2.7             | M         | 4         | J          | 12.2 (0.480)                 |
| 133              | 3.3             | K         | 4         | N          | 12.2 (0.480)                 |
| 134              | 3.3             | M         | 4         | N          | 12.2 (0.480)                 |
| 381              | 3.3             | K         | 4         | J          | 12.2 (0.480)                 |
| 382              | 3.3             | M         | 4         | J          | 12.2 (0.480)                 |
| 135              | 3.9             | K         | 4         | N          | 16.5 (0.650)                 |
| 136              | 3.9             | M         | 4         | N          | 16.5 (0.650)                 |
| 383              | 3.9             | K         | 4         | J          | 16.5 (0.650)                 |
| 384              | 3.9             | M         | 4         | J          | 16.5 (0.650)                 |
| 137              | 4.7             | K         | 3         | N          | 6.10 (0.240)                 |
| 138              | 4.7             | M         | 3         | N          | 6.10 (0.240)                 |
| 385              | 4.7             | K         | 3         | J          | 6.10 (0.240)                 |
| 386              | 4.7             | M         | 3         | J          | 6.10 (0.240)                 |
| 139              | 5.6             | K         | 3         | N          | 6.10 (0.240)                 |
| 140              | 5.6             | M         | 3         | N          | 6.10 (0.240)                 |
| 387              | 5.6             | K         | 3         | J          | 6.10 (0.240)                 |
| 388              | 5.6             | M         | 3         | J          | 6.10 (0.240)                 |
| 141              | 6.8             | K         | 3         | N          | 9.14 (0.360)                 |
| 142              | 6.8             | M         | 3         | N          | 9.14 (0.360)                 |
| 389              | 6.8             | K         | 3         | J          | 9.14 (0.360)                 |
| 390              | 6.8             | M         | 3         | J          | 9.14 (0.360)                 |
| 143              | 8.2             | K         | 3         | N          | 9.14 (0.360)                 |
| 144              | 8.2             | M         | 3         | N          | 9.14 (0.360)                 |
| 391              | 8.2             | K         | 3         | J          | 9.14 (0.360)                 |
| 392              | 8.2             | M         | 3         | J          | 9.14 (0.360)                 |

| DSCC Dwg. 87106- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| <b>200V</b>      |                 |           |           |            |                              |
| 145              | 10              | K         | 3         | N          | 12.2 (0.480)                 |
| 146              | 10              | M         | 3         | N          | 12.2 (0.480)                 |
| 393              | 10              | K         | 3         | J          | 12.2 (0.480)                 |
| 394              | 10              | M         | 3         | J          | 12.2 (0.480)                 |
| 147              | 12              | K         | 3         | N          | 16.5 (0.650)                 |
| 148              | 12              | M         | 3         | N          | 16.5 (0.650)                 |
| 395              | 12              | K         | 3         | J          | 16.5 (0.650)                 |
| 396              | 12              | M         | 3         | J          | 16.5 (0.650)                 |
| 149              | 15              | K         | 1         | N          | 9.14 (0.360)                 |
| 150              | 15              | M         | 1         | N          | 9.14 (0.360)                 |
| 397              | 15              | K         | 1         | J          | 9.14 (0.360)                 |
| 398              | 15              | M         | 1         | J          | 9.14 (0.360)                 |
| 151              | 18              | K         | 1         | N          | 12.2 (0.480)                 |
| 152              | 18              | M         | 1         | N          | 12.2 (0.480)                 |
| 399              | 18              | K         | 1         | J          | 12.2 (0.480)                 |
| 400              | 18              | M         | 1         | J          | 12.2 (0.480)                 |
| 153              | 22              | K         | 1         | N          | 16.5 (0.650)                 |
| 154              | 22              | M         | 1         | N          | 16.5 (0.650)                 |
| 401              | 22              | K         | 1         | J          | 16.5 (0.650)                 |
| 402              | 22              | M         | 1         | J          | 16.5 (0.650)                 |
| 155              | 27              | K         | 1         | N          | 16.5 (0.650)                 |
| 156              | 27              | M         | 1         | N          | 16.5 (0.650)                 |
| 403              | 27              | K         | 1         | J          | 16.5 (0.650)                 |
| 404              | 27              | M         | 1         | J          | 16.5 (0.650)                 |
| 157              | 33              | K         | 2         | N          | 12.2 (0.480)                 |
| 158              | 33              | M         | 2         | N          | 12.2 (0.480)                 |
| 405              | 33              | K         | 2         | J          | 12.2 (0.480)                 |
| 406              | 33              | M         | 2         | J          | 12.2 (0.480)                 |
| 159              | 39              | K         | 2         | N          | 16.5 (0.650)                 |
| 160              | 39              | M         | 2         | N          | 16.5 (0.650)                 |
| 407              | 39              | K         | 2         | J          | 16.5 (0.650)                 |
| 408              | 39              | M         | 2         | J          | 16.5 (0.650)                 |
| 161              | 47              | K         | 6         | N          | 6.10 (0.240)                 |
| 162              | 47              | M         | 6         | N          | 6.10 (0.240)                 |
| 409              | 47              | K         | 6         | J          | 6.10 (0.240)                 |
| 410              | 47              | M         | 6         | J          | 6.10 (0.240)                 |
| 163              | 56              | K         | 6         | N          | 9.14 (0.360)                 |
| 164              | 56              | M         | 6         | N          | 9.14 (0.360)                 |
| 411              | 56              | K         | 6         | J          | 9.14 (0.360)                 |
| 412              | 56              | M         | 6         | J          | 9.14 (0.360)                 |
| 165              | 68              | K         | 6         | N          | 9.14 (0.360)                 |
| 166              | 68              | M         | 6         | N          | 9.14 (0.360)                 |
| 413              | 68              | K         | 6         | J          | 9.14 (0.360)                 |
| 414              | 68              | M         | 6         | J          | 9.14 (0.360)                 |
| 167              | 82              | K         | 6         | N          | 12.2 (0.480)                 |
| 168              | 82              | M         | 6         | N          | 12.2 (0.480)                 |
| 415              | 82              | K         | 6         | J          | 12.2 (0.480)                 |
| 416              | 82              | M         | 6         | J          | 12.2 (0.480)                 |
| 169              | 100             | K         | 6         | N          | 16.5 (0.650)                 |
| 170              | 100             | M         | 6         | N          | 16.5 (0.650)                 |
| 417              | 100             | K         | 6         | J          | 16.5 (0.650)                 |
| 418              | 100             | M         | 6         | J          | 16.5 (0.650)                 |
| 171              | 120             | K         | 6         | N          | 16.5 (0.650)                 |
| 172              | 120             | M         | 6         | N          | 16.5 (0.650)                 |
| 419              | 120             | K         | 6         | J          | 16.5 (0.650)                 |
| 420              | 120             | M         | 6         | J          | 16.5 (0.650)                 |



# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles DSCC Dwg. #87106 (X7R)



U.S. Preferred Styles

## Electrical characteristics

| DSCC Dwg. 87106- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| 500V             |                 |           |           |            |                              |
| 173              | .15             | K         | 5         | N          | 3.05 (0.120)                 |
| 174              | .15             | M         | 5         | N          | 3.05 (0.120)                 |
| 421              | .15             | K         | 5         | J          | 3.05 (0.120)                 |
| 422              | .15             | M         | 5         | J          | 3.05 (0.120)                 |
| 175              | .18             | K         | 5         | N          | 6.10 (0.240)                 |
| 176              | .18             | M         | 5         | N          | 6.10 (0.240)                 |
| 423              | .18             | K         | 5         | J          | 6.10 (0.240)                 |
| 424              | .18             | M         | 5         | J          | 6.10 (0.240)                 |
| 177              | .22             | K         | 5         | N          | 6.10 (0.240)                 |
| 178              | .22             | M         | 5         | N          | 6.10 (0.240)                 |
| 425              | .22             | K         | 5         | J          | 6.10 (0.240)                 |
| 426              | .22             | M         | 5         | J          | 6.10 (0.240)                 |
| 179              | .27             | K         | 5         | N          | 6.10 (0.240)                 |
| 180              | .27             | M         | 5         | N          | 6.10 (0.240)                 |
| 427              | .27             | K         | 5         | J          | 6.10 (0.240)                 |
| 428              | .27             | M         | 5         | J          | 6.10 (0.240)                 |
| 181              | .33             | K         | 5         | N          | 9.14 (0.360)                 |
| 182              | .33             | M         | 5         | N          | 9.14 (0.360)                 |
| 429              | .33             | K         | 5         | J          | 9.14 (0.360)                 |
| 430              | .33             | M         | 5         | J          | 9.14 (0.360)                 |
| 183              | .39             | K         | 5         | N          | 9.14 (0.360)                 |
| 184              | .39             | M         | 5         | N          | 9.14 (0.360)                 |
| 431              | .39             | K         | 5         | J          | 9.14 (0.360)                 |
| 432              | .39             | M         | 5         | J          | 9.14 (0.360)                 |
| 185              | .47             | K         | 5         | N          | 9.14 (0.360)                 |
| 186              | .47             | M         | 5         | N          | 9.14 (0.360)                 |
| 433              | .47             | K         | 5         | J          | 9.14 (0.360)                 |
| 434              | .47             | M         | 5         | J          | 9.14 (0.360)                 |
| 187              | .56             | K         | 5         | N          | 12.2 (0.480)                 |
| 188              | .56             | M         | 5         | N          | 12.2 (0.480)                 |
| 435              | .56             | K         | 5         | J          | 12.2 (0.480)                 |
| 436              | .56             | M         | 5         | J          | 12.2 (0.480)                 |
| 189              | .68             | K         | 5         | N          | 16.5 (0.650)                 |
| 190              | .68             | M         | 5         | N          | 16.5 (0.650)                 |
| 437              | .68             | K         | 5         | J          | 16.5 (0.650)                 |
| 438              | .68             | M         | 5         | J          | 16.5 (0.650)                 |
| 231              | .82             | K         | 4         | N          | 9.14 (0.360)                 |
| 232              | .82             | M         | 4         | N          | 9.14 (0.360)                 |
| 439              | .82             | K         | 4         | J          | 9.14 (0.360)                 |
| 440              | .82             | M         | 4         | J          | 9.14 (0.360)                 |
| 191              | 1.0             | K         | 4         | N          | 9.14 (0.360)                 |
| 192              | 1.0             | M         | 4         | N          | 9.14 (0.360)                 |
| 441              | 1.0             | K         | 4         | J          | 9.14 (0.360)                 |
| 442              | 1.0             | M         | 4         | J          | 9.14 (0.360)                 |
| 193              | 1.2             | K         | 4         | N          | 9.14 (0.360)                 |
| 194              | 1.2             | M         | 4         | N          | 9.14 (0.360)                 |
| 443              | 1.2             | K         | 4         | J          | 9.14 (0.360)                 |
| 444              | 1.2             | M         | 4         | J          | 9.14 (0.360)                 |
| 195              | 1.5             | K         | 4         | N          | 12.2 (0.480)                 |
| 196              | 1.5             | M         | 4         | N          | 12.2 (0.480)                 |
| 445              | 1.5             | K         | 4         | J          | 12.2 (0.480)                 |
| 446              | 1.5             | M         | 4         | J          | 12.2 (0.480)                 |
| 197              | 1.8             | K         | 4         | N          | 16.5 (0.650)                 |
| 198              | 1.8             | M         | 4         | N          | 16.5 (0.650)                 |
| 447              | 1.8             | K         | 4         | J          | 16.5 (0.650)                 |
| 448              | 1.8             | M         | 4         | J          | 16.5 (0.650)                 |
| 233              | 2.2             | K         | 3         | N          | 6.10 (0.240)                 |
| 234              | 2.2             | M         | 3         | N          | 6.10 (0.240)                 |
| 449              | 2.2             | K         | 3         | J          | 6.10 (0.240)                 |
| 450              | 2.2             | M         | 3         | J          | 6.10 (0.240)                 |
| 199              | 2.7             | K         | 3         | N          | 9.14 (0.360)                 |
| 200              | 2.7             | M         | 3         | N          | 9.14 (0.360)                 |
| 451              | 2.7             | K         | 3         | J          | 9.14 (0.360)                 |
| 452              | 2.7             | M         | 3         | J          | 9.14 (0.360)                 |

| DSCC Dwg. 87106- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| 500V             |                 |           |           |            |                              |
| 201              | 3.3             | K         | 3         | N          | 9.14 (0.360)                 |
| 202              | 3.3             | M         | 3         | N          | 9.14 (0.360)                 |
| 453              | 3.3             | K         | 3         | J          | 9.14 (0.360)                 |
| 454              | 3.3             | M         | 3         | J          | 9.14 (0.360)                 |
| 203              | 3.9             | K         | 3         | N          | 9.14 (0.360)                 |
| 204              | 3.9             | M         | 3         | N          | 9.14 (0.360)                 |
| 455              | 3.9             | K         | 3         | J          | 9.14 (0.360)                 |
| 456              | 3.9             | M         | 3         | J          | 9.14 (0.360)                 |
| 205              | 4.7             | K         | 3         | N          | 12.2 (0.480)                 |
| 206              | 4.7             | M         | 3         | N          | 12.2 (0.480)                 |
| 457              | 4.7             | K         | 3         | J          | 12.2 (0.480)                 |
| 458              | 4.7             | M         | 3         | J          | 12.2 (0.480)                 |
| 207              | 5.6             | K         | 3         | N          | 16.5 (0.650)                 |
| 208              | 5.6             | M         | 3         | N          | 16.5 (0.650)                 |
| 459              | 5.6             | K         | 3         | J          | 16.5 (0.650)                 |
| 460              | 5.6             | M         | 3         | J          | 16.5 (0.650)                 |
| 235              | 6.8             | K         | 1         | N          | 12.2 (0.480)                 |
| 236              | 6.8             | M         | 1         | N          | 12.2 (0.480)                 |
| 461              | 6.8             | K         | 1         | J          | 12.2 (0.480)                 |
| 462              | 6.8             | M         | 1         | J          | 12.2 (0.480)                 |
| 209              | 8.2             | K         | 1         | N          | 12.2 (0.480)                 |
| 210              | 8.2             | M         | 1         | N          | 12.2 (0.480)                 |
| 463              | 8.2             | K         | 1         | J          | 12.2 (0.480)                 |
| 464              | 8.2             | M         | 1         | J          | 12.2 (0.480)                 |
| 211              | 10              | K         | 1         | N          | 12.2 (0.480)                 |
| 212              | 10              | M         | 1         | N          | 12.2 (0.480)                 |
| 465              | 10              | K         | 1         | J          | 12.2 (0.480)                 |
| 466              | 10              | M         | 1         | J          | 12.2 (0.480)                 |
| 213              | 12              | K         | 1         | N          | 16.5 (0.650)                 |
| 214              | 12              | M         | 1         | N          | 16.5 (0.650)                 |
| 467              | 12              | K         | 1         | J          | 16.5 (0.650)                 |
| 468              | 12              | M         | 1         | J          | 16.5 (0.650)                 |
| 237              | 15              | K         | 2         | N          | 16.5 (0.650)                 |
| 238              | 15              | M         | 2         | N          | 16.5 (0.650)                 |
| 469              | 15              | K         | 2         | J          | 16.5 (0.650)                 |
| 470              | 15              | M         | 2         | J          | 16.5 (0.650)                 |
| 215              | 18              | K         | 2         | N          | 16.5 (0.650)                 |
| 216              | 18              | M         | 2         | N          | 16.5 (0.650)                 |
| 471              | 18              | K         | 2         | J          | 16.5 (0.650)                 |
| 472              | 18              | M         | 2         | J          | 16.5 (0.650)                 |
| 239              | 22              | K         | 6         | N          | 9.14 (0.360)                 |
| 240              | 22              | M         | 6         | N          | 9.14 (0.360)                 |
| 473              | 22              | K         | 6         | J          | 9.14 (0.360)                 |
| 474              | 22              | M         | 6         | J          | 9.14 (0.360)                 |
| 217              | 27              | K         | 6         | N          | 9.14 (0.360)                 |
| 218              | 27              | M         | 6         | N          | 9.14 (0.360)                 |
| 475              | 27              | K         | 6         | J          | 9.14 (0.360)                 |
| 476              | 27              | M         | 6         | J          | 9.14 (0.360)                 |
| 219              | 33              | K         | 6         | N          | 12.2 (0.480)                 |
| 220              | 33              | M         | 6         | N          | 12.2 (0.480)                 |
| 477              | 33              | K         | 6         | J          | 12.2 (0.480)                 |
| 478              | 33              | M         | 6         | J          | 12.2 (0.480)                 |
| 221              | 39              | K         | 6         | N          | 16.5 (0.650)                 |
| 222              | 39              | M         | 6         | N          | 16.5 (0.650)                 |
| 479              | 39              | K         | 6         | J          | 16.5 (0.650)                 |
| 480              | 39              | M         | 6         | J          | 16.5 (0.650)                 |

# SMPS Stacked MLC Capacitors

(SM Style) SM Military Styles DSCC Dwg. #88011 (C0G)



U.S. Preferred Styles

## CG (C0G) Electrical characteristics per MIL-C-20

| DSCC Dwg. 88011- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| 50V              |                 |           |           |            |                              |
| 001*             | .056            | J         | 5         | N          | 3.05 (0.120)                 |
| 002*             | .056            | K         | 5         | N          | 3.05 (0.120)                 |
| 003*             | .068            | J         | 5         | N          | 6.10 (0.240)                 |
| 004*             | .068            | K         | 5         | N          | 6.10 (0.240)                 |
| 005*             | .082            | J         | 5         | N          | 6.10 (0.240)                 |
| 006*             | .082            | K         | 5         | N          | 6.10 (0.240)                 |
| 007*             | .10             | J         | 5         | N          | 6.10 (0.240)                 |
| 008*             | .10             | K         | 5         | N          | 6.10 (0.240)                 |
| 009*             | .12             | J         | 5         | N          | 9.14 (0.360)                 |
| 010*             | .12             | K         | 5         | N          | 9.14 (0.360)                 |
| 011*             | .15             | J         | 5         | N          | 9.14 (0.360)                 |
| 012*             | .15             | K         | 5         | N          | 9.14 (0.360)                 |
| 013*             | .18             | J         | 5         | N          | 12.2 (0.480)                 |
| 014*             | .18             | K         | 5         | N          | 12.2 (0.480)                 |
| 015*             | .22             | J         | 5         | N          | 12.2 (0.480)                 |
| 016*             | .22             | K         | 5         | N          | 12.2 (0.480)                 |
| 017*             | .27             | J         | 5         | N          | 16.5 (0.650)                 |
| 018*             | .27             | K         | 5         | N          | 16.5 (0.650)                 |
| 019*             | .33             | J         | 4         | N          | 9.14 (0.360)                 |
| 020*             | .33             | K         | 4         | N          | 9.14 (0.360)                 |
| 021*             | .39             | J         | 4         | N          | 12.2 (0.480)                 |
| 022*             | .39             | K         | 4         | N          | 12.2 (0.480)                 |
| 023*             | .47             | J         | 4         | N          | 12.2 (0.480)                 |
| 024*             | .47             | K         | 4         | N          | 12.2 (0.480)                 |
| 025*             | .56             | J         | 4         | N          | 16.5 (0.650)                 |
| 026*             | .56             | K         | 4         | N          | 16.5 (0.650)                 |
| 027*             | .68             | J         | 3         | N          | 6.10 (0.240)                 |
| 028*             | .68             | K         | 3         | N          | 6.10 (0.240)                 |
| 029*             | .82             | J         | 3         | N          | 6.10 (0.240)                 |
| 030*             | .82             | K         | 3         | N          | 6.10 (0.240)                 |
| 031*             | 1.0             | J         | 3         | N          | 9.14 (0.360)                 |
| 032*             | 1.0             | K         | 3         | N          | 9.14 (0.360)                 |
| 033*             | 1.2             | J         | 3         | N          | 9.14 (0.360)                 |
| 034*             | 1.2             | K         | 3         | N          | 9.14 (0.360)                 |
| 035*             | 1.5             | J         | 3         | N          | 12.2 (0.480)                 |
| 036*             | 1.5             | K         | 3         | N          | 12.2 (0.480)                 |
| 037*             | 1.8             | J         | 3         | N          | 12.2 (0.480)                 |
| 038*             | 1.8             | K         | 3         | N          | 12.2 (0.480)                 |
| 039*             | 2.2             | J         | 3         | N          | 16.5 (0.650)                 |
| 040*             | 2.2             | K         | 3         | N          | 16.5 (0.650)                 |
| 041*             | 2.7             | J         | 1         | N          | 9.14 (0.360)                 |
| 042*             | 2.7             | K         | 1         | N          | 9.14 (0.360)                 |
| 043*             | 3.3             | J         | 1         | N          | 12.2 (0.480)                 |
| 044*             | 3.3             | K         | 1         | N          | 12.2 (0.480)                 |
| 045*             | 3.9             | J         | 1         | N          | 12.2 (0.480)                 |
| 046*             | 3.9             | K         | 1         | N          | 12.2 (0.480)                 |
| 047*             | 4.7             | J         | 1         | N          | 16.5 (0.650)                 |
| 048*             | 4.7             | K         | 1         | N          | 16.5 (0.650)                 |
| 049*             | 5.6             | J         | 2         | N          | 16.5 (0.650)                 |
| 050*             | 5.6             | K         | 2         | N          | 16.5 (0.650)                 |
| 051*             | 6.8             | J         | 6         | N          | 9.14 (0.360)                 |
| 052*             | 6.8             | K         | 6         | N          | 9.14 (0.360)                 |
| 053*             | 8.2             | J         | 6         | N          | 9.14 (0.360)                 |
| 054*             | 8.2             | K         | 6         | N          | 9.14 (0.360)                 |
| 055*             | 10              | J         | 6         | N          | 12.2 (0.480)                 |
| 056*             | 10              | K         | 6         | N          | 12.2 (0.480)                 |
| 057*             | 12              | J         | 6         | N          | 12.2 (0.480)                 |
| 058*             | 12              | K         | 6         | N          | 12.2 (0.480)                 |
| 059*             | 15              | J         | 6         | N          | 16.5 (0.650)                 |
| 060*             | 15              | K         | 6         | N          | 16.5 (0.650)                 |
| 100V             |                 |           |           |            |                              |
| 061*             | .047            | J         | 5         | N          | 6.10 (0.240)                 |
| 062*             | .047            | K         | 5         | N          | 6.10 (0.240)                 |
| 063*             | .056            | J         | 5         | N          | 6.10 (0.240)                 |
| 064*             | .056            | K         | 5         | N          | 6.10 (0.240)                 |
| 065*             | .068            | J         | 5         | N          | 6.10 (0.240)                 |
| 066*             | .068            | K         | 5         | N          | 6.10 (0.240)                 |
| 067*             | .082            | J         | 5         | N          | 6.10 (0.240)                 |
| 068*             | .082            | K         | 5         | N          | 6.10 (0.240)                 |
| 069*             | .10             | J         | 5         | N          | 9.14 (0.360)                 |
| 070*             | .10             | K         | 5         | N          | 9.14 (0.360)                 |
| 071*             | .12             | J         | 5         | N          | 9.14 (0.360)                 |
| 072*             | .12             | K         | 5         | N          | 9.14 (0.360)                 |
| 073*             | .15             | J         | 5         | N          | 12.2 (0.480)                 |
| 074*             | .15             | K         | 5         | N          | 12.2 (0.480)                 |
| 075*             | .18             | J         | 5         | N          | 12.2 (0.480)                 |
| 076*             | .18             | K         | 5         | N          | 12.2 (0.480)                 |
| 077*             | .22             | J         | 5         | N          | 16.5 (0.650)                 |
| 078*             | .22             | K         | 5         | N          | 16.5 (0.650)                 |
| 079*             | .27             | J         | 4         | N          | 9.14 (0.360)                 |

| DSCC Dwg. 88011- | Cap. Value (µF) | Cap. Tol. | Case Code | Lead Style | Max. A Dimension mm (inches) |
|------------------|-----------------|-----------|-----------|------------|------------------------------|
| 100V (continued) |                 |           |           |            |                              |
| 080*             | .27             | K         | 4         | N          | 9.14 (0.360)                 |
| 081*             | .33             | J         | 4         | N          | 12.2 (0.480)                 |
| 082*             | .33             | K         | 4         | N          | 12.2 (0.480)                 |
| 083*             | .39             | J         | 4         | N          | 12.2 (0.480)                 |
| 084*             | .39             | K         | 4         | N          | 12.2 (0.480)                 |
| 085*             | .47             | J         | 4         | N          | 16.5 (0.650)                 |
| 086*             | .47             | K         | 4         | N          | 16.5 (0.650)                 |
| 087*             | .56             | J         | 4         | N          | 16.5 (0.650)                 |
| 088*             | .56             | K         | 4         | N          | 16.5 (0.650)                 |
| 089*             | .68             | J         | 3         | N          | 6.10 (0.240)                 |
| 090*             | .68             | K         | 3         | N          | 6.10 (0.240)                 |
| 091*             | .82             | J         | 3         | N          | 9.14 (0.360)                 |
| 092*             | .82             | K         | 3         | N          | 9.14 (0.360)                 |
| 093*             | 1.0             | J         | 3         | N          | 9.14 (0.360)                 |
| 094*             | 1.0             | K         | 3         | N          | 9.14 (0.360)                 |
| 095*             | 1.2             | J         | 3         | N          | 12.2 (0.480)                 |
| 096*             | 1.2             | K         | 3         | N          | 12.2 (0.480)                 |
| 097*             | 1.5             | J         | 3         | N          | 12.2 (0.480)                 |
| 098*             | 1.5             | K         | 3         | N          | 12.2 (0.480)                 |
| 099*             | 1.8             | J         | 3         | N          | 16.5 (0.650)                 |
| 100*             | 1.8             | K         | 3         | N          | 16.5 (0.650)                 |
| 101*             | 2.2             | J         | 1         | N          | 12.2 (0.480)                 |
| 102*             | 2.2             | K         | 1         | N          | 12.2 (0.480)                 |
| 103*             | 2.7             | J         | 1         | N          | 12.2 (0.480)                 |
| 104*             | 2.7             | K         | 1         | N          | 12.2 (0.480)                 |
| 105*             | 3.3             | J         | 1         | N          | 16.5 (0.650)                 |
| 106*             | 3.3             | K         | 1         | N          | 16.5 (0.650)                 |
| 107*             | 3.9             | J         | 2         | N          | 12.2 (0.480)                 |
| 108*             | 3.9             | K         | 2         | N          | 12.2 (0.480)                 |
| 109*             | 4.7             | J         | 2         | N          | 16.5 (0.650)                 |
| 110*             | 4.7             | K         | 2         | N          | 16.5 (0.650)                 |
| 111*             | 5.6             | J         | 6         | N          | 9.14 (0.360)                 |
| 112*             | 5.6             | K         | 6         | N          | 9.14 (0.360)                 |
| 113*             | 6.8             | J         | 6         | N          | 9.14 (0.360)                 |
| 114*             | 6.8             | K         | 6         | N          | 9.14 (0.360)                 |
| 115*             | 8.2             | J         | 6         | N          | 12.2 (0.480)                 |
| 116*             | 8.2             | K         | 6         | N          | 12.2 (0.480)                 |
| 117*             | 10              | J         | 6         | N          | 16.5 (0.650)                 |
| 118*             | 10              | K         | 6         | N          | 16.5 (0.650)                 |
| 119*             | 12              | J         | 6         | N          | 16.5 (0.650)                 |
| 120*             | 12              | K         | 6         | N          | 16.5 (0.650)                 |
| 200V             |                 |           |           |            |                              |
| 121*             | .022            | J         | 5         | N          | 3.05 (0.120)                 |
| 122*             | .022            | K         | 5         | N          | 3.05 (0.120)                 |
| 123*             | .027            | J         | 5         | N          | 6.10 (0.240)                 |
| 124*             | .027            | K         | 5         | N          | 6.10 (0.240)                 |
| 125*             | .033            | J         | 5         | N          | 6.10 (0.240)                 |
| 126*             | .033            | K         | 5         | N          | 6.10 (0.240)                 |
| 127*             | .039            | J         | 5         | N          | 6.10 (0.240)                 |
| 128*             | .039            | K         | 5         | N          | 6.10 (0.240)                 |
| 129*             | .047            | J         | 5         | N          | 9.14 (0.360)                 |
| 130*             | .047            | K         | 5         | N          | 9.14 (0.360)                 |
| 131*             | .056            | J         | 5         | N          | 9.14 (0.360)                 |
| 132*             | .056            | K         | 5         | N          | 9.14 (0.360)                 |
| 133*             | .068            | J         | 5         | N          | 12.2 (0.480)                 |
| 134*             | .068            | K         | 5         | N          | 12.2 (0.480)                 |
| 135*             | .082            | J         | 5         | N          | 12.2 (0.480)                 |
| 136*             | .082            | K         | 5         | N          | 12.2 (0.480)                 |
| 137*             | .10             | J         | 5         | N          | 16.5 (0.650)                 |
| 138*             | .10             | K         | 5         | N          | 16.5 (0.650)                 |
| 139*             | .12             | J         | 4         | N          | 9.14 (0.360)                 |
| 140*             | .12             | K         | 4         | N          | 9.14 (0.360)                 |
| 141*             | .15             | J         | 4         | N          | 9.14 (0.360)                 |
| 142*             | .15             | K         | 4         | N          | 9.14 (0.360)                 |
| 143*             | .18             | J         | 4         | N          | 12.2 (0.480)                 |
| 144*             | .18             | K         | 4         | N          | 12.2 (0.480)                 |
| 145*             | .22             | J         | 4         | N          | 12.2 (0.480)                 |
| 146*             | .22             | K         | 4         | N          | 12.2 (0.480)                 |
| 147*             | .27             | J         | 4         | N          | 16.5 (0.650)                 |
| 148*             | .27             | K         | 4         | N          | 16.5 (0.650)                 |
| 149*             | .33             | J         | 3         | N          | 6.10 (0.240)                 |
| 150*             | .33             | K         | 3         | N          | 6.10 (0.240)                 |
| 151*             | .39             | J         | 3         | N          | 6.10 (0.240)                 |
| 152*             | .39             | K         | 3         | N          | 6.10 (0.240)                 |
| 153*             | .47             | J         | 3         | N          | 9.14 (0.360)                 |
| 154*             | .47             | K         | 3         | N          | 9.14 (0.360)                 |
| 155*             | .56             | J         | 3         | N          | 9.14 (0.360)                 |
| 156*             | .56             | K         | 3         | N          | 9.14 (0.360)                 |
| 157*             | .68             | J         | 3         | N          | 12.2 (0.480)                 |
| 158*             | .68             | K         | 3         | N          | 12.2 (0.480)                 |

| DSCC<br>Dwg.<br>88011- | Cap.<br>Value<br>(µF) | Cap.<br>Tol. | Case<br>Code | Lead<br>Style | Max. A<br>Dimension<br>mm (inches) |
|------------------------|-----------------------|--------------|--------------|---------------|------------------------------------|
| 200V (continued)       |                       |              |              |               |                                    |
| 159*                   | .82                   | J            | 3            | N             | 16.5 (0.650)                       |
| 160*                   | .82                   | K            | 3            | N             | 16.5 (0.650)                       |
| 161*                   | 1.0                   | J            | 3            | N             | 16.5 (0.650)                       |
| 162*                   | 1.0                   | K            | 3            | N             | 16.5 (0.650)                       |
| 163*                   | 1.2                   | J            | 1            | N             | 12.2 (0.480)                       |
| 164*                   | 1.2                   | K            | 1            | N             | 12.2 (0.480)                       |
| 165*                   | 1.5                   | J            | 1            | N             | 12.2 (0.480)                       |
| 166*                   | 1.5                   | K            | 1            | N             | 12.2 (0.480)                       |
| 167*                   | 1.8                   | J            | 1            | N             | 16.5 (0.650)                       |
| 168*                   | 1.8                   | K            | 1            | N             | 16.5 (0.650)                       |
| 169*                   | 2.2                   | J            | 2            | N             | 12.2 (0.480)                       |
| 170*                   | 2.2                   | K            | 2            | N             | 12.2 (0.480)                       |
| 171*                   | 2.7                   | J            | 2            | N             | 16.5 (0.650)                       |
| 172*                   | 2.7                   | K            | 2            | N             | 16.5 (0.650)                       |
| 173*                   | 3.3                   | J            | 6            | N             | 9.14 (0.360)                       |
| 174*                   | 3.3                   | K            | 6            | N             | 9.14 (0.360)                       |
| 175*                   | 3.9                   | J            | 6            | N             | 9.14 (0.360)                       |
| 176*                   | 3.9                   | K            | 6            | N             | 9.14 (0.360)                       |
| 177*                   | 4.7                   | J            | 6            | N             | 12.2 (0.480)                       |
| 178*                   | 4.7                   | K            | 6            | N             | 12.2 (0.480)                       |
| 179*                   | 5.6                   | J            | 6            | N             | 16.5 (0.650)                       |
| 180*                   | 5.6                   | K            | 6            | N             | 16.5 (0.650)                       |
| 500V                   |                       |              |              |               |                                    |
| 181*                   | .010                  | J            | 5            | N             | 3.05 (0.120)                       |
| 182*                   | .010                  | K            | 5            | N             | 3.05 (0.120)                       |
| 183*                   | .012                  | J            | 5            | N             | 6.10 (0.240)                       |
| 184*                   | .012                  | K            | 5            | N             | 6.10 (0.240)                       |
| 185*                   | .015                  | J            | 5            | N             | 6.10 (0.240)                       |
| 186*                   | .015                  | K            | 5            | N             | 6.10 (0.240)                       |
| 187*                   | .018                  | J            | 5            | N             | 6.10 (0.240)                       |
| 188*                   | .018                  | K            | 5            | N             | 6.10 (0.240)                       |
| 189*                   | .022                  | J            | 5            | N             | 9.14 (0.360)                       |
| 190*                   | .022                  | K            | 5            | N             | 9.14 (0.360)                       |
| 191*                   | .027                  | J            | 5            | N             | 9.14 (0.360)                       |
| 192*                   | .027                  | K            | 5            | N             | 9.14 (0.360)                       |
| 193*                   | .033                  | J            | 5            | N             | 12.2 (0.480)                       |
| 194*                   | .033                  | K            | 5            | N             | 12.2 (0.480)                       |
| 195*                   | .039                  | J            | 5            | N             | 12.2 (0.480)                       |
| 196*                   | .039                  | K            | 5            | N             | 12.2 (0.480)                       |
| 197*                   | .047                  | J            | 5            | N             | 16.5 (0.650)                       |
| 198*                   | .047                  | K            | 5            | N             | 16.5 (0.650)                       |
| 199*                   | .056                  | J            | 4            | N             | 9.14 (0.360)                       |
| 200*                   | .056                  | K            | 4            | N             | 9.14 (0.360)                       |
| 201*                   | .068                  | J            | 4            | N             | 9.14 (0.360)                       |
| 202*                   | .068                  | K            | 4            | N             | 9.14 (0.360)                       |
| 203*                   | .082                  | J            | 4            | N             | 12.2 (0.480)                       |
| 204*                   | .082                  | K            | 4            | N             | 12.2 (0.480)                       |
| 205*                   | .10                   | J            | 4            | N             | 12.2 (0.480)                       |
| 206*                   | .10                   | K            | 4            | N             | 12.2 (0.480)                       |
| 207*                   | .12                   | J            | 4            | N             | 16.5 (0.650)                       |
| 208*                   | .12                   | K            | 4            | N             | 16.5 (0.650)                       |
| 209*                   | .15                   | J            | 3            | N             | 6.10 (0.240)                       |
| 210*                   | .15                   | K            | 3            | N             | 6.10 (0.240)                       |
| 211*                   | .18                   | J            | 3            | N             | 6.10 (0.240)                       |
| 212*                   | .18                   | K            | 3            | N             | 6.10 (0.240)                       |
| 213*                   | .22                   | J            | 3            | N             | 9.14 (0.360)                       |
| 214*                   | .22                   | K            | 3            | N             | 9.14 (0.360)                       |
| 215*                   | .27                   | J            | 3            | N             | 9.14 (0.360)                       |
| 216*                   | .27                   | K            | 3            | N             | 9.14 (0.360)                       |
| 217*                   | .33                   | J            | 3            | N             | 12.2 (0.480)                       |
| 218*                   | .33                   | K            | 3            | N             | 12.2 (0.480)                       |
| 219*                   | .39                   | J            | 3            | N             | 16.5 (0.650)                       |
| 220*                   | .39                   | K            | 3            | N             | 16.5 (0.650)                       |
| 221*                   | .47                   | J            | 1            | N             | 9.14 (0.360)                       |
| 222*                   | .47                   | K            | 1            | N             | 9.14 (0.360)                       |
| 223*                   | .56                   | J            | 1            | N             | 12.2 (0.480)                       |
| 224*                   | .56                   | K            | 1            | N             | 12.2 (0.480)                       |
| 225*                   | .68                   | J            | 1            | N             | 12.2 (0.480)                       |
| 226*                   | .68                   | K            | 1            | N             | 12.2 (0.480)                       |
| 227*                   | .82                   | J            | 1            | N             | 16.5 (0.650)                       |
| 228*                   | .82                   | K            | 1            | N             | 16.5 (0.650)                       |
| 229*                   | 1.0                   | J            | 2            | N             | 12.2 (0.480)                       |
| 230*                   | 1.0                   | K            | 2            | N             | 12.2 (0.480)                       |
| 231*                   | 1.2                   | J            | 2            | N             | 16.5 (0.650)                       |
| 232*                   | 1.2                   | K            | 2            | N             | 16.5 (0.650)                       |
| 233*                   | 1.5                   | J            | 6            | N             | 9.14 (0.360)                       |
| 234*                   | 1.5                   | K            | 6            | N             | 9.14 (0.360)                       |
| 235*                   | 1.8                   | J            | 6            | N             | 12.2 (0.480)                       |
| 236*                   | 1.8                   | K            | 6            | N             | 12.2 (0.480)                       |
| 237*                   | 2.2                   | J            | 6            | N             | 16.5 (0.650)                       |
| 238*                   | 2.2                   | K            | 6            | N             | 16.5 (0.650)                       |

# SMPS Stacked MLC Capacitors



## (SM9 Style) Technical Information on SMPS Capacitors

U.S. Preferred Styles

### ELECTRICAL SPECIFICATIONS

#### Temperature Coefficient

C0G: A Temperature Coefficient -  $0 \pm 30$  ppm/°C, -55° to +125°C

X7R: C Temperature Coefficient -  $\pm 15\%$ , -55° to +125°C

Z5U: E Temperature Coefficient - +22, -56%, +10° to +85°C

#### Capacitance Test (MIL-STD-202 Method 305)

C0G: 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

X7R: 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

Z5U: 25°C, 0.5 Vrms max (open circuit voltage) at 1KHz

#### Dissipation Factor 25°C

C0G: 0.15% Max @ 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

X7R: 2.5% Max @ 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

Z5U: 3.0% Max @ 25°C, 0.5 Vrms max (open circuit voltage) at 1KHz

#### Insulation Resistance 25°C (MIL-STD-202 Method 302)

C0G and X7R: 100K M $\Omega$  or 1000 M $\Omega$ - $\mu$ F, whichever is less.

Z5U: 10K M $\Omega$  or 1000 M $\Omega$ - $\mu$ F, whichever is less.

#### Insulation Resistance 125°C (MIL-STD-202 Method 302)

C0G and X7R: 10K M $\Omega$  or 100 M $\Omega$ - $\mu$ F, whichever is less.

Z5U: 1K M $\Omega$  or 100 M $\Omega$ - $\mu$ F, whichever is less.

#### Dielectric Withstanding Voltage 25°C (Flash Test)

C0G and X7R: 250% rated voltage for 5 seconds with 50 mA max charging current. (500 Volt units @ 750 VDC)

Z5U: 200% rated voltage for 5 seconds with 50 mA max charging current.

#### Life Test (1000 hrs)

C0G and X7R: 200% rated voltage at +125°C. (500 Volt units @ 600 VDC)

Z5U: 150% rated voltage at +85°C

#### Moisture Resistance (MIL-STD-202 Method 106)

C0G, X7R, Z5U: Ten cycles with no voltage applied.

#### Thermal Shock (MIL-STD-202 Method 107, Condition A)

#### Immersion Cycling (MIL-STD-202 Method 104, Condition B)

#### Resistance To Solder Heat (MIL-STD-202, Method 210, Condition B, for 20 seconds)



### Typical ESR (m $\Omega$ )

#### 24 $\mu$ F Performance

|              | Aluminum Electrolytic | Tantalum | MLC |
|--------------|-----------------------|----------|-----|
| ESR @ 50KHz  | 2,100                 | 140      | 1   |
| ESR @ 100KHz | 2,000                 | 125      | 1   |
| ESR @ 500KHz | 1,600                 | 105      | 2.5 |
| ESR @ 1MHz   | 1,500                 | 105      | 5   |
| ESR @ 5MHz   | 1,200                 | 140      | 10  |
| ESR @ 10MHz  | 1,700                 | 190      | 14  |

### HOW TO ORDER

#### AVX Styles: SM91, SM92, SM93, SM94, SM95, SM96

| SM9                | 1                    | 7                                           | C                             | 106                                                                                                                                                                                       | M                                                                                                                                                             | A                           | N                                                                | 660                                            |
|--------------------|----------------------|---------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------|------------------------------------------------|
| AVX Style Size     | Size                 | Voltage                                     | Temperature Coefficient       | Capacitance Code                                                                                                                                                                          | Capacitance Tolerance                                                                                                                                         | Test Level                  | Termination                                                      | Height                                         |
| SM9 = Plastic Case | See dimensions chart | 50V = 5<br>100V = 1<br>200V = 2<br>500V = 7 | C0G = A<br>X7R = C<br>Z5U = E | (2 significant digits + no. of zeros)<br>10 pF = 100<br>100 pF = 101<br>1,000 pF = 102<br>22,000 pF = 223<br>220,000 pF = 224<br>1 $\mu$ F = 105<br>10 $\mu$ F = 106<br>100 $\mu$ F = 107 | C0G: J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>X7R: K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = +80, -20%<br>Z5U: Z = +80, -20%<br>P = GMV (+100, -0%) | A = Standard<br>B = Hi-Rel* | N = Straight Lead<br>J = Leads formed in<br>L = Leads formed out | See table on next page for max cap. per height |

Note: Capacitors with X7R and Z5U dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations.

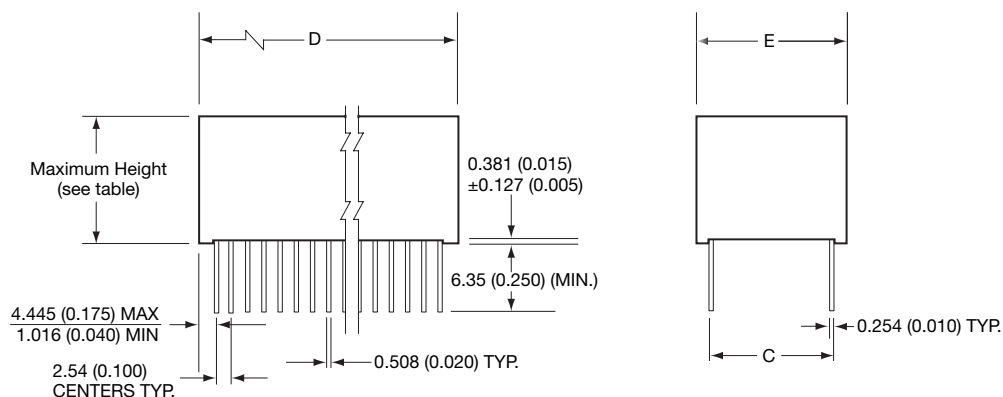
\*Hi-Rel screening for C0G and X7R only. Screening consists of 100% Group A (B Level), Subgroup 1 per MIL-PRF-49470.

# SMPS Stacked MLC Capacitors

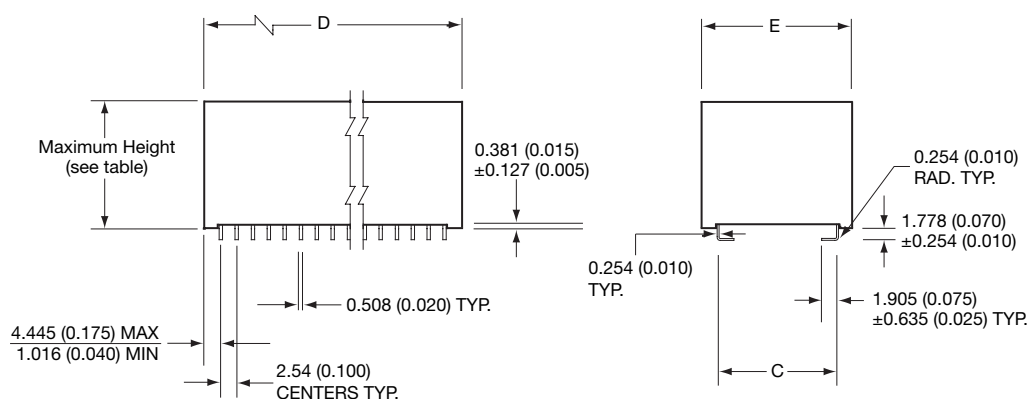
## Encapsulated in DAP (Diallyl Phthalate) Case (SM9 Style)



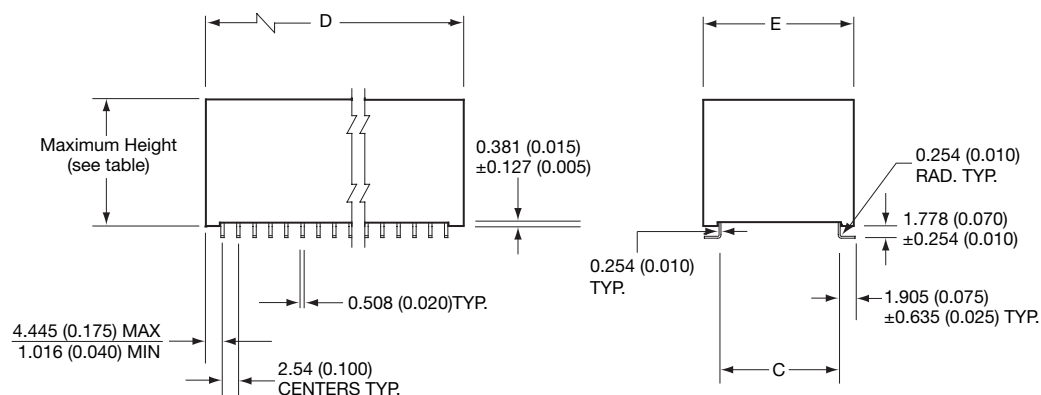
U.S. Preferred Styles



**“N” STYLE LEADS**



**“J” STYLE LEADS**



**“L” STYLE LEADS**

## DIMENSIONS

millimeters (inches)

| Case Code   | $\pm 0.635$ (0.025) <sup>C</sup> | $\pm 0.254$ (0.010) <sup>D</sup> | $+0.000$ (0.000) $-0.254$ (0.010) <sup>E</sup> | No. of Leads per side* |
|-------------|----------------------------------|----------------------------------|------------------------------------------------|------------------------|
| <b>SM91</b> | 11.4 (0.450)                     | 54.7 (2.155)                     | 14.7 (0.580)                                   | 20                     |
| <b>SM92</b> | 20.3 (0.800)                     | 41.0 (1.615)                     | 24.1 (0.950)                                   | 15                     |
| <b>SM93</b> | 11.4 (0.450)                     | 29.3 (1.155)                     | 14.7 (0.580)                                   | 10                     |
| <b>SM94</b> | 10.2 (0.400)                     | 12.3 (0.485)                     | 12.3 (0.485)                                   | 4                      |
| <b>SM95</b> | 6.35 (0.250)                     | 9.02 (0.355)                     | 9.02 (0.355)                                   | 3                      |
| <b>SM96</b> | 31.8 (1.250)                     | 54.7 (2.155)                     | 36.3 (1.430)                                   | 20                     |

\*Leads styles N, J or L available



# SMPS Stacked MLC Capacitors

## Encapsulated in DAP (Diallyl Phthalate) Case (SM9 Style)



U.S. Preferred Styles

### Max Capacitance (μF) Available Versus Style with Height of 0.270" - 6.86mm

| AVX<br>STYLE | SM91 _____ AN270 |      |      |      | SM92 _____ AN270 |      |      |      | SM93 _____ AN270 |      |      |      | SM94 _____ AN270 |      |      |      | SM95 _____ AN270 |      |      |      | SM96 _____ AN270 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 1.0              | .70  | .40  | .18  | 1.2              | 1.0  | .60  | .26  | .47              | .40  | .20  | .09  | .16              | .13  | .07  | .02  | .05              | .04  | .02  | .01  | 3.2              | 2.4  | 1.3  | .50  |
| X7R          | 27               | 12   | 7.0  | 2.6  | 41               | 18   | 11   | 4.0  | 18               | 6.0  | 3.6  | 1.3  | 7.5              | 1.8  | 1.1  | .40  | 2.8              | .68  | .40  | .16  | 80               | 40   | 24   | 9.4  |
| Z5U          | 84               | 32   | 12   | --   | 110              | 46   | 34   | --   | 40               | 15   | 6.0  | --   | 12               | 4.6  | 3.0  | --   | 4.6              | 1.8  | .72  | --   | 260              | 140  | 92   | --   |

### Max Capacitance (μF) Available Versus Style with Height of 0.390" - 9.91mm

| AVX<br>STYLE | SM91 _____ AN390 |      |      |      | SM92 _____ AN390 |      |      |      | SM93 _____ AN390 |      |      |      | SM94 _____ AN390 |      |      |      | SM95 _____ AN390 |      |      |      | SM96 _____ AN390 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 2.0              | 1.4  | .80  | .36  | 2.4              | 2.0  | 1.2  | .52  | 1.0              | .80  | .40  | .18  | .32              | .26  | .14  | .05  | .10              | .08  | .05  | .02  | 6.4              | 4.8  | 2.6  | 1.0  |
| X7R          | 54               | 24   | 14   | 5.2  | 82               | 36   | 22   | 8.0  | 36               | 12   | 7.2  | 2.6  | 15               | 3.6  | 2.2  | .80  | 5.6              | 1.3  | .80  | .32  | 160              | 80   | 48   | 18   |
| Z5U          | 160              | 64   | 24   | --   | 230              | 92   | 68   | --   | 80               | 30   | 12   | --   | 24               | 9.2  | 6.0  | --   | 9.2              | 3.6  | 1.4  | --   | 520              | 280  | 180  | --   |

### Max Capacitance (μF) Available Versus Style with Height of 0.530" - 13.46mm

| AVX<br>STYLE | SM91 _____ AN530 |      |      |      | SM92 _____ AN530 |      |      |      | SM93 _____ AN530 |      |      |      | SM94 _____ AN530 |      |      |      | SM95 _____ AN530 |      |      |      | SM96 _____ AN530 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 3.0              | 2.1  | 1.2  | .54  | 3.6              | 3.0  | 1.8  | .78  | 1.5              | 1.2  | .60  | .27  | .48              | .39  | .21  | .07  | .15              | .12  | .07  | .03  | 9.6              | 7.2  | 3.9  | 1.5  |
| X7R          | 82               | 36   | 21   | 7.8  | 120              | 54   | 33   | 12   | 54               | 18   | 10   | 3.9  | 22               | 5.4  | 3.3  | 1.2  | 8.2              | 2.0  | 1.2  | .48  | 240              | 120  | 72   | 28   |
| Z5U          | 250              | 96   | 36   | --   | 350              | 130  | 100  | --   | 120              | 45   | 18   | --   | 36               | 13   | 9.0  | --   | 13               | 5.4  | 2.1  | --   | 780              | 430  | 270  | --   |

### Max Capacitance (μF) Available Versus Style with Height of 0.660" - 16.76mm

| AVX<br>STYLE | SM91 _____ AN660 |      |      |      | SM92 _____ AN660 |      |      |      | SM93 _____ AN660 |      |      |      | SM94 _____ AN660 |      |      |      | SM95 _____ AN660 |      |      |      | SM96 _____ AN660 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 4.0              | 2.8  | 1.6  | .72  | 4.8              | 4.0  | 2.4  | 1.0  | 2.0              | 1.6  | .80  | .36  | .64              | .52  | .28  | .10  | .20              | .16  | .10  | .04  | 12               | 9.6  | 5.2  | 2.0  |
| X7R          | 110              | 48   | 28   | 10   | 160              | 72   | 44   | 16   | 72               | 24   | 14   | 5.2  | 30               | 7.2  | 4.4  | 1.6  | 10               | 2.7  | 1.6  | .64  | 320              | 160  | 96   | 37   |
| Z5U          | 330              | 120  | 48   | --   | 470              | 180  | 130  | --   | 160              | 60   | 24   | --   | 48               | 18   | 12   | --   | 18               | 7.2  | 2.8  | --   | 1000             | 570  | 360  | --   |

### Max Capacitance (μF) Available Versus Style with Height of 0.800" - 20.3mm

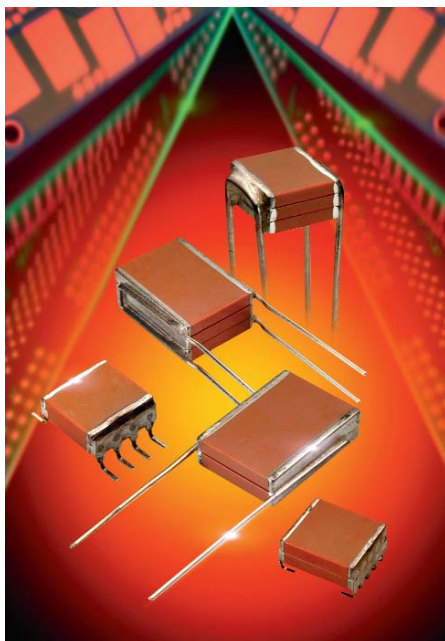
| AVX<br>STYLE | SM91 _____ AN800 |      |      |      | SM92 _____ AN800 |      |      |      | SM93 _____ AN800 |      |      |      | SM94 _____ AN800 |      |      |      | SM95 _____ AN800 |      |      |      | SM96 _____ AN800 |      |      |      |
|--------------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|------------------|------|------|------|
|              | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V | 50V              | 100V | 200V | 500V |
| C0G          | 5.0              | 3.5  | 2.0  | .90  | 6.0              | 5.0  | 3.0  | 1.3  | 2.5              | 2.0  | 1.0  | .45  | .80              | .65  | .35  | .12  | .25              | .20  | .12  | .05  | 16               | 12   | 6.5  | 2.5  |
| X7R          | 130              | 60   | 35   | 13   | 200              | 90   | 55   | 20   | 90               | 30   | 18   | 6.5  | 36               | 9.0  | 5.5  | 2.0  | 12               | 3.4  | 2.0  | .80  | 400              | 200  | 120  | 47   |
| Z5U          | 420              | 160  | 60   | --   | 590              | 230  | 170  | --   | 200              | 75   | 30   | --   | 60               | 23   | 15   | --   | 23               | 9.0  | 3.6  | --   | 1300             | 720  | 460  | --   |

# SMPS Capacitors Chip Assemblies

CH/CV - Radial, Dual-in-Line,  
4 Terminal/SMT 'J' & 'L' Ranges



European Preferred Styles



10nF to 180  $\mu$ F

50V to 500 VDC

-55°C to +125°C

BS9100 approved

Low ESR/ESL

1B/C0G and 2C1/X7R Dielectrics

This range allows SMPS engineers to select the best volumetric solution for input and output filter applications in high reliability designs. Utilizing advanced multilayer ceramic techniques to minimize ESR/ESL giving high current handling properties appropriate for filtering, smoothing and decoupling circuits.

## ELECTRICAL SPECIFICATIONS

**Temperature Coefficient** CECC 30 000, (4.24.1)

1B/C0G: A Temperature Coefficient -  $0 \pm 30$  ppm/°C, -55° to +125°C

2C1/X7R: C Temperature Characteristic -  $\pm 15\%$ , -55° to +125°C

**Capacitance Test 25°C**

1B/C0G: Measured at 1 VRMS max at 1KHz (1MHz for 100 pF or less)

2C1/X7R: Measured at 1 VRMS max at 1KHz

**Dissipation Factor 25°C**

1B/C0G: 0.15% max at 1KHz, 1 VRMS max (1MHz for 100 pF or less)

2C1/X7R: 2.5% max at 1KHz, 1 VRMS max

**Insulation Resistance 25°C**

1B/C0G & 2C1/X7R: 100K megohms or 1000 megohms- $\mu$ F, whichever is less

**Dielectric Withstanding Voltage 25°C** (Flash Test)

1B/C0G & 2C1/X7R: 250% rated voltage for 5 seconds with 50 mA max charging current. (500 Volt units @ 150% rated voltage)

**Dielectric Withstanding Voltage 25°C** (Flash Test)

1B/C0G & 2C1/X7R: 250% rated voltage for 5 seconds with 50 mA max charging current. (500 Volt units @ 150% rated voltage)

**Life Test** (1000 hrs) CECC 30 000 (4.23)

1B/C0G & 2C1/X7R: 200% rated voltage at +125°C. (500 Volt units @ 120% rated voltage)

**Damp Heat** IEC 68-2-3, 56 days.

**Thermal Shock** IEC 68-2-14

-55°C to +125°C, 5 cycles

**Resistance to Solder Heat** IEC 68-2-20

**Vibration** IEC 68-2-6

10Hz - 2000Hz, 0.75mm or 98m/sec<sup>2</sup>, 6 hrs.

**Bump** IEC 68-2-29

390m/sec<sup>2</sup>, 4000 bumps

## MARKING

### CH and CV 4x, 5x, 81-84

A5C  
225K  
xxxxxx

Top line A (AVX). Voltage code, dielectric code.  
Middle line capacitance code, tolerance code.  
Bottom line 6 digit batch code.

### Other CH, CV Styles

AVX  
5C  
156M  
xxxxxx

Top line AVX.  
Second line voltage code, dielectric code.  
Third line capacitance code, tolerance code.  
Bottom line, 6 digit batch code.



# SMPS Capacitors (CV Style)

## Chip Assemblies

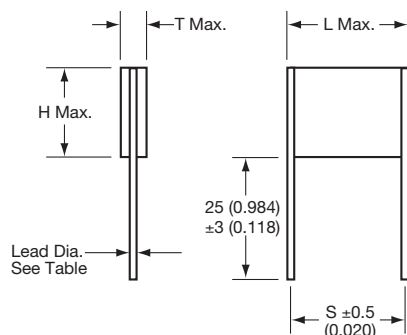


European Preferred Styles

### VERTICALLY MOUNTED RADIAL PRODUCT

Part Number format (CVxxxxxxxxxxA2)

Typical Part Number CV525C106MA30A2



#### DIMENSIONS

millimeters (inches)

| Style   | L (max)      | H (max)      | S (nom)       | Lead Dia (nom) |
|---------|--------------|--------------|---------------|----------------|
| CV41-44 | 10.6 (0.417) | 8.7 (0.342)  | 8.2 (0.322)   | 0.7 (0.028)    |
| CV51-54 | 11.9 (0.468) | 10.7 (0.421) | 10.2 (0.400)  | 0.9 (0.035)    |
| CV61-64 | 16.5 (0.649) | 13.6 (0.535) | 15.2 (0.600)  | 0.9 (0.035)    |
| CV71-74 | 17.8 (0.700) | 21.6 (0.850) | 15.2 (0.600)  | 0.9 (0.035)    |
| CV76-79 | 22.7 (0.893) | 16.6 (0.653) | 21.2* (0.834) | 0.9 (0.035)    |

\*Tolerance  $\pm 0.8$

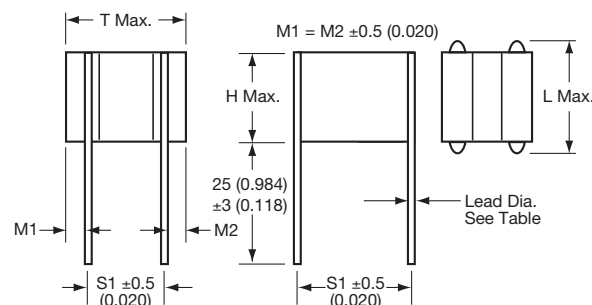
millimeters (inches)

| Style            | T max        |
|------------------|--------------|
| CV41/51/61/71/76 | 3.80 (0.150) |
| CV42/52/62/72/77 | 7.40 (0.291) |
| CV43/53/63/73/78 | 11.1 (0.437) |
| CV44/54/64/74/79 | 14.8 (0.583) |

### VERTICALLY MOUNTED 4 TERMINAL RADIAL PRODUCT

Part Number format (CVxxxxxxxx3xx4)

Typical Part Number CV435C106MA30A4



#### DIMENSIONS

millimeters (inches)

| Style   | L (max)      | H (max)      | S (nom)       | Lead Dia (nom) |
|---------|--------------|--------------|---------------|----------------|
| CV43-44 | 10.6 (0.417) | 8.7 (0.342)  | 8.2 (0.322)   | 0.7 (0.028)    |
| CV53-54 | 11.9 (0.468) | 10.7 (0.421) | 10.2 (0.400)  | 0.9 (0.035)    |
| CV63-64 | 16.5 (0.649) | 13.6 (0.535) | 15.2 (0.600)  | 0.9 (0.035)    |
| CV73-74 | 17.8 (0.700) | 21.6 (0.850) | 15.2 (0.600)  | 0.9 (0.035)    |
| CV78-79 | 22.7 (0.893) | 16.6 (0.653) | 21.2* (0.834) | 0.9 (0.035)    |

\*Tolerance  $\pm 0.8$  (0.031)

millimeters (inches)

| Style            | T max        | S1           |
|------------------|--------------|--------------|
| CV43/53/63/73/78 | 11.1 (0.437) | 5.08 (0.200) |
| CV44/54/64/74/79 | 14.8 (0.583) | 7.62 (0.300) |

Note 1. This style is only available in 3 & 4 chip assemblies

### HOW TO ORDER

| CV                    | 52        | 5                                           | C                  | 106                                                                                                   | M                                                                 | A                  | 3                                                         | 0              | A               | 2                                                    |
|-----------------------|-----------|---------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------|-----------------------------------------------------------|----------------|-----------------|------------------------------------------------------|
| Style Code            | Size Code | Voltage Code                                | Dielectric Code    | Capacitance Code                                                                                      | Capacitance Tolerance                                             | Specification Code | Finish Code                                               | Lead Dia. Code | Lead Space Code | Lead Style Code                                      |
| (see product section) |           | 5 = 50V<br>1 = 100V<br>2 = 200V<br>7 = 500V | A = C0G<br>C = X7R | (2 significant digits + no. of zeros)<br>eg. 105 = 1 $\mu$ F<br>106 = 10 $\mu$ F<br>107 = 100 $\mu$ F | J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>P = -0 +100% | A = Non-customized | 3 = Uncoated<br>8 = Coated<br>(classified as uninsulated) | 0 = Standard   | A = Standard    | 2 = 2 Terminal<br>4 = 4 Terminal<br>See Note 1 above |

Note: See page 91 for How to Order BS9100 parts

# SMPS Capacitors (CH Style)

## Chip Assemblies

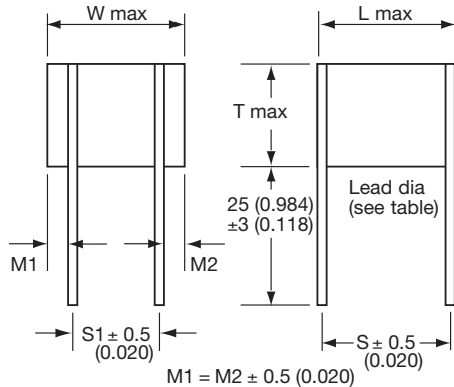


European Preferred Styles

### HORIZONTALLY MOUNTED 4 TERMINAL RADIAL PRODUCT

Part Number format (CHxxxxxxxx3xx4)

Typical Part Number CH782C106MA30A4



#### DIMENSIONS

millimeters (inches)

| Style   | L (max)      | W (max)      | S (nom)       | S Lead Dia (nom) | S1 (nom)     |
|---------|--------------|--------------|---------------|------------------|--------------|
| CH42-44 | 10.6 (0.417) | 8.7 (0.342)  | 8.2 (0.322)   | 0.7 (0.028)      | 5.08 (0.200) |
| CH52-54 | 11.9 (0.468) | 10.7 (0.421) | 10.2 (0.400)  | 0.9 (0.035)      | 7.62 (0.300) |
| CH62-64 | 16.5 (0.649) | 13.6 (0.535) | 15.2 (0.600)  | 0.9 (0.035)      | 7.62 (0.300) |
| CH72-74 | 17.8 (0.700) | 21.6 (0.850) | 15.2 (0.600)  | 0.9 (0.035)      | 15.2 (0.600) |
| CH77-79 | 22.7 (0.893) | 16.6 (0.653) | 21.2* (0.834) | 0.9 (0.035)      | 10.2 (0.400) |
| CH82-84 | 14.1 (0.555) | 38.2 (1.503) | 10.2 (0.400)  | 0.9 (0.035)      | 27.9 (1.100) |
| CH87-89 | 17.8 (0.700) | 38.2 (1.503) | 15.2 (0.600)  | 1.0 (0.039)      | 27.9 (1.100) |
| CH92-94 | 22.7 (0.893) | 40.6 (1.598) | 21.2* (0.834) | 1.2 (0.047)      | 30.5 (1.200) |

\*Tolerance ± 0.8

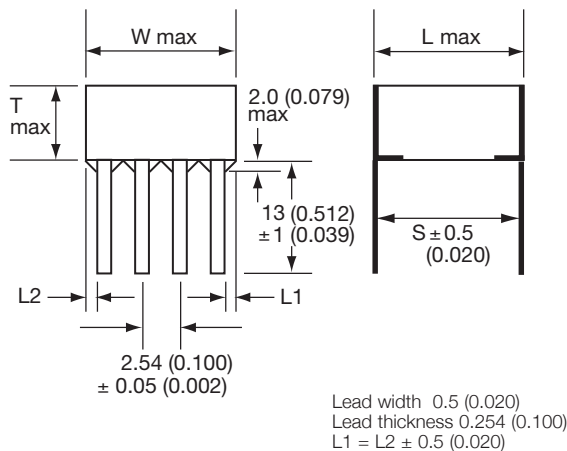
NOTE: This style is only available in 2, 3 & 4 chip assemblies only

| Style                  | T max        |
|------------------------|--------------|
| CH42/52/62/72/77/87/92 | 7.4 (0.291)  |
| CH43/53/63/73/78/88/93 | 11.1 (0.437) |
| CH44/54/64/74/79/89/94 | 14.8 (0.583) |

### HORIZONTALLY MOUNTED DUAL-IN-LINE PRODUCT

Part Number format (CHxxxxxxxx0A0)

Typical Part Number CH615C106MA30A0



#### DIMENSIONS

millimeters (inches)

| Style   | L (max)      | W (max)      | S (nom)       | No. of Leads per side |
|---------|--------------|--------------|---------------|-----------------------|
| CH41-44 | 9.2 (0.362)  | 8.7 (0.342)  | 8.2 (0.322)   | 3                     |
| CH51-54 | 10.7 (0.421) | 10.7 (0.421) | 10.2 (0.400)  | 4                     |
| CH61-64 | 14.9 (0.586) | 13.6 (0.535) | 14.0 (0.551)  | 5                     |
| CH71-74 | 16.8 (0.661) | 21.6 (0.850) | 15.2 (0.600)  | 7                     |
| CH76-79 | 21.6 (0.850) | 16.6 (0.653) | 20.3* (0.800) | 6                     |
| CH81-84 | 12.0 (0.472) | 38.2 (1.503) | 10.2 (0.400)  | 14                    |
| CH86-89 | 18.9 (0.744) | 38.2 (1.503) | 15.2 (0.600)  | 14                    |
| CH91-94 | 24.0 (0.944) | 40.6 (1.598) | 20.3* (0.800) | 14                    |

\*Tolerance ± 0.8 (0.031)

millimeters (inches)

| Style                     | T max        |
|---------------------------|--------------|
| CH41/51/61/71/76/81/86/91 | 3.8 (0.150)  |
| CH42/52/62/72/77/82/87/92 | 7.4 (0.291)  |
| CH43/53/63/73/78/83/88/93 | 11.1 (0.437) |
| CH44/54/64/74/79/84/89/94 | 14.8 (0.583) |

### HOW TO ORDER

| CH                    | 52        | 5                                           | C                  | 106                                                                                    | M                                               | A                  | 3                                                         | 0              | A               | 0                                           |
|-----------------------|-----------|---------------------------------------------|--------------------|----------------------------------------------------------------------------------------|-------------------------------------------------|--------------------|-----------------------------------------------------------|----------------|-----------------|---------------------------------------------|
| Style Code            | Size Code | Voltage Code                                | Dielectric Code    | Capacitance Code                                                                       | Capacitance Tolerance                           | Specification Code | Finish Code                                               | Lead Dia. Code | Lead Space Code | Lead Style Code                             |
| (see product section) |           | 5 = 50V<br>1 = 100V<br>2 = 200V<br>7 = 500V | A = C0G<br>C = X7R | (2 significant digits + no. of zeros)<br>eg. 105 = 1 µF<br>106 = 10 µF<br>107 = 100 µF | J = ±5%<br>K = ±10%<br>M = ±20%<br>P = -0 +100% | A = Non-customized | 3 = Uncoated<br>8 = Coated<br>(classified as uninsulated) | 0 = Standard   | A = Standard    | 0 = Straight dual in line<br>4 = 4 Terminal |

Note: See page 91 for How to Order BS9100 parts



# SMPS Capacitors (CH Style)

## Chip Assemblies

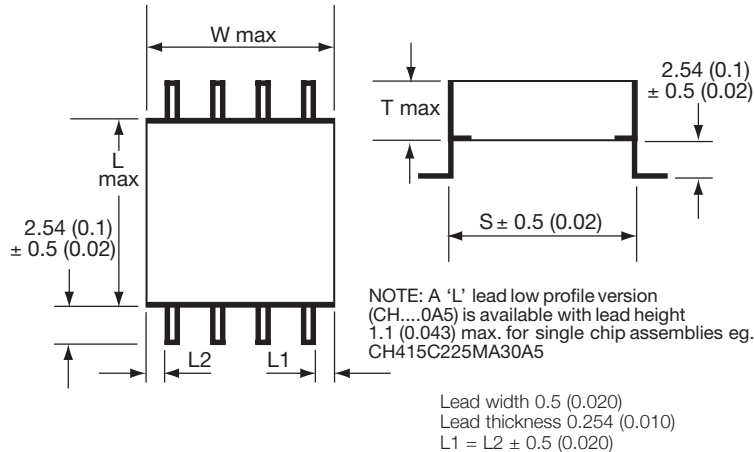


European Preferred Styles

### HORIZONTALLY MOUNTED 'L' LEAD SMT PRODUCT

Part Number format (CHxxxxxxxxxx0A7)

Typical Part Number CH411C275KA30A7



#### DIMENSIONS

millimeters (inches)

| Style   | L (max)      | W (max)      | S (nom)       | No. of Leads per side |
|---------|--------------|--------------|---------------|-----------------------|
| CH41-44 | 9.2 (0.362)  | 8.7 (0.342)  | 8.2 (0.322)   | 3                     |
| CH51-54 | 10.7 (0.421) | 10.7 (0.421) | 10.2 (0.400)  | 4                     |
| CH61-64 | 14.9 (0.586) | 13.6 (0.535) | 14.0 (0.551)  | 5                     |
| CH71-74 | 16.8 (0.661) | 21.6 (0.850) | 15.2 (0.600)  | 7                     |
| CH76-79 | 21.6 (0.850) | 16.6 (0.653) | 20.3* (0.800) | 6                     |
| CH81-84 | 12.0 (0.472) | 38.2 (1.503) | 10.2 (0.400)  | 14                    |
| CH86-89 | 18.9 (0.744) | 38.2 (1.503) | 15.2 (0.600)  | 14                    |
| CH91-94 | 24.0 (0.944) | 40.6 (1.598) | 20.3* (0.800) | 14                    |

\*Tolerance ± 0.8 (0.031)

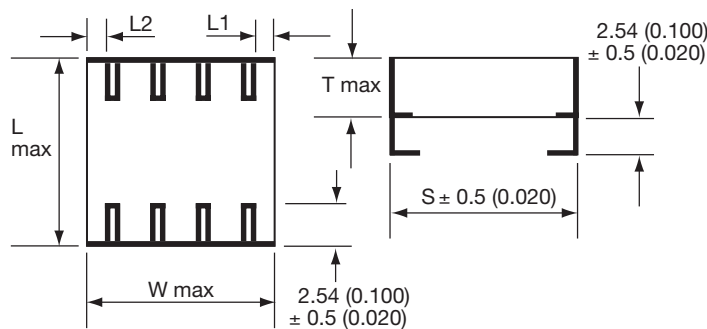
millimeters (inches)

| Style                     | T max        |
|---------------------------|--------------|
| CH41/51/61/71/76/81/86/91 | 3.8 (0.150)  |
| CH42/52/62/72/77/82/87/92 | 7.4 (0.291)  |
| CH43/53/63/73/78/83/88/93 | 11.1 (0.437) |
| CH44/54/64/74/79/84/89/94 | 14.8 (0.583) |

### HORIZONTALLY MOUNTED 'J' LEAD SMT PRODUCT

Part Number format (CHxxxxxxxxxx0A8)

Typical Part Number CH411C275KA30A8



#### DIMENSIONS

millimeters (inches)

| Style   | L (max)      | W (max)      | S (nom)       | No. of Leads per side |
|---------|--------------|--------------|---------------|-----------------------|
| CH41-44 | 9.2 (0.362)  | 8.7 (0.342)  | 8.2 (0.322)   | 3                     |
| CH51-54 | 10.7 (0.421) | 10.7 (0.421) | 10.2 (0.400)  | 4                     |
| CH61-64 | 14.9 (0.586) | 13.6 (0.535) | 14.0 (0.551)  | 5                     |
| CH71-74 | 16.8 (0.661) | 21.6 (0.850) | 15.2 (0.600)  | 7                     |
| CH76-79 | 21.6 (0.850) | 16.6 (0.653) | 20.3* (0.800) | 6                     |
| CH81-84 | 12.0 (0.472) | 38.2 (1.503) | 10.2 (0.400)  | 14                    |
| CH86-89 | 18.9 (0.744) | 38.2 (1.503) | 15.2 (0.600)  | 14                    |
| CH91-94 | 24.0 (0.944) | 40.6 (1.598) | 20.3* (0.800) | 14                    |

\*Tolerance ± 0.8 (0.031)

millimeters (inches)

| Style                     | T max        |
|---------------------------|--------------|
| CH41/51/61/71/76/81/86/91 | 3.8 (0.150)  |
| CH42/52/62/72/77/82/87/92 | 7.4 (0.291)  |
| CH43/53/63/73/78/83/88/93 | 11.1 (0.437) |
| CH44/54/64/74/79/84/89/94 | 14.8 (0.583) |

### HOW TO ORDER

| CH                    | 52        | 5                                           | C                  | 106                                                                                    | M                                               | A                  | 3                                                         | 0              | A               | 7                                                                                                                      |
|-----------------------|-----------|---------------------------------------------|--------------------|----------------------------------------------------------------------------------------|-------------------------------------------------|--------------------|-----------------------------------------------------------|----------------|-----------------|------------------------------------------------------------------------------------------------------------------------|
| Style Code            | Size Code | Voltage Code                                | Dielectric Code    | Capacitance Code                                                                       | Capacitance Tolerance                           | Specification Code | Finish Code                                               | Lead Dia. Code | Lead Space Code | Lead Style Code                                                                                                        |
| (see product section) |           | 5 = 50V<br>1 = 100V<br>2 = 200V<br>7 = 500V | A = C0G<br>C = X7R | (2 significant digits + no. of zeros)<br>eg. 105 = 1 μF<br>106 = 10 μF<br>107 = 100 μF | J = ±5%<br>K = ±10%<br>M = ±20%<br>P = -0 +100% | A = Non-customized | 3 = Uncoated<br>8 = Coated<br>(classified as uninsulated) | 0 = Standard   | A = Standard    | 3 = Low profile 'J' (single chip)<br>5 = Low profile 'L' (single chip)<br>7 = 'L' Dual in line<br>8 = 'J' Dual in line |

Note: See page 91 for How to Order BS9100 parts

# SMPS Capacitors (CH/CV Style)

## Chip Assemblies



European Preferred Styles

### C0G DIELECTRIC ULTRA STABLE CERAMIC

|            | CH/CV41-44<br>Styles |     |     |     | CH/CV51-54<br>Styles |     |     |     | CH/CV61-64<br>Styles |     |     |     | CH/CV71-74<br>Styles |     |     |     | CH/CV76-79<br>Styles |     |     |     | CH81-84<br>Styles |     |     |     | CH86-89<br>Styles |     |     |     | CH91-94<br>Styles |     |     |     |    |
|------------|----------------------|-----|-----|-----|----------------------|-----|-----|-----|----------------------|-----|-----|-----|----------------------|-----|-----|-----|----------------------|-----|-----|-----|-------------------|-----|-----|-----|-------------------|-----|-----|-----|-------------------|-----|-----|-----|----|
| Voltage DC |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| Cap μF     | 50                   | 100 | 200 | 500 | 50                   | 100 | 200 | 500 | 50                   | 100 | 200 | 500 | 50                   | 100 | 200 | 500 | 50                   | 100 | 200 | 500 | 50                | 100 | 200 | 500 | 50                | 100 | 200 | 500 | 50                | 100 | 200 | 500 |    |
| 0.01       |                      |     |     | 41  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.012      |                      |     |     | 41  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.015      |                      |     |     | 41  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.018      |                      |     |     | 41  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.022      |                      |     |     | 42  |                      |     |     | 51  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.027      |                      |     |     | 42  |                      |     |     | 51  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.033      |                      |     | 41  | 42  |                      |     |     | 52  |                      |     |     | 61  |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.039      |                      |     | 41  | 42  |                      |     |     | 52  |                      |     |     | 61  |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.047      |                      | 41  | 41  | 43  |                      |     |     | 52  |                      |     |     | 61  |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.056      |                      | 41  | 41  | 43  |                      |     |     | 52  |                      |     |     | 61  |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.068      | 41                   | 41  | 41  | 44  |                      |     | 51  | 53  |                      |     |     | 62  |                      |     | 71  |     |                      | 76  |     |     |                   | 81  |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.082      | 41                   | 41  | 42  |     |                      |     | 51  | 53  |                      |     |     | 62  |                      |     | 71  |     |                      | 76  |     |     |                   | 81  |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.1        | 41                   | 42  | 42  |     |                      | 51  | 51  | 54  |                      |     |     | 62  |                      |     | 71  |     |                      | 76  |     |     |                   | 81  |     |     |                   |     |     |     |                   |     |     |     |    |
| 0.12       | 42                   | 42  | 42  |     | 51                   | 51  | 52  |     |                      |     | 61  | 62  |                      |     | 72  |     |                      | 77  |     |     |                   | 81  |     |     |                   | 86  |     |     |                   |     |     |     |    |
| 0.15       | 42                   | 42  | 42  |     | 51                   | 52  | 52  |     |                      | 61  | 61  | 63  |                      |     | 72  |     |                      | 77  |     |     |                   | 81  |     |     |                   | 86  |     |     |                   |     |     |     |    |
| 0.18       | 42                   | 42  | 43  |     | 51                   | 52  | 52  |     |                      | 61  | 61  | 63  |                      |     | 72  |     |                      | 77  |     |     |                   | 82  |     |     |                   | 86  |     |     |                   |     |     |     |    |
| 0.22       | 42                   | 43  | 43  |     | 52                   | 52  | 52  |     | 61                   | 61  | 62  | 64  |                      |     | 71  | 72  |                      | 76  | 77  |     |                   | 81  | 82  |     |                   | 86  |     |     |                   |     | 91  |     |    |
| 0.27       | 43                   | 43  | 44  |     | 52                   | 52  | 53  |     | 61                   | 62  | 62  |     |                      | 71  | 71  | 73  |                      | 76  | 76  | 78  |                   | 81  | 81  | 82  |                   |     | 87  |     |                   |     | 91  |     |    |
| 0.33       | 43                   | 44  |     |     | 52                   | 53  | 53  |     | 61                   | 62  | 62  |     |                      | 71  | 71  | 73  |                      | 76  | 76  | 78  |                   | 81  | 81  | 82  |                   |     | 87  |     |                   |     | 91  |     |    |
| 0.39       | 44                   |     |     |     | 52                   | 53  | 54  |     | 62                   | 62  | 62  |     | 71                   | 71  | 72  | 74  | 76                   | 76  | 77  | 79  | 81                | 81  | 81  | 83  |                   |     | 86  | 87  |                   |     |     | 92  |    |
| 0.47       |                      |     |     |     | 53                   | 54  |     |     | 62                   | 62  | 63  |     | 71                   | 71  | 72  |     | 76                   | 76  | 77  |     | 81                | 81  | 81  | 83  |                   |     | 86  | 87  |                   |     |     | 92  |    |
| 0.56       |                      |     |     |     | 53                   |     |     |     | 62                   | 63  | 63  |     | 71                   | 72  | 72  |     | 76                   | 77  | 77  |     | 81                | 81  | 82  | 84  |                   |     | 86  | 86  | 88                |     |     | 92  |    |
| 0.68       |                      |     |     |     | 54                   |     |     |     | 62                   | 63  | 64  |     | 72                   | 72  | 72  |     | 77                   | 77  | 77  |     | 81                | 82  | 82  |     |                   | 86  | 86  | 86  | 88                |     |     | 92  |    |
| 0.82       |                      |     |     |     |                      |     |     |     | 63                   | 64  |     |     | 72                   | 72  | 73  |     | 77                   | 77  | 78  |     | 82                | 82  | 82  |     |                   | 86  | 86  | 87  | 89                |     |     | 91  | 93 |
| 1          |                      |     |     |     |                      |     |     |     | 63                   | 64  |     |     | 72                   | 72  | 73  |     | 77                   | 77  | 78  |     | 82                | 82  | 82  |     |                   | 86  | 87  | 87  |                   |     | 91  | 91  | 93 |
| 1.2        |                      |     |     |     |                      |     |     |     | 64                   |     |     |     | 72                   | 73  | 74  |     | 77                   | 78  | 79  |     | 82                | 82  | 83  |     |                   | 87  | 87  | 87  |                   | 91  | 91  | 92  | 94 |
| 1.5        |                      |     |     |     |                      |     |     |     |                      |     |     |     | 73                   | 73  |     |     | 78                   | 78  |     |     | 82                | 83  | 83  |     |                   | 87  | 87  | 87  |                   | 91  | 92  | 92  |    |
| 1.8        |                      |     |     |     |                      |     |     |     |                      |     |     |     | 73                   | 74  |     |     | 78                   | 79  |     |     | 83                | 83  | 84  |     |                   | 87  | 87  | 88  |                   | 92  | 92  | 92  |    |
| 2.2        |                      |     |     |     |                      |     |     |     |                      |     |     |     | 74                   |     |     |     | 79                   |     |     |     | 83                | 84  |     |     |                   | 87  | 88  | 88  |                   | 92  | 92  | 92  |    |
| 2.7        |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     | 84                |     |     |     |                   | 88  | 88  | 89  |                   | 92  | 92  | 93  |    |
| 3.3        |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   | 88  | 89  |     |                   | 92  | 93  | 93  |    |
| 3.9        |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   | 89  |     |     |                   | 93  | 93  | 94  |    |
| 4.7        |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   | 93  | 94  |     |    |
| 5.6        |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   | 94  |     |     |    |

NB Figures in cells refer to size within ordering information

# SMPS Capacitors (CH/CV Style)

## Chip Assemblies

### X7R DIELECTRIC STABLE CERAMIC

|             | CH/CV41-44<br>Styles |     |     |     | CH/CV51-54<br>Styles |     |     |     | CH/CV61-64<br>Styles |     |     |     | CH/CV71-74<br>Styles |     |     |     | CH/CV76-79<br>Styles |     |     |     | CH81-84<br>Styles |     |     |     | CH86-89<br>Styles |     |     |     | CH91-94<br>Styles |     |     |     |  |
|-------------|----------------------|-----|-----|-----|----------------------|-----|-----|-----|----------------------|-----|-----|-----|----------------------|-----|-----|-----|----------------------|-----|-----|-----|-------------------|-----|-----|-----|-------------------|-----|-----|-----|-------------------|-----|-----|-----|--|
| Voltage DC  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| Cap $\mu$ F | 50                   | 100 | 200 | 500 | 50                   | 100 | 200 | 500 | 50                   | 100 | 200 | 500 | 50                   | 100 | 200 | 500 | 50                   | 100 | 200 | 500 | 50                | 100 | 200 | 500 | 50                | 100 | 200 | 500 | 50                | 100 | 200 | 500 |  |
| 0.12        |                      |     |     | 41  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.15        |                      |     |     | 41  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.18        |                      |     |     | 41  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.22        |                      |     |     | 41  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.27        |                      |     |     | 42  |                      |     |     | 51  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.33        |                      |     | 41  | 42  |                      |     |     | 51  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.39        |                      |     | 41  | 42  |                      |     |     | 51  |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.47        |                      |     | 41  | 42  |                      |     |     | 52  |                      |     |     | 61  |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.56        |                      |     | 41  | 43  |                      |     |     | 52  |                      |     |     | 61  |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.68        |                      |     | 42  | 43  |                      |     | 51  | 52  |                      |     |     | 61  |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   |     |     |     |  |
| 0.82        |                      |     | 42  | 44  |                      |     | 51  | 52  |                      |     |     | 61  |                      |     | 71  |     |                      | 76  |     |     |                   | 81  |     |     |                   |     |     |     |                   |     |     |     |  |
| 1           |                      | 41  | 42  | 44  |                      |     | 51  | 53  |                      |     | 61  | 62  |                      |     | 71  |     |                      | 76  |     |     |                   | 81  |     |     |                   |     |     |     |                   |     |     |     |  |
| 1.2         |                      | 41  | 42  |     |                      |     | 52  | 53  |                      |     | 61  | 62  |                      |     | 71  |     |                      | 76  |     |     |                   | 81  |     |     |                   |     |     |     |                   |     |     |     |  |
| 1.5         |                      | 41  | 43  |     |                      |     | 52  | 54  |                      |     | 61  | 62  |                      |     | 71  |     |                      | 76  |     |     |                   | 81  |     |     |                   | 86  |     |     |                   |     |     |     |  |
| 1.8         | 41                   | 41  | 43  |     |                      |     | 52  |     |                      |     | 61  | 62  |                      |     | 72  |     |                      | 77  |     |     |                   | 82  |     |     |                   | 86  |     |     |                   |     |     |     |  |
| 2.2         | 41                   | 41  | 44  |     |                      | 51  | 52  |     |                      |     | 61  | 63  |                      | 71  | 72  |     |                      | 76  | 77  |     |                   | 81  | 82  |     |                   |     | 86  |     |                   |     |     |     |  |
| 2.7         | 41                   | 41  |     |     |                      | 51  | 53  |     |                      |     | 62  | 63  |                      | 71  | 72  |     |                      | 76  | 77  |     |                   | 81  | 82  |     |                   |     | 87  |     |                   |     | 91  |     |  |
| 3.3         | 41                   | 42  |     |     |                      | 51  | 53  |     |                      |     | 62  | 64  |                      |     | 71  | 72  |                      |     | 76  | 77  |                   |     | 81  | 82  |                   |     |     | 87  |                   |     | 91  |     |  |
| 3.9         | 42                   | 42  |     |     | 51                   | 51  | 54  |     |                      |     | 62  |     |                      | 72  | 73  |     |                      | 77  | 78  |     |                   | 81  | 83  |     |                   | 86  | 87  |     |                   |     | 91  |     |  |
| 4.7         | 42                   | 42  |     |     | 51                   | 52  |     |     |                      | 61  | 62  |     |                      | 72  | 73  |     |                      | 77  | 78  |     |                   | 82  | 83  |     |                   | 86  | 87  |     |                   |     | 91  |     |  |
| 5.6         | 42                   | 42  |     |     | 51                   | 52  |     |     |                      | 61  | 63  |     |                      | 72  | 74  |     |                      | 77  | 79  |     |                   | 82  | 84  |     |                   | 86  | 88  |     |                   |     | 92  |     |  |
| 6.8         | 42                   | 43  |     |     | 52                   | 52  |     |     | 61                   | 61  | 63  |     |                      | 72  |     |     |                      | 77  |     |     |                   | 82  |     |     |                   | 86  | 88  |     |                   |     | 92  |     |  |
| 8.2         | 43                   | 43  |     |     | 52                   | 52  |     |     | 61                   | 61  | 64  |     |                      | 71  | 73  |     |                      | 76  | 78  |     |                   | 82  |     |     |                   | 87  | 89  |     |                   |     | 91  | 92  |  |
| 10          | 43                   | 44  |     |     | 52                   | 53  |     |     | 61                   | 62  | 64  |     |                      | 71  | 73  |     |                      | 76  | 78  |     |                   | 83  |     |     |                   | 87  |     |     |                   |     | 91  | 92  |  |
| 12          | 44                   |     |     |     | 53                   | 53  |     |     | 62                   | 62  |     |     | 71                   | 71  | 74  |     |                      | 76  | 76  | 79  |                   |     | 81  | 83  |                   |     | 87  |     |                   |     | 92  | 93  |  |
| 15          |                      |     |     |     | 53                   | 54  |     |     | 62                   | 62  |     |     | 71                   | 71  |     |     |                      | 76  | 76  |     |                   | 81  | 81  | 84  |                   |     | 86  | 87  |                   |     | 92  | 93  |  |
| 18          |                      |     |     |     | 54                   |     |     |     | 62                   | 63  |     |     | 71                   | 72  |     |     |                      | 76  | 77  |     |                   | 81  | 81  |     |                   |     | 86  | 88  |                   |     | 92  | 94  |  |
| 22          |                      |     |     |     | 54                   |     |     |     | 62                   | 63  |     |     | 72                   | 72  |     |     |                      | 77  | 77  |     |                   | 81  | 82  |     |                   | 86  | 86  | 88  |                   |     | 92  |     |  |
| 27          |                      |     |     |     |                      |     |     |     | 63                   | 64  |     |     | 72                   | 72  |     |     |                      | 77  | 77  |     |                   | 82  | 82  |     |                   | 86  | 86  | 89  |                   |     |     | 93  |  |
| 33          |                      |     |     |     |                      |     |     |     | 63                   | 64  |     |     | 72                   | 73  |     |     |                      | 77  | 78  |     |                   | 82  | 82  |     |                   | 86  | 87  |     |                   |     | 91  | 93  |  |
| 39          |                      |     |     |     |                      |     |     |     | 64                   |     |     |     | 72                   | 73  |     |     |                      | 77  | 78  |     |                   | 82  | 82  |     |                   | 87  | 87  |     |                   | 91  | 91  | 94  |  |
| 47          |                      |     |     |     |                      |     |     |     |                      |     |     |     | 73                   | 74  |     |     |                      | 78  | 79  |     |                   | 82  | 83  |     |                   | 87  | 87  |     |                   | 91  | 92  |     |  |
| 56          |                      |     |     |     |                      |     |     |     |                      |     |     |     | 73                   |     |     |     |                      | 78  |     |     |                   | 83  | 83  |     |                   | 87  | 87  |     |                   | 92  | 92  |     |  |
| 68          |                      |     |     |     |                      |     |     |     |                      |     |     |     | 74                   |     |     |     |                      | 79  |     |     |                   | 83  | 84  |     |                   | 87  | 88  |     |                   | 92  | 92  |     |  |
| 82          |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     | 84                |     |     |     |                   | 88  | 88  |     |                   | 92  | 92  |     |  |
| 100         |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   | 88  | 89  |     |                   | 92  | 93  |     |  |
| 120         |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   | 89  |     |     |                   | 93  | 93  |     |  |
| 150         |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   | 93  | 94  |     |  |
| 180         |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                      |     |     |     |                   |     |     |     |                   |     |     |     |                   | 94  |     |     |  |

NB Figures in cells refer to size within ordering information

# SMPS Capacitors (RH Style)



European Preferred Styles

## RH - Surface Mount 'J' Lead Range



0.1  $\mu$ F to 10.0  $\mu$ F  
50V to 500 VDC  
-55°C to +125°C

Low ESR/ESL  
2C1/X7R Dielectric

This range of uncoated MLC capacitors are processed for input and output filter capacitors in high frequency DC-DC convertor applications above 10 Watts e.g. telecomms and instrumentation, where high volume and low cost is required. These products are available in surface mount 'J' leaded versions and can be supplied in bulk and tape/reel packaging.

## ELECTRICAL SPECIFICATIONS

**Temperature Coefficient** CECC 30 000, (4.24.1)

2C1/X7R: C Temperature Characteristic -  $\pm 15\%$ , -55°C to +125°C

**Capacitance Test**

2C1/X7R: Measured at 1 VRMS max at 1KHz

**Dissipation Factor 25°C**

2C1/X7R: 2.5% max at 1KHz, 1 VRMS max

**Insulation Resistance 25°C**

2C1/X7R: 100K megohms or 1000 megohms- $\mu$ F, whichever is less

**Dielectric Withstanding Voltage 25°C (Flash Test)**

2C1/X7R: 250% rated voltage for 5 seconds with 50 mA max charging current. (500 Volt units @ 150% rated voltage)

**Life Test** (1000 hrs) CECC 30 000 (4.23)

2C1/X7R: 200% rated voltage at +125°C.  
(500 Volt units @ 120% rated voltage)

**Thermal Shock** IEC 68.2.14

-55°C to +125°C, 5 cycles

**Resistance to Solder Heat** IEC 68.2.20

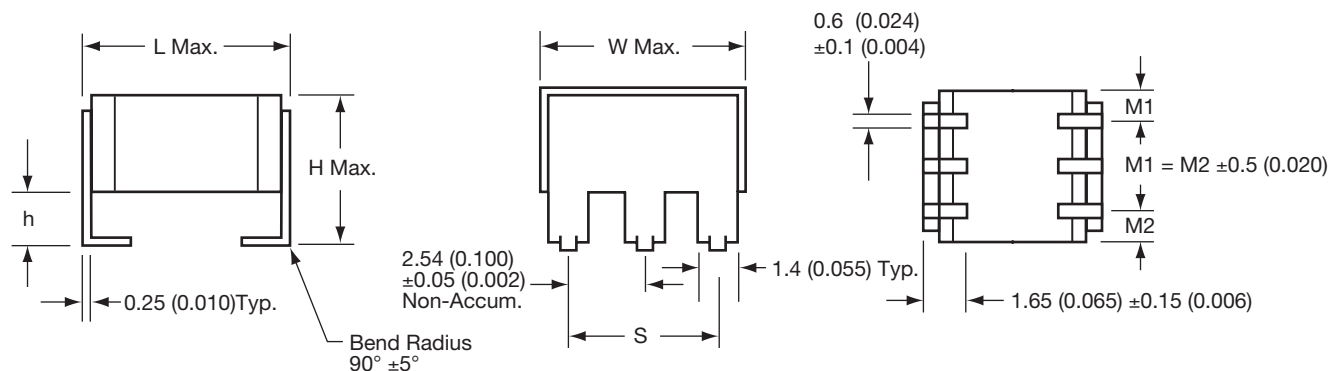
| Typical ESR (m $\Omega$ ) 3 $\mu$ F, 100V X7R |    |
|-----------------------------------------------|----|
| ESR @ 100KHz                                  | 17 |
| ESR @ 500KHz                                  | 12 |
| ESR @ 1MHz                                    | 14 |

## DIMENSIONS

millimeters (inches)

| Style | L max        | W max        | H max        | S $\pm 0.1$<br>( $\pm 0.004$ ) | h                                       | No. of leads<br>per side |
|-------|--------------|--------------|--------------|--------------------------------|-----------------------------------------|--------------------------|
| RH21  | 7.62 (0.300) | 5.40 (0.213) | 4.60 (0.181) | 2.50 (0.098)                   | 1.50 $\pm 0.30$<br>(0.059 $\pm 0.012$ ) | 2                        |
| RH22  | 7.62 (0.300) | 5.40 (0.213) | 7.50 (0.295) | 2.50 (0.098)                   | 1.50 $\pm 0.30$<br>(0.059 $\pm 0.012$ ) | 2                        |
| RH31  | 7.62 (0.300) | 7.00 (0.270) | 5.08 (0.200) | 5.08 (0.200)                   | 1.78 $\pm 0.25$<br>(0.070 $\pm 0.010$ ) | 3                        |
| RH32  | 7.62 (0.300) | 7.00 (0.270) | 8.13 (0.320) | 5.08 (0.200)                   | 1.78 $\pm 0.25$<br>(0.070 $\pm 0.010$ ) | 3                        |
| RH41  | 9.20 (0.362) | 8.70 (0.342) | 4.90 (0.192) | 5.08 (0.200)                   | 1.60 $\pm 0.10$<br>(0.062 $\pm 0.004$ ) | 3                        |
| RH42  | 9.20 (0.362) | 8.70 (0.342) | 8.20 (0.323) | 5.08 (0.200)                   | 1.60 $\pm 0.10$<br>(0.062 $\pm 0.004$ ) | 3                        |
| RH51  | 10.7 (0.421) | 10.7 (0.421) | 4.90 (0.192) | 7.62 (0.300)                   | 1.60 $\pm 0.10$<br>(0.062 $\pm 0.004$ ) | 4                        |
| RH52  | 10.7 (0.421) | 10.7 (0.421) | 8.20 (0.323) | 7.62 (0.300)                   | 1.60 $\pm 0.10$<br>(0.062 $\pm 0.004$ ) | 4                        |
| RH61  | 14.9 (0.586) | 13.6 (0.535) | 4.90 (0.192) | 10.2 (0.400)                   | 1.60 $\pm 0.10$<br>(0.062 $\pm 0.004$ ) | 5                        |
| RH62  | 14.9 (0.586) | 13.6 (0.535) | 8.20 (0.323) | 10.2 (0.400)                   | 1.60 $\pm 0.10$<br>(0.062 $\pm 0.004$ ) | 5                        |

## DIMENSIONS millimeters (inches)



# SMPS Capacitors (RH Style)

## RH - Surface Mount 'J' Lead Range



European Preferred Styles

### 2C1/X7R STABLE DIELECTRIC

|             | RH21/RH22<br>Style |     |     |     | RH31/RH32<br>Style |     |     |      | RH41/RH42<br>Style |     |     |      | RH51/RH52<br>Style |     |     |     | RH61/RH62<br>Style |     |      |     |
|-------------|--------------------|-----|-----|-----|--------------------|-----|-----|------|--------------------|-----|-----|------|--------------------|-----|-----|-----|--------------------|-----|------|-----|
| Voltage DC  |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| Cap $\mu$ F | 50                 | 100 | 200 | 500 | 50                 | 100 | 200 | 500  | 50                 | 100 | 200 | 500  | 50                 | 100 | 200 | 500 | 50                 | 100 | 200  | 500 |
| 0.047       |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.056       |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.068       |                    |     |     |     |                    |     |     | RH31 |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.082       |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.1         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.12        |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.15        |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.18        |                    |     |     |     |                    |     |     | RH32 |                    |     |     | RH41 |                    |     |     |     |                    |     |      |     |
| 0.22        |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.27        |                    |     |     |     |                    |     |     | RH31 |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.33        |                    |     |     |     |                    |     |     |      |                    |     |     | RH42 |                    |     |     |     |                    |     |      |     |
| 0.39        |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.47        |                    |     |     |     |                    |     |     |      |                    |     |     | RH41 |                    |     |     |     |                    |     | RH51 |     |
| 0.56        |                    |     |     |     |                    |     |     | RH32 |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.68        |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.78        |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 0.82        |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 1           |                    |     |     |     |                    |     |     | RH31 |                    |     |     | RH42 |                    |     |     |     |                    |     |      |     |
| 1.2         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 1.5         | RH21               |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 1.8         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 2.2         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 2.7         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 3           |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 3.3         | RH22               |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 3.9         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 4.4         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 4.7         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 5.6         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 6.8         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 8.2         |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 10          |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 12          |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 15          |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 18          |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 22          |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |
| 27          |                    |     |     |     |                    |     |     |      |                    |     |     |      |                    |     |     |     |                    |     |      |     |

For availability of further parts in the RH21/RH22 Series, contact manufacturing.

### PACKAGING

| Style | Qty/Reel 13" | Max. Qty/Waffle Pack |
|-------|--------------|----------------------|
| RH21  | see note     | 270                  |
| RH22  | see note     | 270                  |
| RH31  | 800          | 108                  |
| RH32  | 500          | 108                  |
| RH41  | 800          | 108                  |
| RH42  | see note     | 100                  |
| RH51  | 750          | 88                   |
| RH52  | see note     | 100                  |
| RH61  | 500          | 126                  |
| RH62  | see note     | 42                   |

Note: T&R is not yet available. Contact manufacturing for further information as this will be available in the future.

### HOW TO ORDER

**RH**  
|

**Style Code**  
(see table above)

**31**  
|

**Size Code**

**5**  
|

**Voltage Code**  
5 = 50V  
1 = 100V  
2 = 200V  
7 = 500V

**C**  
|

**Dielectric Code**  
C = X7R

**225**  
|

**Capacitance Code**  
(2 significant digits + no. of zeros)  
eg. 105 = 1  $\mu$ F  
104 = 0.1  $\mu$ F

**M**  
|

**Capacitance Tolerance**  
K =  $\pm$ 10%  
M =  $\pm$ 20%

**A**  
|

**Specification Code**  
A = Non customized

**3**  
|

**Package Code**  
3 = Waffle Pack  
A = Tape & Reel

**0**  
|

**Lead Dia. Code**  
0 = Standard

**A**  
|

**Lead Space Code**  
A = Standard

**3**  
|

**Lead Style Code**  
3 = 'J' Lead

# SMPS Capacitors

## Assembly Guidelines

### Reliability

AVX has been involved in numerous military and customer High Reliability programs for over 40 years.

Reliability [% Failure Rate (FR%) or Mean Time Between Failure (MTBF)] is based on the number of failures and the cumulative test hours expanded by test versus use acceleration factors. The acceleration factors are calculated according to the following relationships:

$$\text{Temperature Acceleration} = 10^{\left(\frac{T_T - T_U}{25}\right)}$$

Where:  
 $T_T$  = test temp. (°C)  
 $T_U$  = use temp. (°C)

$$\text{Voltage Acceleration} = \left(\frac{V_T}{V_U}\right)^3$$

Where:  
 $V_T$  = test voltage  
 $V_U$  = use voltage

Military Reliability levels are usually expressed in terms of rated conditions versus test conditions (generally 125°C and 2X WVDC). If actual conditions are less than rated, the reliability levels will improve significantly over rated and can be calculated by use of the above relationship for determining accelerated test hours. For example, if the actual use conditions were 75°C and 1/2 WVDC rating for a 125°C rated part, the acceleration factors are 64X for voltage and 100X for temperature. Reliabilities based on current testing can be obtained by contacting AVX.

### General Processing Guidelines

#### Soldering

The SM styles capacitors are generally quite large relative to other types of MLC capacitors. As a result of the size, precautions must be taken before subjecting the parts to any soldering operation in order to prevent thermal shock. Preheat prior to soldering is essential. The heating rate of the SupraCap® ceramic bodies during preheat must not exceed 4°C/second. The preheat temperature must be within 50°C of the peak temperature reached by the ceramic bodies, adjacent to lead material, through the soldering process. The leads are attached to the chip stack with 10 / 88 / 2 (Sn / Pb / Ag, Solidus 268°C, Liquidus 290°C).

### Vibration Specifications\*

Due to the weight of the SupraCap® and the size and strength of the lead frame used, when the SupraCap® is to be used in an application where it will undergo high frequency vibration, we strongly recommend using our potted SM9 styles SupraCap®.

If other DIP styles SupraCap® are to be used in a high frequency vibration environment, the SupraCap® should be supported in some way to prevent oscillation of the capacitor assembly which will result in lead breakage. If "strapping" the SupraCap® to the board is the chosen method of support, care should be taken not to chip the ceramic or apply undue pressure so that cracking of the ceramic results.

If bonding the SupraCap® to the board with adhesive, consideration of the CTE (coefficient of thermal expansion) is necessary. A mismatch between the CTE of the ceramic and adhesive can cause the ceramic to crack during temperature cycles.

### Processing Guidelines\*

There are practical size limitations for MLCs which prohibit reliable direct mounting of chip capacitors larger than 2225 (.22" x .25") to a substrate. These large chips are subject to thermal shock cracking and thermal cycling solder joint fatigue. Even 1812 (.18" x .12") and 2225 chip capacitors will have solder joint failures due to mechanical fatigue after ≈ 1500 thermal cycles from 0 to 85°C on FR4 and ≈ 3000 cycles on alumina from -55 to 125°C. This is due to differences in the Coefficient of Thermal Expansion (CTE) between MLCs and substrate materials used in hybrids and surface mount assemblies. Materials used in the manufacture of all electronic components and substrates have wide ranges of CTEs as shown in Table 1.

**Table 1**

**CTEs of Typical Components and Substrates**

| Material                              | CTE (ppm/°C) |
|---------------------------------------|--------------|
| Alloy 42                              | 5.3          |
| Alumina                               | ~7           |
| Barium Titanate Capacitor Body        | 10-12        |
| Copper                                | 17.6         |
| Copper Clad Invar                     | 6-7          |
| Filled Epoxy Resin (<T <sub>g</sub> ) | 18-25        |
| FR4/G-10 PC Board (X, Y)              | ~18          |
| Nickel or Steel                       | 15           |
| Polyimide/Glass PCB (X, Y)            | ~12          |
| Polyimide/Kevlar PCB (X, Y)           | ~7           |
| Tantalum                              | 6.5          |
| Tin Lead Alloys                       | ~27          |

### Linear Displacement

This CTE difference translates into mechanical stress that is due to the linear displacement of substrate and component. Linear displacement is a function of ΔCTE (CTE<sub>sub</sub> – CTE<sub>comp</sub>) and the overall length of the component. Long components/ substrates have large linear displacements even with a small ΔCTE which will cause high stress in the solder joints and fatigue after a few temperature cycles. Figure 1 shows linear displacement for conditions where ΔCTE is positive and negative.

\* Reference AVX Technical Information paper, "Processing Guidelines for SMPS Capacitors."

# SMPS Capacitors

## Assembly Guidelines

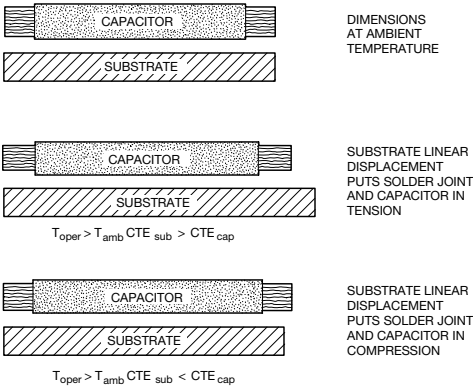


Figure 1. Linear Displacement Between Component and Substrate

## General Processing Guidelines

Figure 2 shows the location of maximum stress in the solder joint due to positive and negative DCTE and linear displacement.



Figure 2

## Stress Relief

Leadframes on larger capacitor sizes (greater than 2225) must be used to minimize mechanical stress on the solder joints during temperature cycling which is normal operation for power supplies (Figure 3). Failing solder joints increase both ESR and ESL causing an increase in ripple, noise and heat, accelerating failure.

## Layout

Effective solder dams must be used to keep all molten solder on the solder lands during reflow or solder will migrate away from the land, causing opens or weak solder joints. High frequency output filters cannot use low power layout techniques such as necked down conductors because of the stringent inductance requirements.

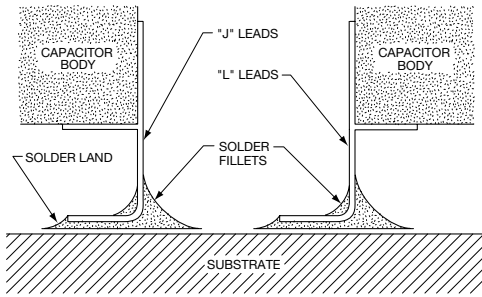


Figure 3. "J" and "L" Leadframes Mounted on Capacitors to Relieve Stress

## Inductance

Adding leadframes has a small impact on component inductance but this is the price that must be paid for reliable operation over temperature. Figure 4 shows typical leadframe inductance that is added for two lead standoff distances (0.020" and 0.050") versus the number of leads along one side of SupraCap® which are specifically designed output filter capacitors for 1 MHz and above switchers. The actual inductance will be somewhat less because the leadframes flare out from the lead where the leadframe is attached to the capacitor body.

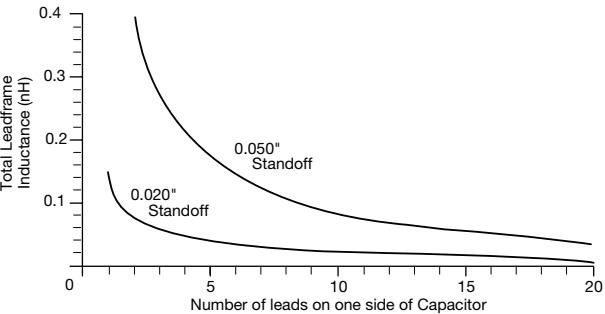


Figure 4. Number of Leads on One Side of Capacitor vs. Total Leadframe Inductance vs. Substrate Standoff Height

Very high frequency switch mode power supplies place tremendous restrictions on output filter capacitors. In addition to handling high ripple current (low ESR), ESL must approach zero nano henrys, part must be truly surface mountable and be available in new configurations to be integrated into transmission lines to further reduce inductance with load currents greater than 40A at 1 MHz and as frequencies move above 1-2 MHz.

The total inductance is the sum of each side of the part where the inductance of one side is the parallel combination of each lead in the leadframe. That inductance is given by:

$$L \text{ (nH)} = 5 \times \ell [\ln(2 \times \ell) / (B+C) + 1/2]$$

Where  $\ell$  = lead length in inches

$\ln$  = natural log

$B+C$  = lead cross section in inches

so  $L_1 \text{ (nH)} = 2 \times L \text{ (nH)}$  where  $L_1$  is the total inductance of the leadframe.

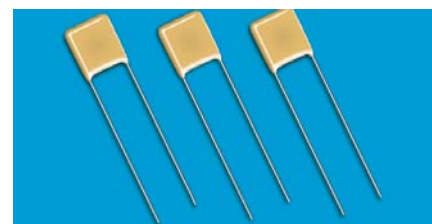
# SMPS Capacitors (SK Style)



## Commercial Radial Range

### PRODUCT OFFERING – C0G, X7R AND Z5U

AVX SK styles are conformally coated MLC capacitors for input or output filtering in switch mode power supplies. They are specially processed to handle high currents and are low enough in cost for commercial SMPS application.



### ELECTRICAL SPECIFICATIONS

#### Temperature Coefficient

C0G: A Temperature Coefficient -  $0 \pm 30$  ppm/°C, -55° to +125°C

X7R: C Temperature Coefficient -  $\pm 15\%$ , -55° to +125°C

Z5U: E Temperature Coefficient - +22, -56%, +10° to +85°C

#### Capacitance Test (MIL-STD-202 Method 305)

C0G: 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

X7R: 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

Z5U: 25°C, 0.5 Vrms max (open circuit voltage) at 1KHz

#### Dissipation Factor 25°C

C0G: 0.15% Max @ 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

X7R: 2.5% Max @ 25°C,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

Z5U: 3.0% Max @ 25°C, 0.5 Vrms max (open circuit voltage) at 1KHz

#### Insulation Resistance 25°C (MIL-STD-202 Method 302)

C0G and X7R: 100K M $\Omega$  or 1000 M $\Omega$ - $\mu$ F, whichever is less.

Z5U: 10K M $\Omega$  or 1000 M $\Omega$ - $\mu$ F, whichever is less.

#### Insulation Resistance 125°C (MIL-STD-202 Method 302)

C0G and X7R: 10K M $\Omega$  or 100 M $\Omega$ - $\mu$ F, whichever is less.

Z5U: 1K M $\Omega$  or 100 M $\Omega$ - $\mu$ F, whichever is less.

#### Dielectric Withstanding Voltage 25°C (Flash Test)

C0G and X7R: 250% rated voltage for 5 seconds with 50 mA max charging current. (500 Volt units @ 750 VDC)

Z5U: 200% rated voltage for 5 seconds with 50 mA max charging current.

#### Life Test (1000 hrs)

C0G and X7R: 200% rated voltage at +125°C. (500 Volt units @ 600 VDC)

Z5U: 150% rated voltage at +85°C

#### Moisture Resistance (MIL-STD-202 Method 106)

C0G, X7R, Z5U: Ten cycles with no voltage applied.

#### Thermal Shock (MIL-STD-202 Method 107, Condition A)

#### Immersion Cycling (MIL-STD-202 Method 104, Condition B)

#### Resistance To Solder Heat (MIL-STD-202, Method 210, Condition B, for 20 seconds)

### HOW TO ORDER

| SK                                                                                                                                                                                                                   | 01              | 3                                                      | E                             | 125                                                                                                          | Z                                                                                                                                                             | A                           | A         | *            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------------------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------|--------------|
| Style                                                                                                                                                                                                                | Size            | Voltage                                                | Temperature Coefficient       | Capacitance Code                                                                                             | Capacitance Tolerance                                                                                                                                         | Test Level                  | Leads     | Packaging    |
|                                                                                                                                                                                                                      | See chart below | 25V = 3<br>50V = 5<br>100V = 1<br>200V = 2<br>500V = 7 | Z5U = E<br>X7R = C<br>C0G = A | (2 significant digits + no. of zeros)<br>22 nF = 223<br>220 nF = 224<br>1 $\mu$ F = 105<br>100 $\mu$ F = 107 | C0G: J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>X7R: K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = +80, -20%<br>Z5U: Z = +80, -20%<br>P = GMV (+100, -0%) | A = Standard<br>B = Hi-Rel* | A = Leads | (See Note 1) |
| <b>Note 1:</b> No suffix signifies bulk packaging, which is AVX standard packaging. SK01, SK*3, SK*4, SK*5, SK*6, SK*9 & SK*0 are available taped and reel per EIA-468. Use suffix "TR1" if tape & reel is required. |                 |                                                        |                               |                                                                                                              |                                                                                                                                                               |                             |           |              |

Note: Capacitors with X7R and Z5U dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations.

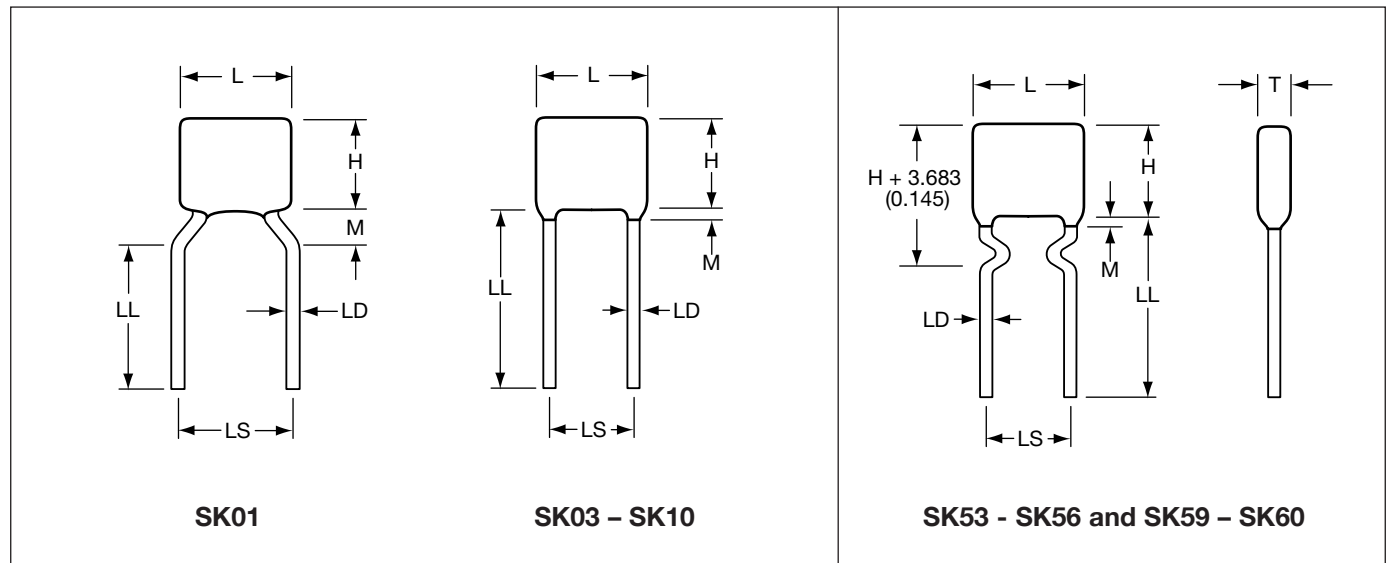
\*Hi-Rel screening for C0G and X7R only. Screening consists of 100% Group A (B Level), Subgroup 1 per MIL-PRF-49470.

| TAPE & REEL QUANTITY |        |
|----------------------|--------|
| Part                 | Pieces |
| SK01                 | 2000   |
| SK03/SK53            | 1000   |
| SK04/SK54            | 1000   |
| SK05/SK55            | 500    |
| SK06/SK56            | 500    |
| SK09/SK59            | 500    |
| SK10/SK60            | 400    |

# SMPS Capacitors (SK Style)



## Product Offering – C0G, X7R and Z5U



### C0G Capacitance Range (μF)

| Style     | 25 WVDC<br>min./max. | 50 WVDC<br>min./max. | 100 WVDC<br>min./max. | 200 WVDC<br>min./max. | 500 WVDC<br>min./max. |
|-----------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|
| SK01      | .001/0.015           | .001/0.012           | .001/0.010            | .0010/0.0056          | .0010/0.0018          |
| SK03/SK53 | .01/0.056            | .01/0.047            | .01/0.039             | .001/0.022            | .001/0.0068           |
| SK04/SK54 | .01/0.12             | .01/0.10             | .01/0.082             | .01/0.047             | .001/0.015            |
| SK05/SK55 | .01/0.18             | .01/0.15             | .01/0.12              | .01/0.068             | .001/0.022            |
| SK06/SK56 | .10/0.56             | .01/0.47             | .01/0.39              | .01/0.22              | .01/0.068             |
| SK07      | .10/0.68             | .01/0.56             | .01/0.47              | .01/0.27              | .01/0.082             |
| SK08      | .82/1.20             | .68/1.10             | .56/0.82              | .33/0.47              | .10/0.15              |
| SK09/SK59 | .10/0.27             | .01/0.22             | .01/0.18              | .01/0.10              | .001/0.039            |
| SK10/SK60 | .10/0.68             | .01/0.56             | .01/0.47              | .01/0.27              | .01/0.082             |

### X7R Capacitance Range (μF)

| Style     | 25 WVDC<br>min./max. | 50 WVDC<br>min./max. | 100 WVDC<br>min./max. | 200 WVDC<br>min./max. | 500 WVDC<br>min./max. |
|-----------|----------------------|----------------------|-----------------------|-----------------------|-----------------------|
| SK01      | .01/0.39             | .01/0.33             | .01/0.27              | .01/0.12              | .001/0.033            |
| SK03/SK53 | .10/2.2              | .10/1.8              | .01/1.5               | .01/0.56              | .01/0.18              |
| SK04/SK54 | .10/4.7              | .10/3.3              | .10/2.7               | .01/1.0               | .01/0.33              |
| SK05/SK55 | .10/6.8              | .10/5.6              | .10/3.9               | .10/1.8               | .01/0.56              |
| SK06/SK56 | 1.0/15               | 1.0/10               | .10/5.6               | .10/3.9               | .10/1.2               |
| SK07      | 1.0/18               | 1.0/14               | 1.0/8.2               | .10/4.7               | .10/1.8               |
| SK08      | 22/33                | 15/22                | 10/15                 | 5.6/8.2               | 2.2/3.3               |
| SK09/SK59 | .10/8.2              | .10/5.6              | .10/3.3               | .10/2.2               | .10/1.0               |
| SK10/SK60 | 1.0/18               | 1.0/12               | .10/6.8               | .10/4.7               | .10/1.5               |

### Z5U Capacitance Range (μF)

| Style     | 25 WVDC<br>min./max. | 50 WVDC<br>min./max. | 100 WVDC<br>min./max. | 200 WVDC<br>min./max. |
|-----------|----------------------|----------------------|-----------------------|-----------------------|
| SK01      | .10/1.2              | .10/0.82             | .10/0.47              | .10/0.33              |
| SK03/SK53 | .10/5.6              | .10/3.30             | .10/2.20              | .10/1.50              |
| SK04/SK54 | 1.0/10.0             | 1.0/8.20             | .10/4.70              | .10/3.30              |
| SK05/SK55 | 1.0/18.0             | 1.0/10.00            | 1.0/6.80              | .10/4.70              |
| SK06/SK56 | 1.0/47.0             | 1.0/39.00            | 1.0/22.00             | 1.0/15.00             |
| SK07      | 1.0/68.0             | 1.0/47.00            | 1.0/27.00             | 1.0/18.00             |
| SK08      | 82/120.0             | 56/100.00            | 33/47.00              | 22/33.00              |
| SK09/SK59 | 1.0/27.0             | 1.0/18.00            | 1.0/10.00             | 1.0/6.80              |
| SK10/SK60 | 1.0/56.0             | 1.0/39.00            | 1.0/22.00             | 1.0/18.00             |

## DIMENSIONS

millimeters (inches)

| Style                                                                                                                                                                                                                      | L (max.)     | H (max.)     | T (max.)     | LS (nom.)    | LD (nom.)     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|--------------|--------------|---------------|
| SK01                                                                                                                                                                                                                       | 5.08 (0.200) | 5.08 (0.200) | 5.08 (0.200) | 5.08 (0.200) | 0.508 (0.020) |
| SK03/SK53                                                                                                                                                                                                                  | 7.62 (0.300) | 7.62 (0.300) | 5.08 (0.200) | 5.08 (0.200) | 0.508 (0.020) |
| SK04/SK54                                                                                                                                                                                                                  | 10.2 (0.400) | 10.2 (0.400) | 5.08 (0.200) | 5.08 (0.200) | 0.508 (0.020) |
| SK05/SK55                                                                                                                                                                                                                  | 12.7 (0.500) | 12.7 (0.500) | 5.08 (0.200) | 10.2 (0.400) | 0.635 (0.025) |
| SK06/SK56                                                                                                                                                                                                                  | 22.1 (0.870) | 15.2 (0.600) | 5.08 (0.200) | 20.1 (0.790) | 0.813 (0.032) |
| SK07                                                                                                                                                                                                                       | 27.9 (1.100) | 15.2 (0.600) | 5.08 (0.200) | 24.9 (0.980) | 0.813 (0.032) |
| SK08                                                                                                                                                                                                                       | 27.9 (1.100) | 15.2 (0.600) | 8.89 (0.350) | 24.9 (0.980) | 0.813 (0.032) |
| SK09/SK59                                                                                                                                                                                                                  | 17.0 (0.670) | 13.7 (0.540) | 5.08 (0.200) | 14.6 (0.575) | 0.635 (0.025) |
| SK10/SK60                                                                                                                                                                                                                  | 23.6 (0.930) | 18.3 (0.720) | 6.35 (0.250) | 20.3 (0.800) | 0.813 (0.032) |
| L = Length<br>H = Height<br>T = Thickness<br>M = Meniscus 1.52 (0.060) max.<br>LS = Lead Spacing Nominal ±.787 (0.031)<br>LL = Lead Length 50.8 (2.000) max./25.4 (1.000) min.<br>LD = Lead Diameter Nominal ±.050 (0.002) |              |              |              |              |               |



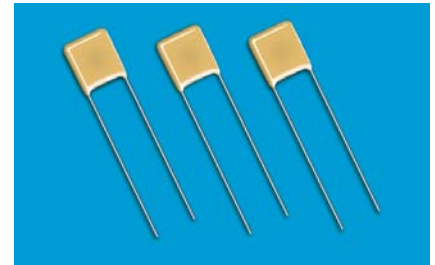
# SMPS Capacitors (SE Style)



## Extended Commercial Radial Range

### PRODUCT OFFERING – X7R

AVX SE styles offer capacitance extension to popular SK ranges. The CV product for SE-series, X7R capacitors (TCC:  $\pm 15\%$  over  $-55$  to  $+125^\circ\text{C}$ ) compares favorably to high CV ranges offered by other suppliers in much less stable Y5U dielectric (TCC:  $+22/-56\%$  over  $-30$  to  $+85^\circ\text{C}$ ). SE style capacitors are conformally coated and are designed for input and output filtering applications in switch mode power supplies.



### ELECTRICAL SPECIFICATIONS

#### Temperature Coefficient

X7R: Temperature Coefficient  $\pm 15\%$ ,  $-55^\circ$  to  $+125^\circ\text{C}$

#### Capacitance Test (MIL-STD-202 Method 305)

X7R:  $25^\circ\text{C}$ ,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

#### Dissipation Factor $25^\circ\text{C}$

X7R: 2.5% Max @  $25^\circ\text{C}$ ,  $1.0 \pm 0.2$  Vrms (open circuit voltage) at 1KHz

#### Insulation Resistance $25^\circ\text{C}$ (MIL-STD-202 Method 302)

X7R: 100K M $\Omega$  or 1000 M $\Omega$ - $\mu\text{F}$ , whichever is less.

#### Insulation Resistance $125^\circ\text{C}$ (MIL-STD-202 Method 302)

X7R: 10K M $\Omega$  or 100 M $\Omega$ - $\mu\text{F}$ , whichever is less.

#### Dielectric Withstanding Voltage $25^\circ\text{C}$ (Flash Test)

X7R: 250% rated voltage for 5 seconds with 50 mA max charging current.

#### Life Test (1000 hrs)

X7R: 200% rated voltage at  $+125^\circ\text{C}$

#### Moisture Resistance (MIL-STD-202 Method 106)

X7R: Ten cycles with no voltage applied.

#### Thermal Shock (MIL-STD-202 Method 107, Condition A)

#### Immersion Cycling (MIL-STD-202 Method 104, Condition B)

#### Resistance To Solder Heat (MIL-STD-202, Method 210, Condition B, for 20 seconds)

### HOW TO ORDER

| SE    | 01                      | 3                                         | C                                  | 125                                                                                                                                          | M                                                                                  | A                                         | A                  | *                         |
|-------|-------------------------|-------------------------------------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------|--------------------|---------------------------|
| Style | Size<br>See chart below | Voltage<br>25V = 3<br>50V = 5<br>100V = 1 | Temperature Coefficient<br>X7R = C | Capacitance Code<br>(2 significant digits + no. of zeros)<br>22 nF = 223<br>220 nF = 224<br>1 $\mu\text{F}$ = 105<br>100 $\mu\text{F}$ = 107 | Capacitance Tolerance<br>X7R: K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = $+80, -20\%$ | Test Level<br>A = Standard<br>B = Hi-Rel* | Leads<br>A = Leads | Packaging<br>(See Note 1) |

**Note 1:** No suffix signifies bulk packaging, which is AVX standard packaging. Parts available tape and reel per EIA-468. Use suffix "TR1" if tape & reel is required.

Note: Capacitors with X7R dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations.

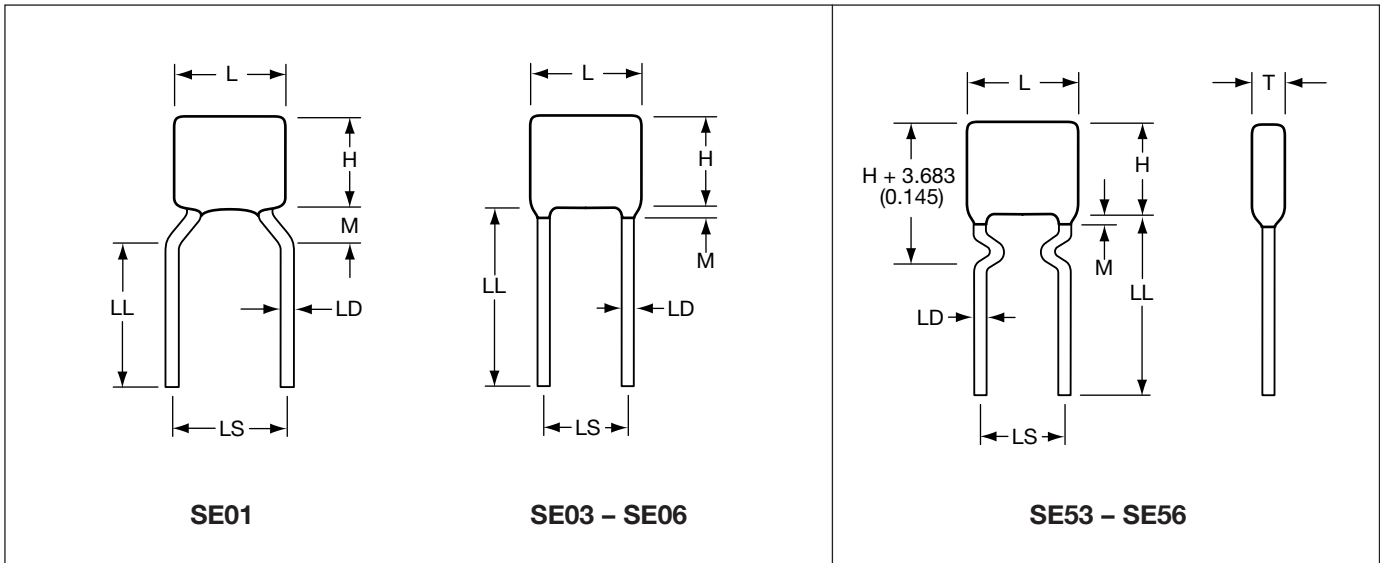
\*Hi-Rel screening consists of 100% Group A, Subgroup 1 per MIL-PRF-39014.

| TAPE & REEL QUANTITY |        |
|----------------------|--------|
| Part                 | Pieces |
| SE01                 | 2000   |
| SE03/SE53            | 1000   |
| SE04/SE54            | 1000   |
| SE05/SE55            | 500    |

# SMPS Capacitors (SE Style)



## Product Offering – X7R



### X7R Capacitance Range (μF)

| Style     | 25 WVDC<br>min./max. | 50 WVDC<br>min./max. | 100 WVDC<br>min./max. |
|-----------|----------------------|----------------------|-----------------------|
| SE01      | 0.47/1.5             | 0.39/1.0             | 0.33/0.68             |
| SE03/SE53 | 2.7/6.8              | 2.2/4.7              | 1.8/3.3               |
| SE04/SE54 | 5.6/12               | 3.9/10               | 3.3/6.8               |
| SE05/SE55 | 8.2/18               | 6.8/12               | 4.7/8.2               |
| SE06/SE56 | 18/39                | 12/27                | 6.8/15                |

### DIMENSIONS

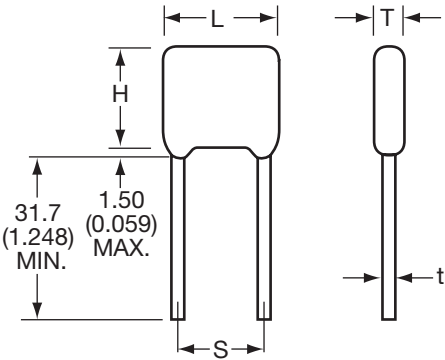
millimeters (inches)

| Style                                                                                                                                                                                                                                  | L (max.)     | H (max.)     | T (max.)     | LS (nom.)    | LD (nom.)     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------|--------------|--------------|---------------|
| SE01                                                                                                                                                                                                                                   | 5.08 (0.200) | 5.08 (0.200) | 5.08 (0.200) | 5.08 (0.200) | 0.508 (0.020) |
| SE03/SE53                                                                                                                                                                                                                              | 7.62 (0.300) | 7.62 (0.300) | 5.08 (0.200) | 5.08 (0.200) | 0.508 (0.020) |
| SE04/SE54                                                                                                                                                                                                                              | 10.2 (0.400) | 10.2 (0.400) | 5.08 (0.200) | 5.08 (0.200) | 0.508 (0.020) |
| SE05/SE55                                                                                                                                                                                                                              | 12.7 (0.500) | 12.7 (0.500) | 5.08 (0.200) | 10.2 (0.400) | 0.635 (0.025) |
| SE06/SE56                                                                                                                                                                                                                              | 22.1 (0.870) | 15.2 (0.600) | 5.08 (0.200) | 20.1 (0.790) | 0.813 (0.032) |
| L = Length<br>H = Height<br>T = Thickness<br>M = Meniscus 1.52 (0.060) max.<br>LS = Lead Spacing Nominal $\pm 0.787$ (0.031)<br>LL = Lead Length 50.8 (2.000) max./25.4 (1.000 min.)<br>LD = Lead Diameter Nominal $\pm 0.050$ (0.002) |              |              |              |              |               |

# SMPS Capacitors (CECC Offering)



European Preferred Styles



## DIMENSIONS

millimeters (inches)

| Size Code | Length (L)<br>(max.) | Height (H)<br>(max.) | Thickness (T)<br>(max.) | Nom (t)      | S ±0.4        |
|-----------|----------------------|----------------------|-------------------------|--------------|---------------|
| BR40      | 10.16 (0.400)        | 11.7 (0.460)         | 3.81 (0.150)            | 0.51 (0.020) | 5.08 (0.200)  |
| BR50      | 12.7 (0.500)         | 12.7 (0.500)         | 5.1 (0.200)             | 0.64 (0.025) | 10.16 (0.400) |
| BR84      | 23.6 (0.930)         | 17.78 (0.700)        | 6.35 (0.250)            | 0.76 (0.030) | 20.32 (0.800) |

## CECC APPROVED RANGE

|      | 1B/C0G<br>CECC 30 601 801 Issue 1 |         |         |         | 2C1/X7R<br>CECC 30 701 801 Issue 1 |         |         |         |
|------|-----------------------------------|---------|---------|---------|------------------------------------|---------|---------|---------|
|      | 50V                               | 100V    | 200V    | 500V    | 50V                                | 100V    | 200V    | 500V    |
| BR40 | 683-104                           | 473-683 | 333-473 | 4R5-153 | 185-275                            | 125-185 | 334-474 | 473-154 |
| BR50 | 124-224                           | 104-154 | 683-104 | 820-333 | 395-475                            | 225-395 | 684-105 | 104-394 |
| BR84 | 104-564                           | 104-474 | 104-334 | 223-104 | 475-186                            | 475-156 | 105-335 | 474-155 |

## HOW TO ORDER

**BR**

Style  
Code

**84**

Size  
Code  
See  
table  
above

**1**

Voltage  
Code  
5 = 50V  
1 = 100V  
2 = 200V  
7 = 500V

**C**

Dielectric  
Code  
A = C0G  
C = X7R

**156**

Capacitance  
Code  
(2 significant  
digits + no.  
of zeros)

**K**

Capacitance  
Tolerance  
G = ±2%  
C0G only  
J = ±5%  
C0G only  
K = ±10%  
M = ±20%  
P = -0 +100%

**T**

Specification  
Code  
T = CECC

**A**

Lead Length  
Code  
A = 31.7mm min.

Note: If tape and reel is required, add TR to the end of the part number



# ESA Qualified SMPS Capacitors



## High Voltage Chip/Leaded Capacitors

### HIGH VOLTAGE CHIP CAPACITORS

Capacitors, Fixed, Chip, Ceramic Dielectric, Type II, High Voltage, Based on Styles 1812 and 1825 for use in ESA space programs, according to ESA/ SCC Generic Specification 3009 and associated Detail Specification 3009/034 as recommended by the Space Components Coordination Group. (ranges in table below)

Note: Variants 01 to 12: metallized pads

| Size | Variant | Rated Voltage (kV) | Tolerance (%) | Capacitance Code (E12) |
|------|---------|--------------------|---------------|------------------------|
| 1812 | 01      | 1.0                | $\pm 10$      | 392 - 223              |
|      | 02      |                    | $\pm 20$      |                        |
|      | 03      |                    | $\pm 10$      |                        |
|      | 04      | 2.0                | $\pm 10$      | 152 - 182              |
|      | 05      |                    | $\pm 20$      |                        |
|      | 06      |                    | $\pm 10$      |                        |
| 1825 | 07      | 1.0                | $\pm 10$      | 273 - 563              |
|      | 08      |                    | $\pm 20$      |                        |
|      | 09      |                    | $\pm 10$      |                        |
|      | 10      | 2.0                | $\pm 10$      | 222 - 682              |
|      | 11      |                    | $\pm 20$      |                        |
|      | 12      |                    | $\pm 10$      |                        |



### HOW TO ORDER

Parts should be ordered using the ESA variant number as follows:

**3009034**

Detail Spec Number

**XX**

Type Variant  
(per table)

**B**

Test Level

C = Standard test level  
B = Level C plus serialized and capacitance recorded before and after 100% burn-in.

**XXX**

Capacitance Code

The first two digits represent significant figures and the third digit specifies the number of zeros to follow; i.e.  
102 = 1000pF  
103 = 10000pF

Eg 300903401C223

### HIGH VOLTAGE LEADED CAPACITORS

Capacitors, Fixed, Ceramic Dielectric, Type II, High Voltage, 1.0 to 5.0 kV, Based on Case Styles VR, CV and CH for use in ESA space programs, according to ESA/SCC Generic Specification 3001 and associated Detail Specification 3001/034 as recommended by the Space Components Coordination Group. (ranges in table)

Note 1: Lead Types

- a - Leaded Radial (epoxy coated)
- b - Leaded Radial (Polyurethane Varnish)
- c - Straight Dual in Line
- d - L Dual in Line

Note 2: Tolerances of  $\pm 10\%$  and  $\pm 20\%$  are available

| Case Size | Variant | Lead Type | Capacitance Code (E12) |           |           |           |           |
|-----------|---------|-----------|------------------------|-----------|-----------|-----------|-----------|
|           |         |           | 1.0kV                  | 2.0kV     | 3.0kV     | 4.0kV     | 5.0kV     |
| VR30S     | 01      | a         | 392 - 203              | 152 - 182 | 821 - 102 |           |           |
| VR30      | 02      | a         | 273 - 563              | 222 - 682 | 821 - 392 |           |           |
| VR40      | 03      | a         | 473 - 124              | 822 - 153 | 472 - 103 | 182 - 222 |           |
| VR50      | 04      | a         | 154 - 274              | 183 - 333 | 123 - 183 | 562 - 822 | 332 - 392 |
| VR66      | 05      | a         | 224 - 564              | 393 - 823 | 223 - 393 | 103 - 153 | 682 - 103 |
| VR84      | 06      | a         | 684 - 105              | 473 - 154 | 473 - 683 | 183 - 393 | 123 - 183 |
| VR90      | 07      | a         | 125 - 275              | 184 - 334 | 823 - 184 | 473 - 124 | 223 - 563 |
| CV41      | 08      | b         | 473 - 124              | 822 - 153 | 472 - 103 | 182 - 222 |           |
| CH41      | 09      | c         | 473 - 124              | 822 - 153 | 472 - 103 | 182 - 222 |           |
| CH41      | 10      | d         | 473 - 124              | 822 - 153 | 472 - 103 | 182 - 222 |           |
| CV51      | 11      | b         | 154 - 274              | 183 - 333 | 123 - 183 | 562 - 822 | 332 - 392 |
| CH51      | 12      | c         | 154 - 274              | 183 - 333 | 123 - 183 | 562 - 822 | 332 - 392 |
| CH51      | 13      | d         | 154 - 274              | 183 - 333 | 123 - 183 | 562 - 822 | 332 - 392 |
| CV61      | 14      | b         | 224 - 564              | 393 - 823 | 223 - 393 | 103 - 153 | 682 - 103 |
| CH61      | 15      | c         | 224 - 564              | 393 - 823 | 223 - 393 | 103 - 153 | 682 - 103 |
| CH61      | 16      | d         | 224 - 564              | 393 - 823 | 223 - 393 | 103 - 153 | 682 - 103 |
| CV76      | 17      | b         | 684 - 105              | 473 - 154 | 473 - 683 | 183 - 393 | 123 - 183 |
| CH76      | 18      | c         | 684 - 105              | 473 - 154 | 473 - 683 | 183 - 393 | 123 - 183 |
| CH76      | 19      | d         | 684 - 105              | 473 - 154 | 473 - 683 | 183 - 393 | 123 - 183 |
| CV91      | 20      | b         | 125 - 275              | 184 - 334 | 823 - 184 | 473 - 124 | 223 - 563 |
| CH91      | 21      | c         | 125 - 275              | 184 - 334 | 823 - 184 | 473 - 124 | 223 - 563 |
| CH91      | 22      | d         | 125 - 275              | 184 - 334 | 823 - 184 | 473 - 124 | 223 - 563 |

### HOW TO ORDER

Parts should be ordered using the ESA variant number as follows:

**3001034**

Detail Spec Number

**XX**

Type Variant  
(per table above)

**B**

Test Level

C = Standard test level  
B = Level C plus serialized and capacitance recorded before and after 100% burn-in.

**XXX**

Capacitance Code

The first two digits represent significant figures and the third digit specifies the number of zeros to follow; i.e.  
102 = 1000pF  
103 = 10000pF

**K**

Capacitance Tolerance  
K = 10%  
M = 20%

**X**

Voltage  
M = 1kV  
P = 2kV  
R = 3kV  
S = 4kV  
Z = 5kV

Eg 300103412C274KM

# ESA Qualified SMPS Capacitors



European Preferred Styles

## High Capacitance

### HIGH CAPACITANCE LEADED CAPACITORS

Capacitors, Fixed, Ceramic Dielectric, Type II, High Capacitance, Based on Case Styles BR, CV and CH for use in ESA space programs, according to ESA/SCC Generic Specification 3001 and associated Detail Specification 3001/030 as recommended by the Space Components Coordination Group. (see ranges in table below)

Note 1: Lead Types

- a - Leaded Radial (epoxy coated)
- b - Leaded Radial (Polyurethane Varnish)
- c - Straight Dual in Line
- d - L Dual in Line

Note 2: Tolerances of  $\pm 10\%$  and  $\pm 20\%$  are available

| Case Size | Variant | Figure | Capacitance Code (E12) |           |           |           |
|-----------|---------|--------|------------------------|-----------|-----------|-----------|
|           |         |        | 50V                    | 100V      | 200V      | 500V      |
| BR40      | 01      | a      | 185 - 335              | 125 - 395 | 334 - 564 | 124 - 224 |
| BR50      | 02      | a      | 395 - 565              | 225 - 395 | 684 - 105 | 274 - 394 |
| BR66      | 03      | a      | 685 - 106              | 475 - 825 | 105 - 225 | 474 - 105 |
| BR72      | 04      | a      | 126 - 186              | 825 - 156 | 225 - 335 | 824 - 155 |
| BR84      | 05      | a      | 126 - 186              | 825 - 156 | 225 - 335 | 824 - 155 |
| CV41      | 06      | b      | 185 - 335              | 125 - 275 | 334 - 564 | 124 - 224 |
| CH41      | 07      | c      | 185 - 335              | 125 - 275 | 334 - 564 | 124 - 224 |
| CH41      | 08      | d      | 185 - 335              | 125 - 275 | 334 - 564 | 124 - 224 |
| CH42      | 09      | c      | 395 - 565              | 225 - 395 | 684 - 105 | 274 - 394 |
| CH42      | 10      | d      | 395 - 565              | 225 - 395 | 684 - 105 | 274 - 394 |
| CH43      | 11      | c      | 825 - 106              | 685 - 825 | 155 - 185 | 564 - 684 |
| CH43      | 12      | d      | 825 - 106              | 685 - 825 | 155 - 185 | 564 - 684 |
| CH44      | 13      | c      | 126                    | 106       | 225       | 824 - 105 |
| CH44      | 14      | d      | 126                    | 106       | 225       | 824 - 105 |
| CV51      | 15      | b      | 395 - 565              | 225 - 395 | 684 - 105 | 274 - 394 |
| CH51      | 16      | c      | 395 - 565              | 225 - 395 | 684 - 105 | 274 - 394 |
| CH51      | 17      | d      | 395 - 565              | 225 - 395 | 684 - 105 | 274 - 394 |
| CH52      | 18      | c      | 685 - 106              | 475 - 825 | 125 - 225 | 474 - 824 |
| CH52      | 19      | d      | 685 - 106              | 475 - 825 | 125 - 225 | 474 - 824 |
| CH53      | 20      | c      | 126 - 156              | 106 - 126 | 275 - 335 | 105 - 125 |
| CH53      | 21      | d      | 126 - 156              | 106 - 126 | 275 - 335 | 105 - 125 |
| CH54      | 22      | c      | 186 - 226              | 156       | 395       | 155       |
| CH54      | 23      | d      | 186 - 226              | 156       | 395       | 155       |
| CV61      | 24      | b      | 685 - 106              | 475 - 825 | 105 - 225 | 474 - 105 |
| CH61      | 25      | c      | 685 - 106              | 475 - 825 | 105 - 225 | 474 - 105 |
| CH61      | 26      | d      | 685 - 106              | 475 - 825 | 105 - 225 | 474 - 105 |
| CH62      | 27      | c      | 126 - 226              | 106 - 156 | 275 - 475 | 105 - 185 |
| CH62      | 28      | d      | 126 - 226              | 106 - 156 | 275 - 475 | 105 - 185 |
| CH63      | 29      | c      | 276 - 336              | 186 - 226 | 565 - 685 | 225 - 275 |
| CH63      | 30      | d      | 276 - 336              | 186 - 226 | 565 - 685 | 225 - 275 |
| CH64      | 31      | c      | 396                    | 276 - 336 | 825 - 106 | 335       |
| CH64      | 32      | d      | 396                    | 276 - 336 | 825 - 106 | 335       |
| CV71      | 33      | b      | 126 - 186              | 825 - 156 | 225 - 335 | 824 - 155 |
| CH71      | 34      | c      | 126 - 186              | 825 - 156 | 225 - 335 | 824 - 155 |
| CH71      | 35      | d      | 126 - 186              | 825 - 156 | 225 - 335 | 824 - 155 |
| CH72      | 36      | c      | 226 - 396              | 186 - 276 | 395 - 685 | 185 - 335 |
| CH72      | 37      | d      | 226 - 396              | 186 - 276 | 395 - 685 | 185 - 335 |

| Case Size | Variant | Figure | Capacitance Code (E12) |           |           |           |
|-----------|---------|--------|------------------------|-----------|-----------|-----------|
|           |         |        | 50V                    | 100V      | 200V      | 500V      |
| CH73      | 38      | c      | 476 - 566              | 336 - 396 | 825 - 106 | 395 - 475 |
| CH73      | 39      | d      | 476 - 566              | 336 - 396 | 825 - 106 | 395 - 475 |
| CH74      | 40      | c      | 686                    | 476       | 126       | 565       |
| CH74      | 41      | d      | 686                    | 476       | 126       | 565       |
| CV76      | 42      | b      | 126 - 186              | 825 - 156 | 225 - 335 | 824 - 155 |
| CH76      | 43      | c      | 126 - 186              | 825 - 156 | 225 - 335 | 824 - 155 |
| CH76      | 44      | d      | 126 - 186              | 825 - 156 | 225 - 335 | 824 - 155 |
| CH77      | 45      | c      | 226 - 396              | 186 - 276 | 395 - 685 | 185 - 335 |
| CH77      | 46      | d      | 226 - 396              | 186 - 276 | 395 - 685 | 185 - 335 |
| CH78      | 47      | c      | 476 - 566              | 336 - 396 | 825 - 106 | 395 - 475 |
| CH78      | 48      | d      | 476 - 566              | 336 - 396 | 825 - 106 | 395 - 475 |
| CH79      | 49      | c      | 686                    | 476       | 126       | 565       |
| CH79      | 50      | d      | 686                    | 476       | 126       | 565       |
| CH81      | 51      | c      | 156 - 226              | 126 - 186 | 225 - 395 | 824 - 155 |
| CH81      | 52      | d      | 156 - 226              | 126 - 186 | 225 - 395 | 824 - 155 |
| CH82      | 53      | c      | 276 - 476              | 226 - 396 | 475 - 825 |           |
| CH82      | 54      | d      | 276 - 476              | 226 - 396 | 475 - 825 |           |
| CH83      | 55      | c      | 566 - 686              | 476 - 566 | 10 - 12   |           |
| CH83      | 56      | d      | 566 - 686              | 476 - 566 | 10 - 12   |           |
| CH84      | 57      | c      | 826                    | 686       | 156       |           |
| CH84      | 58      | d      | 826                    | 686       | 156       |           |
| CH86      | 59      | c      | 226 - 336              | 156 - 276 | 395 - 685 | 155 - 225 |
| CH86      | 60      | d      | 226 - 336              | 156 - 276 | 395 - 685 | 155 - 225 |
| CH87      | 61      | c      | 396 - 686              | 336 - 566 | 825 - 156 |           |
| CH87      | 62      | d      | 396 - 686              | 336 - 566 | 825 - 156 |           |
| CH88      | 63      | c      | 826 - 107              | 686 - 826 | 186 - 226 |           |
| CH88      | 64      | d      | 826 - 107              | 686 - 826 | 186 - 226 |           |
| CH89      | 65      | c      | 127                    | 107       | 276       |           |
| CH89      | 66      | d      | 127                    | 107       | 276       |           |
| CH91      | 67      | c      | 396 - 476              | 336 - 396 | 825 - 106 |           |
| CH91      | 68      | d      | 396 - 476              | 336 - 396 | 825 - 106 |           |
| CH92      | 69      | c      | 566 - 107              | 476 - 826 | 126 - 226 |           |
| CH92      | 70      | d      | 566 - 107              | 476 - 826 | 126 - 226 |           |
| CH93      | 71      | c      | 127 - 157              | 107 - 127 | 276 - 336 |           |
| CH93      | 72      | d      | 127 - 157              | 107 - 127 | 276 - 336 |           |
| CH94      | 73      | c      | 187                    | 157       | 396       |           |
| CH94      | 74      | d      | 187                    | 157       | 396       |           |

### HOW TO ORDER

Parts should be ordered using the ESA variant number as follows:

**3001030**

Detail Spec  
Number

**XX**

Type Variant  
(per table above)

**B**

Test Level  
C = Standard test level  
B = Level C plus serialized and  
capacitance recorded before  
and after 100% burn-in.

**XXX**

Capacitance  
Code

The first two digits represent  
significant figures and the third  
digit specifies the number of  
zeros to follow; i.e.  
102 = 1000pF  
103 = 10000pF

**K**

Capacitance  
Tolerance  
K = 10%  
M = 20%

**X**

Voltage  
C = 50V  
E = 100V  
G = 200V  
L = 500V

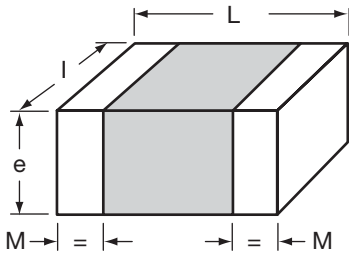
EG 300103018C106KC

Lot Acceptance Testing is available for all our ESA qualified ranges.

LAT 1 42 samples → 12 mechanical + 20 life test + 6 for TC + 4 for solder  
LAT 2 30 samples → 20 life test + 6 for TC + 4 for solder  
LAT 3 10 samples → 6 for TC + 4 for solder



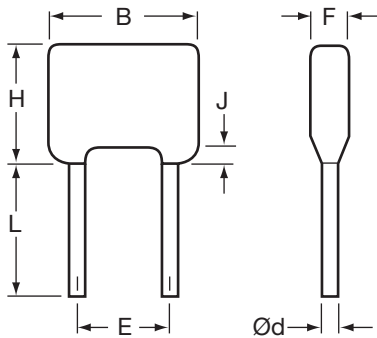
## ESA/SCC DETAIL SPECIFICATION NO. 3009/034 PHYSICAL DIMENSIONS



Millimeters (Inches)

| Symbol | Variants 01 to 06 |                 | Variants 07 to 12 |                 |
|--------|-------------------|-----------------|-------------------|-----------------|
|        | Min.              | Max.            | Min.              | Max.            |
| L      | 4.20<br>(0.165)   | 5.00<br>(0.197) | 4.20<br>(0.165)   | 5.00<br>(0.197) |
| I      | 2.80<br>(0.110)   | 3.60<br>(0.142) | 5.67<br>(0.223)   | 6.67<br>(0.263) |
| e      | –                 | 3.00<br>(0.118) | –                 | 3.30<br>(0.130) |
| M      | 0.25<br>(0.010)   | 0.75<br>(0.030) | 0.25<br>(0.010)   | 0.75<br>(0.030) |

## ESA/SCC DETAIL SPECIFICATION NO. 3001/034 PHYSICAL DIMENSIONS – VR STYLE



Millimeters (Inches)

| Variant | Case Size | B                | Ød              |                 | E               |                  | F               | H                | J               | L               |
|---------|-----------|------------------|-----------------|-----------------|-----------------|------------------|-----------------|------------------|-----------------|-----------------|
|         |           | Max.             | Min.            | Max.            | Min.            | Max.             | Max.            | Max.             | Max.            | Min.            |
| 01      | VR30S     | 7.62<br>(0.300)  | 0.51<br>(0.020) | 0.61<br>(0.024) | 4.58<br>(0.180) | 5.58<br>(0.220)  | 5.00<br>(0.197) | 4.60<br>(0.181)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 02      | VR30      | 7.62<br>(0.300)  | 0.51<br>(0.020) | 0.61<br>(0.024) | 4.58<br>(0.180) | 5.58<br>(0.220)  | 5.00<br>(0.197) | 9.62<br>(0.379)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 03      | VR40      | 10.16<br>(0.400) | 0.51<br>(0.020) | 0.61<br>(0.024) | 4.58<br>(0.180) | 5.58<br>(0.220)  | 5.00<br>(0.197) | 11.7<br>(0.461)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 04      | VR50      | 12.7<br>(0.500)  | 0.59<br>(0.023) | 0.69<br>(0.027) | 9.66<br>(0.380) | 10.66<br>(0.420) | 5.10<br>(0.201) | 14.2<br>(0.559)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 05      | VR66      | 17.5<br>(0.689)  | 0.86<br>(0.034) | 0.96<br>(0.038) | 14.2<br>(0.559) | 15.2<br>(0.598)  | 6.40<br>(0.252) | 16.5<br>(0.650)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 06      | VR84      | 23.62<br>(0.930) | 0.86<br>(0.034) | 0.96<br>(0.038) | 20.4<br>(0.803) | 22.0<br>(0.866)  | 6.40<br>(0.252) | 19.78<br>(0.779) | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 07      | VR90      | 23.5<br>(0.925)  | 0.86<br>(0.034) | 0.96<br>(0.038) | 20.4<br>(0.803) | 22.0<br>(0.866)  | 6.40<br>(0.252) | 42.0<br>(1.654)  | 1.50<br>(0.059) | 31.7<br>(1.248) |

## ESA/SCC DETAIL SPECIFICATION NO. 3001/034 PHYSICAL DIMENSIONS – CV STYLE

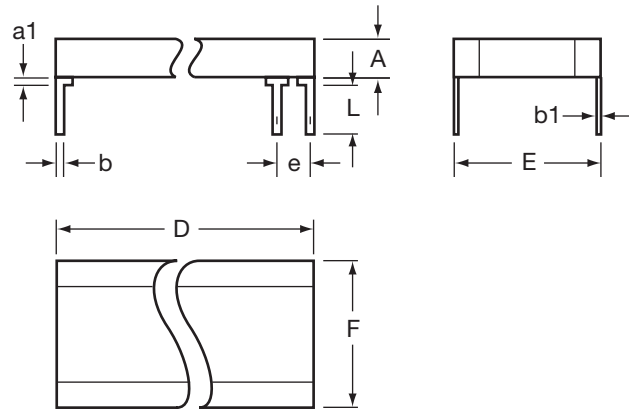


Millimeters (Inches)

| Variant | Case Size | B               | Ød              |                 | E                |                  | F               | H               | L               |                 |
|---------|-----------|-----------------|-----------------|-----------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|
|         |           | Max.            | Min.            | Max.            | Min.             | Max.             | Max.            | Max.            | Min.            | Max.            |
| 08      | CV41      | 10.6<br>(0.417) | 0.65<br>(0.026) | 0.75<br>(0.030) | 7.70<br>(0.303)  | 8.70<br>(0.343)  | 3.80<br>(0.150) | 8.70<br>(0.343) | 22.0<br>(0.866) | 28.0<br>(1.102) |
| 11      | CV51      | 11.9<br>(0.469) | 0.85<br>(0.033) | 0.95<br>(0.037) | 9.66<br>(0.380)  | 10.66<br>(0.420) | 3.80<br>(0.150) | 10.7<br>(0.421) | 22.0<br>(0.866) | 28.0<br>(1.102) |
| 14      | CV61      | 16.5<br>(0.650) | 0.85<br>(0.033) | 0.95<br>(0.037) | 14.74<br>(0.580) | 15.74<br>(0.620) | 3.80<br>(0.150) | 13.6<br>(0.535) | 22.0<br>(0.866) | 28.0<br>(1.102) |
| 17      | CV76      | 22.7<br>(0.894) | 0.85<br>(0.033) | 0.95<br>(0.037) | 20.4<br>(0.803)  | 22.0<br>(0.866)  | 3.80<br>(0.150) | 16.6<br>(0.654) | 22.0<br>(0.866) | 28.0<br>(1.102) |
| 20      | CV91      | 22.7<br>(0.894) | 1.15<br>(0.045) | 1.25<br>(0.049) | 20.4<br>(0.803)  | 22.0<br>(0.866)  | 3.80<br>(0.150) | 40.6<br>(1.598) | 22.0<br>(0.866) | 28.0<br>(1.102) |

## ESA/SCC DETAIL SPECIFICATION NO. 3001/034 PHYSICAL DIMENSIONS – CH STYLE, D.I.L.

Millimeters (Inches)



| Symbol | Min.             | Max.             | Notes |
|--------|------------------|------------------|-------|
| a1     | -                | 2.00<br>(0.079)  | 1     |
| b      | 0.45<br>(0.018)  | 0.55<br>(0.022)  | 1     |
| b1     | 0.204<br>(0.008) | 0.304<br>(0.012) | 1     |
| e      | 2.49<br>(0.098)  | 2.59<br>(0.102)  | 2     |
| L      | 12.0<br>(0.472)  | 14.0<br>(0.551)  | 1     |

Notes: 1 – All leads  
2 – Each space

| Variant | Case Size | A            | D            | E             |               | F            |
|---------|-----------|--------------|--------------|---------------|---------------|--------------|
|         |           | Max.         | Max.         | Min.          | Max.          | Max.         |
| 07      | CH41      | 3.80 (0.150) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 09      | CH42      | 7.40 (0.291) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 11      | CH43      | 11.1 (0.437) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 13      | CH44      | 14.8 (0.583) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 16      | CH51      | 3.80 (0.150) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 18      | CH52      | 7.40 (0.291) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 20      | CH53      | 11.1 (0.437) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 22      | CH54      | 14.8 (0.583) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 25      | CH61      | 3.80 (0.150) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 27      | CH62      | 7.40 (0.291) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 29      | CH63      | 11.1 (0.437) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 31      | CH64      | 14.8 (0.583) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 34      | CH71      | 3.80 (0.150) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 36      | CH72      | 7.40 (0.291) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 38      | CH73      | 11.1 (0.437) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 40      | CH74      | 14.8 (0.583) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 43      | CH76      | 3.80 (0.150) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 45      | CH77      | 7.40 (0.291) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 47      | CH78      | 11.1 (0.437) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 49      | CH79      | 14.8 (0.583) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 51      | CH81      | 3.80 (0.150) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 53      | CH82      | 7.40 (0.291) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 55      | CH83      | 11.1 (0.437) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 57      | CH84      | 14.8 (0.583) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 59      | CH86      | 3.80 (0.150) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 61      | CH87      | 7.40 (0.291) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 63      | CH88      | 11.1 (0.437) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 65      | CH89      | 14.8 (0.583) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 67      | CH91      | 3.80 (0.150) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 69      | CH92      | 7.40 (0.291) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 71      | CH93      | 11.1 (0.437) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 73      | CH94      | 14.8 (0.583) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |

## ESA/SCC DETAIL SPECIFICATION NO. 3001/034 PHYSICAL DIMENSIONS – CH STYLE, L

Millimeters (Inches)



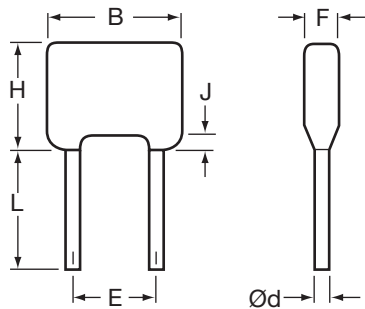
| Variant | Case Size | A            | D            | E             |               | F            |
|---------|-----------|--------------|--------------|---------------|---------------|--------------|
|         |           | Max.         | Max.         | Min.          | Max.          | Max.         |
| 10      | CH41      | 3.80 (0.150) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 13      | CH51      | 3.80 (0.150) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 16      | CH61      | 3.80 (0.150) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 19      | CH76      | 3.80 (0.150) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 22      | CH91      | 3.80 (0.150) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |

| Symbol | Min.            | Max.            | Notes |
|--------|-----------------|-----------------|-------|
| b      | 0.45<br>(0.018) | 0.55<br>(0.022) | 1     |
| e      | 2.49<br>(0.098) | 2.59<br>(0.102) | 2     |
| L      | 2.04<br>(0.080) | 3.01<br>(0.120) | 1     |

Notes: 1 – All leads  
2 – Each space

## ESA/SCC DETAIL SPECIFICATION NO. 3001/030

### PHYSICAL DIMENSIONS – BR STYLE

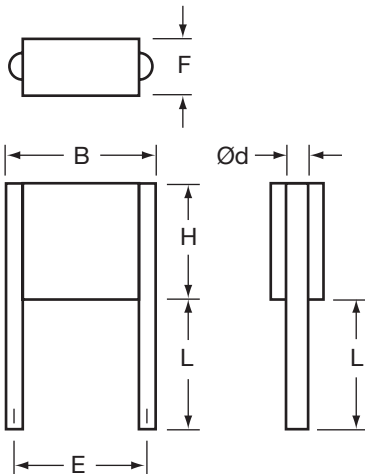


Millimeters (Inches)

| Variant | Case Size | B                | Ød              |                 | E                |                  | F               | H                | J               | L               |
|---------|-----------|------------------|-----------------|-----------------|------------------|------------------|-----------------|------------------|-----------------|-----------------|
|         |           | Max.             | Min.            | Max.            | Min.             | Max.             | Max.            | Max.             | Max.            | Min.            |
| 01      | BR40      | 10.16<br>(0.400) | 0.51<br>(0.020) | 0.61<br>(0.024) | 4.58<br>(0.180)  | 5.58<br>(0.220)  | 5.00<br>(0.197) | 11.7<br>(0.461)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 02      | BR50      | 12.7<br>(0.500)  | 0.59<br>(0.023) | 0.69<br>(0.027) | 9.66<br>(0.380)  | 10.66<br>(0.420) | 5.10<br>(0.201) | 14.2<br>(0.559)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 03      | BR66      | 17.5<br>(0.689)  | 0.86<br>(0.034) | 0.96<br>(0.038) | 14.2<br>(0.559)  | 15.2<br>(0.598)  | 6.40<br>(0.252) | 16.5<br>(0.650)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 04      | BR72      | 19.3<br>(0.760)  | 0.86<br>(0.034) | 0.96<br>(0.038) | 14.74<br>(0.580) | 15.74<br>(0.620) | 6.40<br>(0.252) | 24.0<br>(0.945)  | 1.50<br>(0.059) | 31.7<br>(1.248) |
| 05      | BR84      | 23.62<br>(0.930) | 0.71<br>(0.028) | 0.81<br>(0.032) | 18.93<br>(0.745) | 20.83<br>(0.820) | 6.40<br>(0.252) | 19.78<br>(0.779) | 1.50<br>(0.059) | 31.7<br>(1.248) |

## ESA/SCC DETAIL SPECIFICATION NO. 3001/030

### PHYSICAL DIMENSIONS – CV STYLE

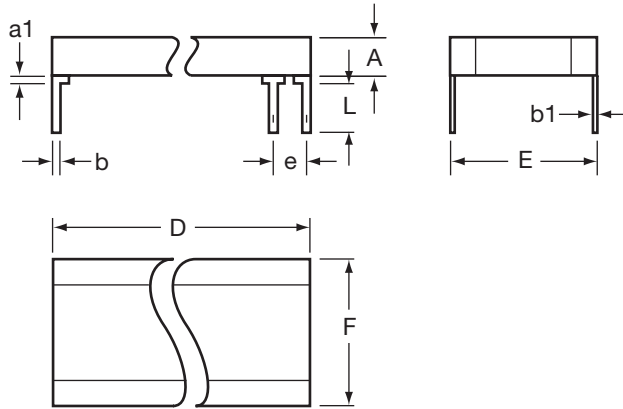


Millimeters (Inches)

| Variant | Case Size | B               | Ød              |                 | E                |                  | F               | H               | L               |                 |
|---------|-----------|-----------------|-----------------|-----------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|
|         |           | Max.            | Min.            | Max.            | Min.             | Max.             | Max.            | Max.            | Min.            | Max.            |
| 06      | CV41      | 10.6<br>(0.417) | 0.65<br>(0.026) | 0.75<br>(0.030) | 7.70<br>(0.303)  | 8.70<br>(0.343)  | 3.80<br>(0.150) | 8.70<br>(0.343) | 22.0<br>(0.866) | 28.0<br>(1.102) |
| 15      | CV51      | 11.9<br>(0.469) | 0.85<br>(0.033) | 0.95<br>(0.037) | 9.66<br>(0.380)  | 10.66<br>(0.420) | 3.80<br>(0.150) | 10.7<br>(0.421) | 22.0<br>(0.866) | 28.0<br>(1.102) |
| 24      | CV61      | 16.5<br>(0.650) | 0.85<br>(0.033) | 0.95<br>(0.037) | 14.74<br>(0.580) | 15.74<br>(0.620) | 3.80<br>(0.150) | 13.6<br>(0.535) | 22.0<br>(0.866) | 28.0<br>(1.102) |
| 33      | CV71      | 17.8<br>(0.701) | 0.85<br>(0.033) | 0.95<br>(0.037) | 14.74<br>(0.580) | 15.74<br>(0.620) | 3.80<br>(0.150) | 21.6<br>(0.850) | 22.0<br>(0.866) | 28.0<br>(1.102) |
| 42      | CV76      | 22.7<br>(0.894) | 0.85<br>(0.033) | 0.95<br>(0.037) | 20.4<br>(0.803)  | 22.0<br>(0.866)  | 3.80<br>(0.150) | 16.6<br>(0.654) | 22.0<br>(0.866) | 28.0<br>(1.102) |

## ESA/SCC DETAIL SPECIFICATION NO. 3001/030 PHYSICAL DIMENSIONS – CH STYLE, D.I.L.

Millimeters (Inches)



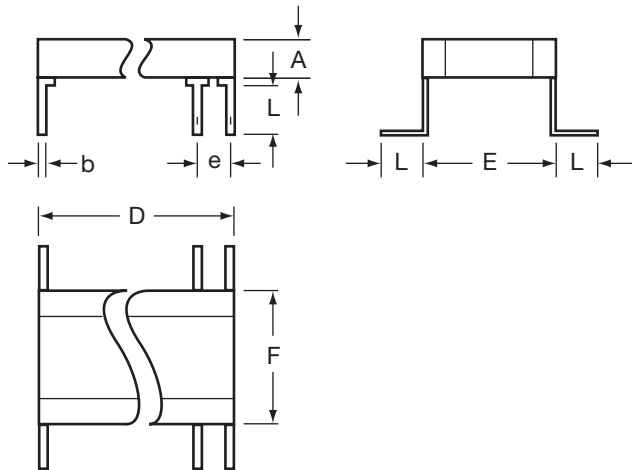
| Symbol | Min.             | Max.             | Notes |
|--------|------------------|------------------|-------|
| a1     | -                | 2.00<br>(0.079)  | 1     |
| b      | 0.45<br>(0.018)  | 0.55<br>(0.022)  | 1     |
| b1     | 0.204<br>(0.008) | 0.304<br>(0.012) | 1     |
| e      | 2.49<br>(0.098)  | 2.59<br>(0.102)  | 2     |
| L      | 2.04<br>(0.080)  | 3.04<br>(0.120)  | 1     |

Notes: 1 – All leads  
2 – Each space

| Variant | Case Size | A            | D            | E             |               | F            |
|---------|-----------|--------------|--------------|---------------|---------------|--------------|
|         |           | Max.         | Max.         | Min.          | Max.          | Max.         |
| 07      | CH41      | 3.80 (0.150) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 09      | CH42      | 7.40 (0.291) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 11      | CH43      | 11.1 (0.437) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 13      | CH44      | 14.8 (0.583) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 16      | CH51      | 3.80 (0.150) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 18      | CH52      | 7.40 (0.291) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 20      | CH53      | 11.1 (0.437) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 22      | CH54      | 14.8 (0.583) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 25      | CH61      | 3.80 (0.150) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 27      | CH62      | 7.40 (0.291) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 29      | CH63      | 11.1 (0.437) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 31      | CH64      | 14.8 (0.583) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 34      | CH71      | 3.80 (0.150) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 36      | CH72      | 7.40 (0.291) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 38      | CH73      | 11.1 (0.437) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 40      | CH74      | 14.8 (0.583) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 43      | CH76      | 3.80 (0.150) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 45      | CH77      | 7.40 (0.291) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 47      | CH78      | 11.1 (0.437) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 49      | CH79      | 14.8 (0.583) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 51      | CH81      | 3.80 (0.150) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 53      | CH82      | 7.40 (0.291) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 55      | CH83      | 11.1 (0.437) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 57      | CH84      | 14.8 (0.583) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 59      | CH86      | 3.80 (0.150) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 61      | CH87      | 7.40 (0.291) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 63      | CH88      | 11.1 (0.437) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 65      | CH89      | 14.8 (0.583) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 67      | CH91      | 3.80 (0.150) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 69      | CH92      | 7.40 (0.291) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 71      | CH93      | 11.1 (0.437) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 73      | CH94      | 14.8 (0.583) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |

## ESA/SCC DETAIL SPECIFICATION NO. 3001/030 PHYSICAL DIMENSIONS – CH STYLE, L

Millimeters (Inches)



| Symbol | Min.            | Max.            | Notes |
|--------|-----------------|-----------------|-------|
| b      | 0.45<br>(0.018) | 0.55<br>(0.022) | 1     |
| e      | 2.49<br>(0.098) | 2.59<br>(0.102) | 2     |
| L      | 2.04<br>(0.080) | 3.04<br>(0.120) | 1     |

Notes: 1 – All leads  
2 – Each space

| Variant | Case Size | A            | D            | E             |               | F            |
|---------|-----------|--------------|--------------|---------------|---------------|--------------|
|         |           | Max.         | Max.         | Min.          | Max.          | Max.         |
| 08      | CH41      | 3.80 (0.150) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 10      | CH42      | 7.40 (0.291) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 12      | CH43      | 11.1 (0.437) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 14      | CH44      | 14.8 (0.583) | 8.70 (0.343) | 7.70 (0.303)  | 8.70 (0.343)  | 9.20 (0.362) |
| 17      | CH51      | 3.80 (0.150) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 19      | CH52      | 7.40 (0.291) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 21      | CH53      | 11.1 (0.437) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 23      | CH54      | 14.8 (0.583) | 10.7 (0.421) | 9.66 (0.380)  | 10.66 (0.420) | 10.7 (0.421) |
| 26      | CH61      | 3.80 (0.150) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 28      | CH62      | 7.40 (0.291) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 30      | CH63      | 11.1 (0.437) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 32      | CH64      | 14.8 (0.583) | 13.6 (0.535) | 13.5 (0.531)  | 14.5 (0.571)  | 14.9 (0.587) |
| 35      | CH71      | 3.80 (0.150) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 37      | CH72      | 7.40 (0.291) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 39      | CH73      | 11.1 (0.437) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 41      | CH74      | 14.8 (0.583) | 21.6 (0.850) | 14.74 (0.580) | 15.74 (0.620) | 16.8 (0.661) |
| 44      | CH76      | 3.80 (0.150) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 46      | CH77      | 7.40 (0.291) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 48      | CH78      | 11.1 (0.437) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 50      | CH79      | 14.8 (0.583) | 16.6 (0.654) | 19.52 (0.769) | 21.12 (0.831) | 21.6 (0.850) |
| 52      | CH81      | 3.80 (0.150) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 54      | CH82      | 7.40 (0.291) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 56      | CH83      | 11.1 (0.437) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 58      | CH84      | 14.8 (0.583) | 38.2 (1.504) | 9.66 (0.380)  | 10.66 (0.420) | 12.0 (0.472) |
| 60      | CH86      | 3.80 (0.150) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 62      | CH87      | 7.40 (0.291) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 64      | CH88      | 11.1 (0.437) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 66      | CH89      | 14.8 (0.583) | 38.2 (1.504) | 14.74 (0.580) | 15.74 (0.620) | 18.9 (0.744) |
| 68      | CH91      | 3.80 (0.150) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 70      | CH92      | 7.40 (0.291) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 72      | CH93      | 11.1 (0.437) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |
| 74      | CH94      | 14.8 (0.583) | 40.6 (1.598) | 19.52 (0.769) | 21.12 (0.831) | 24.0 (0.945) |

# High Voltage DIP Ledged (HV Style)



U.S. Preferred Styles

## C0G Dielectric General Specifications

**Capacitance Range**  
100 pF to 1.2  $\mu$ F  
(25°C, 1.0 $\pm$ 0.2 Vrms (open circuit voltage)  
at 1 KHz, for  $\leq$ 100 pF use 1 MHz)

**Capacitance Tolerances**  
 $\pm$ 5%,  $\pm$ 10%,  $\pm$ 20%

**Operating Temperature Range**  
-55°C to +125°C

**Temperature Characteristic**  
0  $\pm$  30 ppm/°C

**Voltage Ratings**  
1000 VDC thru 5000 VDC (+125°C)

**Dissipation Factor**  
0.15% max.  
(25°C, 1.0 $\pm$ 0.2 Vrms (open circuit voltage)  
at 1 KHz, for  $\leq$ 100 pF use 1 MHz)

**Insulation Resistance** (+25°C, at 500V)  
100K M $\Omega$  min., or 1000 M $\Omega$ - $\mu$ F min.,  
whichever is less

**Insulation Resistance** (+125°C, at 500V)  
10K M $\Omega$  min., or 100 M $\Omega$ - $\mu$ F min.,  
whichever is less

**Dielectric Strength**  
120% rated voltage, 5 seconds

**Life Test**  
100% rated and +125°C

## N1500 General Specifications

**Capacitance Range**  
100 pF to 1.9  $\mu$ F  
(25°C, 1.0 $\pm$ 0.2 Vrms (open circuit voltage)  
at 1 KHz)

**Capacitance Tolerances**  
 $\pm$ 5%,  $\pm$ 10%,  $\pm$ 20%

**Operating Temperature Range**  
-55°C to +125°C

**Temperature Characteristic**  
-1500  $\pm$ 250 ppm/°C

**Voltage Ratings**  
1000 VDC thru 5000 VDC (+125°C)

**Dissipation Factor**  
0.15% max.  
(25°C, 1.0 $\pm$ 0.2 Vrms (open circuit voltage)  
at 1 KHz)

**Insulation Resistance** (+25°C, at 500V)  
100K M $\Omega$  min., or 1000 M $\Omega$ - $\mu$ F min.,  
whichever is less

**Insulation Resistance** (+125°C, at 500V)  
10K M $\Omega$  min., or 100 M $\Omega$ - $\mu$ F min.,  
whichever is less

**Dielectric Strength**  
120% rated voltage, 5 seconds

**Life Test**  
100% rated and +125°C

## X7R Dielectric General Specifications

**Capacitance Range**  
100 pF to 15  $\mu$ F  
(25°C, 1.0 $\pm$ 0.2 Vrms (open circuit voltage)  
at 1 KHz)

**Capacitance Tolerances**  
 $\pm$ 10%,  $\pm$ 20%, +80%, -20%

**Operating Temperature Range**  
-55°C to +125°C

**Temperature Characteristic**  
 $\pm$ 15% (0 VDC)

**Voltage Ratings**  
1000 VDC thru 5000 VDC (+125°C)

**Dissipation Factor**  
2.5% max.  
(25°C, 1.0 $\pm$ 0.2 Vrms (open circuit voltage)  
at 1 KHz)

**Insulation Resistance** (+25°C, at 500V)  
100K M $\Omega$  min., or 1000 M $\Omega$ - $\mu$ F min.,  
whichever is less

**Insulation Resistance** (+125°C, at 500V)  
10K M $\Omega$  min., or 100 M $\Omega$ - $\mu$ F min.,  
whichever is less

**Dielectric Strength**  
120% rated voltage, 5 seconds

**Life Test**  
100% rated and +125°C

## HOW TO ORDER

## AVX Styles: HV01 THRU HV06

| HV        | 01                                   | A                                                         | C                                                             | 105                                                                                                                                                                                                                    | M                                                                                                                                                                                                | A                                        | N                                                                                     | 650                                                                                                            |
|-----------|--------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| AVX Style | Size<br>See dimen-<br>sions<br>chart | Voltage<br>1K = A<br>2K = G<br>3K = H<br>4K = J<br>5K = K | Temperature<br>Coefficient<br>C0G = A<br>X7R = C<br>N1500 = 4 | Capacitance<br>Code<br>(2 significant<br>digits + no.<br>of zeros)<br>10 pF = 100<br>100 pF = 101<br>1,000 pF = 102<br>22,000 pF = 223<br>220,000 pF = 224<br>1 $\mu$ F = 105<br>10 $\mu$ F = 106<br>100 $\mu$ F = 107 | Capacitance<br>Tolerance<br>C0G: J = $\pm$ 5%<br>K = $\pm$ 10%<br>M = $\pm$ 20%<br>X7R: K = $\pm$ 10%<br>M = $\pm$ 20%<br>Z = +80, -20%<br>N1500: J = $\pm$ 5%<br>K = $\pm$ 10%<br>M = $\pm$ 20% | Failure<br>Rate<br>A = Does<br>not apply | Termination<br>N = Straight Lead<br>J = Leads<br>formed in<br>L = Leads<br>formed out | Height<br>Max<br>Dimension "A"<br>120 = 0.120"<br>240 = 0.240"<br>360 = 0.360"<br>480 = 0.480"<br>650 = 0.650" |

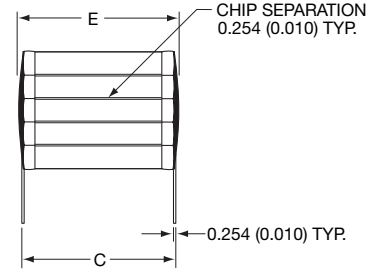
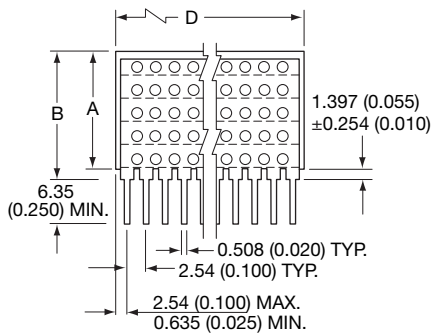
Note: Capacitors with X7R dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations.

# High Voltage DIP Ledged (HV Style)

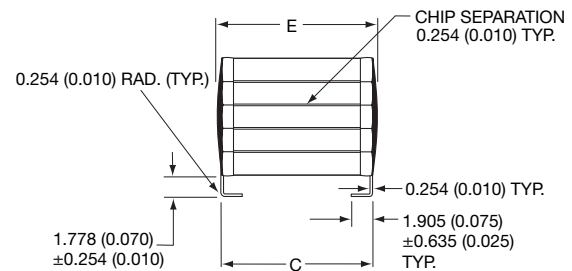
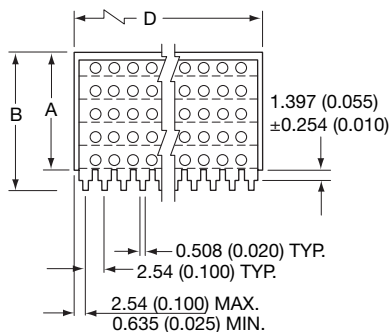


U.S. Preferred Styles

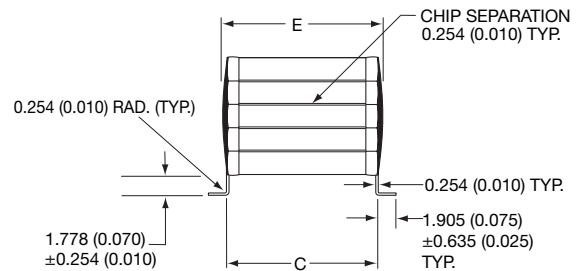
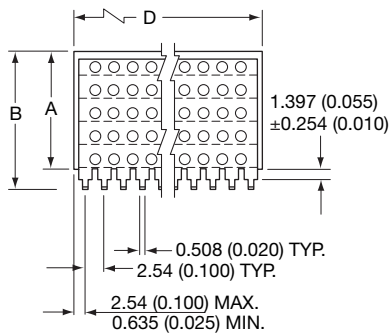
## Surface Mount and Thru-Hole HV Styles



### “N” STYLE LEADS



### “J” STYLE LEADS



### “L” STYLE LEADS

## DIMENSIONS

millimeters (inches)

| Style | A (max.)                              | B (max.)                                                       | C ±.635(±.025) | D ±.635(±.025) | E (max.)     | No. of Leads per side |
|-------|---------------------------------------|----------------------------------------------------------------|----------------|----------------|--------------|-----------------------|
| HV01  | See page 52 for maximum “A” Dimension | For “N” Style Leads, “B” Dimension = “A” Dimension Plus 0.065” | 53.3 (2.100)   | 10.5 (0.415)   | 54.9 (2.160) | 4                     |
| HV02  |                                       |                                                                | 39.1 (1.540)   | 20.3 (0.800)   | 40.7 (1.600) | 8                     |
| HV03  |                                       |                                                                | 27.2 (1.070)   | 10.5 (0.415)   | 28.2 (1.130) | 4                     |
| HV04  |                                       | For “J” & “L” Leads, “B” Dimension = “A” Dimension Plus 0.080” | 10.2 (0.400)   | 10.2 (0.400)   | 11.2 (0.440) | 4                     |
| HV05  |                                       |                                                                | 6.35 (0.250)   | 6.35 (0.250)   | 7.62 (0.300) | 3                     |
| HV06  |                                       |                                                                | 53.3 (2.100)   | 29.0 (1.140)   | 54.9 (2.160) | 11                    |



# High Voltage DIP Ledged (HV Style)



## Surface Mount and Thru-Hole HV Styles

U.S. Preferred Styles

### Max Capacitance (μF) Available Versus Style with Height (A) of 0.120" - 3.05mm

| AVX<br>STYLE | HV01 _____ AN120 |      |      |       |       | HV02 _____ AN120 |      |      |       |       | HV03 _____ AN120 |      |       |       |       | HV04 _____ AN120 |       |       |       |       | HV05 _____ AN120 |       | HV06 _____ AN120 |      |      |      |      |
|--------------|------------------|------|------|-------|-------|------------------|------|------|-------|-------|------------------|------|-------|-------|-------|------------------|-------|-------|-------|-------|------------------|-------|------------------|------|------|------|------|
|              | 1KV              | 2KV  | 3KV  | 4KV   | 5KV   | 1KV              | 2KV  | 3KV  | 4KV   | 5KV   | 1KV              | 2KV  | 3KV   | 4KV   | 5KV   | 1KV              | 2KV   | 3KV   | 4KV   | 5KV   | 1KV              | 2KV   | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  |
| C0G          | .086             | .024 | .011 | .0062 | .0052 | .120             | .034 | .015 | .0088 | .0074 | .042             | .013 | .0058 | .0030 | .0024 | .012             | .0040 | .0018 | .0009 | .0007 | .0048            | .0013 | .240             | .066 | .028 | .018 | .015 |
| N1500        | .140             | .042 | .018 | .010  | .0084 | .200             | .058 | .024 | .014  | .012  | .068             | .020 | .0090 | .0050 | .0040 | .020             | .0066 | .0028 | .0014 | .0012 | .0078            | .0022 | .380             | .100 | .046 | .030 | .026 |
| X7R          | 1.10             | .260 | .150 | .066  | .052  | 1.50             | .360 | .200 | .094  | .078  | .520             | .130 | .072  | .032  | .024  | .160             | .042  | ---   | ---   | ---   | .060             | ---   | 3.00             | .700 | .440 | .200 | .170 |

### Max Capacitance (μF) Available Versus Style with Height (A) of 0.240" - 6.10mm

| AVX<br>STYLE | HV01 _____ AN240 |      |      |      |      | HV02 _____ AN240 |      |      |      |      | HV03 _____ AN240 |      |      |       |       | HV04 _____ AN240 |       |       |       |       | HV05 _____ AN240 |       | HV06 _____ AN240 |      |      |      |      |
|--------------|------------------|------|------|------|------|------------------|------|------|------|------|------------------|------|------|-------|-------|------------------|-------|-------|-------|-------|------------------|-------|------------------|------|------|------|------|
|              | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV   | 5KV   | 1KV              | 2KV   | 3KV   | 4KV   | 5KV   | 1KV              | 2KV   | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  |
| C0G          | .170             | .048 | .022 | .012 | .010 | .240             | .068 | .031 | .017 | .015 | .084             | .026 | .011 | .0060 | .0048 | .025             | .0080 | .0036 | .0018 | .0014 | .0096            | .0027 | .480             | .130 | .056 | .036 | .031 |
| N1500        | .280             | .084 | .036 | .020 | .016 | .400             | .110 | .048 | .028 | .024 | .130             | .040 | .018 | .010  | .0080 | .040             | .013  | .0056 | .0028 | .0025 | .015             | .0044 | .760             | .210 | .092 | .060 | .052 |
| X7R          | 2.20             | .520 | .300 | .130 | .100 | 3.10             | .720 | .400 | .180 | .150 | 1.00             | .270 | .140 | .064  | .048  | .330             | .084  | ---   | ---   | ---   | .120             | ---   | 6.00             | 1.40 | .880 | .400 | .340 |

### Max Capacitance (μF) Available Versus Style with Height (A) of 0.360" - 9.15mm

| AVX<br>STYLE | HV01 _____ AN360 |      |      |      |      | HV02 _____ AN360 |      |      |      |      | HV03 _____ AN360 |      |      |       |       | HV04 _____ AN360 |      |       |       |       | HV05 _____ AN360 |       | HV06 _____ AN360 |      |      |      |      |
|--------------|------------------|------|------|------|------|------------------|------|------|------|------|------------------|------|------|-------|-------|------------------|------|-------|-------|-------|------------------|-------|------------------|------|------|------|------|
|              | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV   | 5KV   | 1KV              | 2KV  | 3KV   | 4KV   | 5KV   | 1KV              | 2KV   | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  |
| C0G          | .250             | .072 | .033 | .018 | .015 | .360             | .100 | .047 | .026 | .022 | .120             | .039 | .017 | .0090 | .0072 | .038             | .012 | .0054 | .0027 | .0022 | .014             | .0040 | .720             | .200 | .084 | .055 | .047 |
| N1500        | .420             | .120 | .055 | .030 | .025 | .600             | .170 | .072 | .043 | .036 | .200             | .060 | .027 | .015  | .012  | .060             | .020 | .0084 | .0043 | .0037 | .023             | .0066 | 1.10             | .310 | .130 | .090 | .078 |
| X7R          | 3.30             | .780 | .450 | .200 | .150 | 4.70             | 1.00 | .600 | .280 | .230 | 1.50             | .410 | .210 | .096  | .072  | .490             | .120 | ---   | ---   | ---   | .180             | ---   | 9.00             | 2.10 | 1.30 | .600 | .510 |

### Max Capacitance (μF) Available Versus Style with Height (A) of 0.480" - 12.2mm

| AVX<br>STYLE | HV01 _____ AN480 |      |      |      |      | HV02 _____ AN480 |      |      |      |      | HV03 _____ AN480 |      |      |      |       | HV04 _____ AN480 |      |       |       |       | HV05 _____ AN480 |       | HV06 _____ AN480 |      |      |      |      |
|--------------|------------------|------|------|------|------|------------------|------|------|------|------|------------------|------|------|------|-------|------------------|------|-------|-------|-------|------------------|-------|------------------|------|------|------|------|
|              | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV  | 5KV   | 1KV              | 2KV  | 3KV   | 4KV   | 5KV   | 1KV              | 2KV   | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  |
| C0G          | .340             | .096 | .044 | .024 | .020 | .480             | .130 | .063 | .035 | .030 | .160             | .052 | .023 | .012 | .0096 | .051             | .016 | .0072 | .0036 | .0029 | .019             | .0054 | .960             | .260 | .110 | .073 | .062 |
| N1500        | .560             | .160 | .073 | .040 | .033 | .800             | .230 | .096 | .057 | .048 | .270             | .080 | .036 | .020 | .016  | .080             | .026 | .011  | .0057 | .0050 | .031             | .0088 | 1.50             | .420 | .180 | .120 | .100 |
| X7R          | 4.40             | 1.00 | .600 | .260 | .200 | 6.30             | 1.40 | .800 | .370 | .310 | 2.00             | .550 | .280 | .120 | .096  | .650             | .160 | ---   | ---   | ---   | .240             | ---   | 12.0             | 2.80 | 1.70 | .800 | .68  |

### Max Capacitance (μF) Available Versus Style with Height (A) of 0.650" - 16.5mm

| AVX<br>STYLE | HV01 _____ AN650 |      |      |      |      | HV02 _____ AN650 |      |      |      |      | HV03 _____ AN650 |      |      |      |      | HV04 _____ AN650 |      |      |       |       | HV05 _____ AN650 |       | HV06 _____ AN650 |      |      |      |      |
|--------------|------------------|------|------|------|------|------------------|------|------|------|------|------------------|------|------|------|------|------------------|------|------|-------|-------|------------------|-------|------------------|------|------|------|------|
|              | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  | 1KV              | 2KV  | 3KV  | 4KV   | 5KV   | 1KV              | 2KV   | 1KV              | 2KV  | 3KV  | 4KV  | 5KV  |
| C0G          | .430             | .120 | .056 | .031 | .026 | .610             | .170 | .079 | .044 | .037 | .210             | .065 | .029 | .015 | .012 | .064             | .020 | .009 | .0045 | .0037 | .024             | .0068 | 1.20             | .330 | .140 | .092 | .078 |
| N1500        | .700             | .210 | .092 | .050 | .042 | 1.00             | .290 | .120 | .072 | .060 | .340             | .100 | .045 | .025 | .020 | .100             | .033 | .014 | .0072 | .0063 | .039             | .011  | 1.90             | .530 | .230 | .150 | .130 |
| X7R          | 5.50             | 1.30 | .750 | .330 | .260 | 7.90             | 1.80 | 1.00 | .470 | .390 | 2.60             | .690 | .360 | .160 | .120 | .820             | .210 | ---  | ---   | ---   | .300             | ---   | 15.0             | 3.50 | 2.20 | 1.00 | .850 |

# High Voltage Leaded (CH Style)

## Radial, Dual-in-Line & 'L' Lead SMT



European Preferred Styles

330 pF to 2.7  $\mu$ F  
1kV to 5kV  
-55°C to +125°C  
1B/C0G and 2C1/X7R Dielectrics

This range of radial, dual-in-line for both through hole and surface mount products is intended for use in high voltage power supplies and voltage multiplier circuits. The multilayer ceramic construction offers excellent volumetric efficiency compared with other high voltage dielectrics. They are suitable for both high reliability and industrial applications.

### ELECTRICAL SPECIFICATIONS

#### Temperature Coefficient CECC 30 000, (4.24.1)

1B/C0G: A Temperature Coefficient -  $0 \pm 30$ ppm/°C

2C1/X7R: C Temperature Characteristic -  $\pm 15\%$  (0v dc)

#### Capacitance Test 25°C

1B/C0G: Measured at 1 VRMS max at 1KHz (1MHz <100 pF)

2C1/X7R: Measured at 1 VRMS max at 1KHz

#### Dissipation Factor 25°C

1B/C0G: 0.15% max at 1KHz, 1 VRMS (1MHz for <100 pF)

2C1/X7R: 2.5% max at 1KHz, 1 VRMS

#### Insulation Resistance

1B/C0G & 2C1/X7R: 100K megohms or 1000 megohms- $\mu$ F, whichever is less

#### Dielectric Withstanding Voltage 25°C

130% rated voltage for 5 seconds

#### Life Test (1000 hrs) CECC 30000 (4.23)

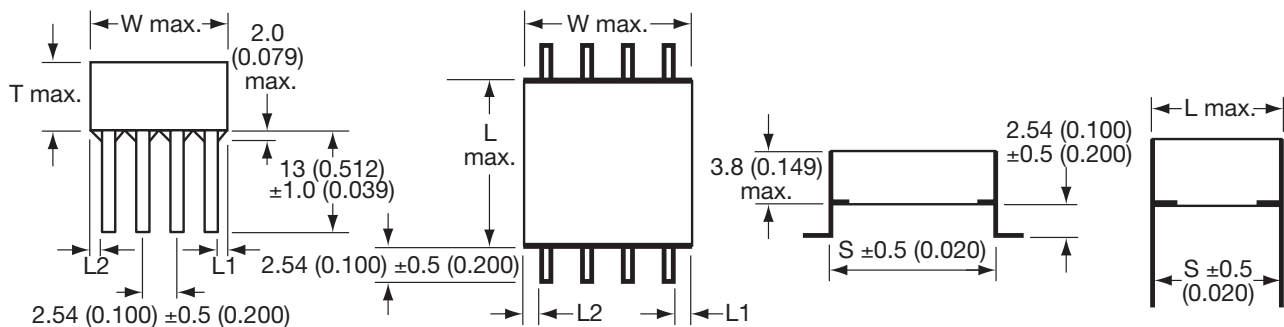
1B/C0G & 2C1/X7R: 120% rated voltage at +125°C.

#### Aging

1B/C0G: Zero

2C1/X7R: 2.5%/decade hour

### DUAL-IN-LINE



### DIMENSIONS

millimeters (inches)

| Style | L<br>(max)   | W<br>(max)   | S<br>(nom)    | No. of<br>Leads<br>per side |
|-------|--------------|--------------|---------------|-----------------------------|
| CH41  | 9.2 (0.362)  | 8.7 (0.342)  | 8.2 (0.323)   | 3                           |
| CH51  | 10.7 (0.421) | 10.7 (0.421) | 10.2 (0.400)  | 4                           |
| CH61  | 14.9 (0.587) | 13.6 (0.535) | 14.0 (0.551)  | 5                           |
| CH76  | 21.6 (0.850) | 21.6 (0.850) | 20.3* (0.800) | 6                           |
| CH91  | 24.0 (0.944) | 40.6 (1.598) | 20.3* (0.800) | 14                          |

\*Tolerance  $\pm 0.8$

### HOW TO ORDER

| CH         | 41        | A                                                   | C                  | 104                                                                                                   | K                                                                 | A                  | 8           | 0              | A               | 7                                                       |
|------------|-----------|-----------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------|-------------|----------------|-----------------|---------------------------------------------------------|
| Style Code | Size Code | Voltage Code                                        | Dielectric Code    | Capacitance Code                                                                                      | Capacitance Tolerance                                             | Specification Code | Finish Code | Lead Dia. Code | Lead Space Code | Lead Style Code                                         |
|            |           | A = 1kV<br>G = 2kV<br>H = 3kV<br>J = 4kV<br>K = 5kV | A = C0G<br>C = X7R | (2 significant digits + no. of zeros)<br>eg. 105 = 1 $\mu$ F<br>106 = 10 $\mu$ F<br>107 = 100 $\mu$ F | J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>P = -0 +100% | A = Non customized | 8 = Varnish | 0 = Standard   | A = Standard    | 0 = Dual in line straight<br>7 = Dual in line 'L' style |



# High Voltage Leaded (CV Style)

## Chip Assemblies

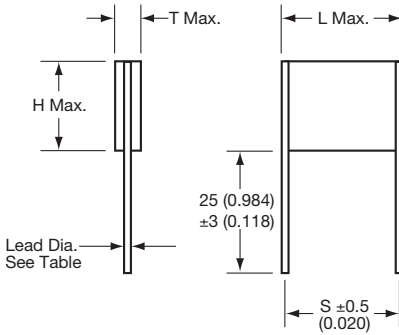


European Preferred Styles

### VERTICALLY MOUNTED RADIAL PRODUCT

Part Number format (CVxxxxxxxxxxA2)

Typical Part Number CV51AC154MA40A2



### DIMENSIONS

millimeters (inches)

| Style | L<br>(max)   | H<br>(max)   | T<br>(max)   | S<br>(nom)    | Lead<br>Dia<br>(nom) |
|-------|--------------|--------------|--------------|---------------|----------------------|
| CV41  | 10.6 (0.417) | 8.70 (0.343) | 3.80 (0.150) | 8.20 (0.323)  | 0.70 (0.028)         |
| CV51  | 11.9 (0.469) | 10.7 (0.421) | 3.80 (0.150) | 10.2 (0.402)  | 0.90 (0.035)         |
| CV61  | 16.5 (0.650) | 13.6 (0.536) | 3.80 (0.150) | 15.2 (0.599)  | 0.90 (0.035)         |
| CV76  | 22.7 (0.893) | 16.6 (0.654) | 3.80 (0.150) | 21.2* (0.835) | 0.90 (0.035)         |
| CV91  | 22.7 (0.893) | 40.6 (1.598) | 3.80 (0.150) | 21.2* (0.835) | 1.20 (0.047)         |

\*Tolerance  $\pm 0.8\text{mm}$  (0.031)

### HOW TO ORDER

**CV**

Style  
Code

**51**

Size  
Code

**A**

Voltage  
Code  
A = 1kV  
G = 2kV  
H = 3kV  
J = 4kV  
K = 5kV

**C**

Dielectric  
Code  
A = C0G  
C = X7R

**154**

Capacitance  
Code  
(2 significant  
digits + no.  
of zeros)  
eg. 105 = 1  $\mu\text{F}$   
106 = 10  $\mu\text{F}$   
107 = 100  $\mu\text{F}$

**M**

Capacitance  
Tolerance  
J =  $\pm 5\%$   
K =  $\pm 10\%$   
M =  $\pm 20\%$   
P = -0 +100%

**A**

Specification  
Code  
A = Non customized

**8**

Finish  
Code  
8 = Varnish

**0**

Lead Dia.  
Code  
0 = Standard

**A**

Lead Space  
Code  
A = Standard

**2**

Lead Style  
Code

# High Voltage Leaded (CH/CV Style)

## Chip Assemblies



European Preferred Styles

### 1B/C0G ULTRA STABLE CERAMIC

|        | CV41-CH41<br>Styles |   |   |   | CV51-CH51<br>Styles |   |   |   | CV61-CH61<br>Styles |   |   |   | CV76-CH76<br>Styles |   |  |  | CV91-CH91<br>Styles |   |   |   |
|--------|---------------------|---|---|---|---------------------|---|---|---|---------------------|---|---|---|---------------------|---|--|--|---------------------|---|---|---|
| Cap pF |                     |   |   |   |                     |   |   |   |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 330    |                     |   |   | K |                     |   |   |   |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 390    |                     |   | J | K |                     |   |   |   |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 470    |                     |   | J | K |                     |   |   |   |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 560    |                     |   | J | K |                     |   |   |   |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 680    |                     |   | J |   |                     |   |   | K |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 820    |                     | H | J |   |                     |   |   | K |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 1000   |                     | H |   |   |                     |   | J | K |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 1200   |                     | H |   |   |                     |   | J | K |                     |   |   |   |                     |   |  |  |                     |   |   |   |
| 1500   |                     | H |   |   |                     |   | J |   |                     |   | K |   |                     |   |  |  |                     |   |   |   |
| 1800   | G                   |   |   |   |                     | H | J |   |                     |   | K |   |                     |   |  |  |                     |   |   |   |
| 2200   | G                   |   |   |   |                     | H |   |   |                     | J | K |   |                     |   |  |  |                     |   |   |   |
| 2700   | G                   |   |   |   |                     | H |   |   |                     | J |   |   |                     | K |  |  |                     |   |   |   |
| 3300   | G                   |   |   |   | G                   |   |   |   | H                   | J |   |   |                     | K |  |  |                     |   |   |   |
| 3900   | G                   |   |   |   | G                   |   |   |   | H                   |   |   |   | J                   | K |  |  |                     |   |   |   |
| 4700   | G                   |   |   |   | G                   |   |   |   | H                   |   |   |   | J                   | K |  |  |                     |   |   |   |
| 5600   | A                   |   |   |   | G                   |   |   |   | H                   |   |   |   | J                   |   |  |  |                     |   |   | K |
| 6800   | A                   |   |   |   | G                   |   |   | G |                     |   |   | H | J                   |   |  |  |                     |   |   | K |
| 8200   | A                   |   |   |   | G                   |   |   | G |                     |   |   | H |                     |   |  |  |                     | J | K |   |
| 10000  | A                   |   |   |   | G                   |   |   | G |                     |   |   | H |                     |   |  |  |                     | J | K |   |
| 12000  | A                   |   |   |   | A                   |   |   | G |                     |   |   | H |                     |   |  |  |                     | J | K |   |
| 15000  | A                   |   |   |   | A                   |   |   | G |                     |   |   | G |                     |   |  |  | H                   | J |   |   |
| 18000  |                     |   |   |   | A                   |   |   | G |                     |   |   | G |                     |   |  |  | H                   | J |   |   |
| 22000  |                     |   |   |   | A                   |   |   | A |                     |   |   | G |                     |   |  |  | H                   |   |   |   |
| 27000  |                     |   |   |   | A                   |   |   | A |                     |   |   | G |                     |   |  |  | H                   |   |   |   |
| 33000  |                     |   |   |   | A                   |   |   | A |                     |   |   | G |                     |   |  |  | H                   |   |   |   |
| 39000  |                     |   |   |   |                     |   |   | A |                     |   |   | G |                     |   |  |  | G                   |   |   |   |
| 47000  |                     |   |   |   |                     |   |   | A |                     |   |   | A |                     |   |  |  | G                   |   |   |   |
| 56000  |                     |   |   |   |                     |   |   | A |                     |   |   | A |                     |   |  |  | G                   |   |   |   |
| 68000  |                     |   |   |   |                     |   |   | A |                     |   |   | A |                     |   |  |  | G                   |   |   |   |
| 82000  |                     |   |   |   |                     |   |   |   |                     |   |   | A |                     |   |  |  | G                   |   |   |   |
| 100000 |                     |   |   |   |                     |   |   |   |                     |   |   | A |                     |   |  |  | G                   |   |   |   |
| 120000 |                     |   |   |   |                     |   |   |   |                     |   |   |   |                     |   |  |  | A                   |   |   |   |
| 150000 |                     |   |   |   |                     |   |   |   |                     |   |   |   |                     |   |  |  | A                   |   |   |   |
| 180000 |                     |   |   |   |                     |   |   |   |                     |   |   |   |                     |   |  |  | A                   |   |   |   |
| 220000 |                     |   |   |   |                     |   |   |   |                     |   |   |   |                     |   |  |  | A                   |   |   |   |
| 270000 |                     |   |   |   |                     |   |   |   |                     |   |   |   |                     |   |  |  | A                   |   |   |   |
| 330000 |                     |   |   |   |                     |   |   |   |                     |   |   |   |                     |   |  |  | A                   |   |   |   |

NB Figures in cells refer to size within ordering information



# High Voltage Leaded (CH/CV Style)

## Chip Assemblies



European Preferred Styles

### 2C1/X7R STABLE CERAMIC

|        | CV41-CH41<br>Styles |   |   |   | CV51-CH51<br>Styles |   |   |   | CV61-CH61<br>Styles |   |  |   | CV76-CH76<br>Styles |   |  |   | CV91-CH91<br>Styles |   |   |  |
|--------|---------------------|---|---|---|---------------------|---|---|---|---------------------|---|--|---|---------------------|---|--|---|---------------------|---|---|--|
| Cap nF |                     |   |   |   |                     |   |   |   |                     |   |  |   |                     |   |  |   |                     |   |   |  |
| 1.2    |                     |   |   | K |                     |   |   |   |                     |   |  |   |                     |   |  |   |                     |   |   |  |
| 1.3    |                     |   |   | K |                     |   |   |   |                     |   |  |   |                     |   |  |   |                     |   |   |  |
| 1.5    |                     |   | J | K |                     |   |   |   |                     |   |  |   |                     |   |  |   |                     |   |   |  |
| 2.2    |                     |   | J | K |                     |   |   |   |                     |   |  |   |                     |   |  |   |                     |   |   |  |
| 2.7    |                     |   | J | K |                     |   |   |   |                     |   |  |   |                     |   |  |   |                     |   |   |  |
| 3.3    |                     |   | J |   |                     |   | K |   |                     |   |  |   |                     |   |  |   |                     |   |   |  |
| 3.9    |                     |   | J |   |                     |   | K |   |                     |   |  |   |                     |   |  |   |                     |   |   |  |
| 4.7    |                     | H | J |   |                     | J |   |   |                     | K |  |   |                     |   |  |   |                     |   |   |  |
| 5.6    |                     | H |   |   |                     | J |   |   |                     | K |  |   |                     |   |  |   |                     |   |   |  |
| 6.8    |                     | H |   |   |                     | J |   |   |                     | K |  |   |                     |   |  |   |                     |   |   |  |
| 8.2    |                     | G | H |   |                     | J |   |   |                     | K |  |   |                     |   |  |   |                     |   |   |  |
| 10     |                     | G |   |   |                     | H |   |   | J                   | K |  |   |                     |   |  |   |                     |   |   |  |
| 12     |                     | G |   |   |                     | H |   |   | J                   |   |  |   |                     | K |  |   |                     |   |   |  |
| 15     |                     | G |   |   |                     | H |   |   | J                   |   |  |   |                     | K |  |   |                     |   |   |  |
| 18     | A                   |   |   |   | G                   | H |   |   | H                   |   |  |   | J                   | K |  |   |                     |   |   |  |
| 22     | A                   |   |   |   | G                   |   |   |   | H                   |   |  |   | J                   |   |  |   |                     |   | K |  |
| 27     | A                   |   |   |   | G                   |   |   |   | H                   |   |  |   | J                   |   |  |   |                     |   | K |  |
| 33     | A                   |   |   |   | G                   |   |   |   | H                   |   |  |   | J                   |   |  |   |                     |   | K |  |
| 39     | A                   |   |   | A |                     |   |   |   | G                   | H |  |   | J                   |   |  |   |                     |   | K |  |
| 47     | A                   |   |   | A |                     |   |   |   | G                   |   |  |   | H                   |   |  |   |                     | J | K |  |
| 56     | A                   |   |   | A |                     |   |   |   | G                   |   |  |   | H                   |   |  |   |                     | J | K |  |
| 68     | A                   |   |   | A |                     |   |   |   | G                   |   |  |   | H                   |   |  |   |                     | J |   |  |
| 82     | A                   |   |   | A |                     |   |   |   | G                   |   |  |   | G                   |   |  |   |                     | H | J |  |
| 100    | A                   |   |   | A |                     |   |   | A |                     |   |  |   | G                   |   |  |   |                     | H | J |  |
| 120    | A                   |   |   | A |                     |   |   | A |                     |   |  |   | G                   |   |  |   |                     | H | J |  |
| 150    |                     |   |   | A |                     |   |   | A |                     |   |  |   | G                   |   |  |   |                     | H |   |  |
| 180    |                     |   |   | A |                     |   |   | A |                     |   |  | A |                     |   |  |   | G                   | H |   |  |
| 220    |                     |   |   | A |                     |   |   | A |                     |   |  | A |                     |   |  |   | G                   |   |   |  |
| 270    |                     |   |   | A |                     |   |   | A |                     |   |  | A |                     |   |  |   | G                   |   |   |  |
| 330    |                     |   |   |   |                     |   |   | A |                     |   |  | A |                     |   |  |   | G                   |   |   |  |
| 390    |                     |   |   |   |                     |   |   | A |                     |   |  | A |                     |   |  | A |                     |   |   |  |
| 470    |                     |   |   |   |                     |   |   | A |                     |   |  | A |                     |   |  | A |                     |   |   |  |
| 560    |                     |   |   |   |                     |   |   | A |                     |   |  | A |                     |   |  | A |                     |   |   |  |
| 680    |                     |   |   |   |                     |   |   |   |                     |   |  | A |                     |   |  | A |                     |   |   |  |
| 820    |                     |   |   |   |                     |   |   |   |                     |   |  | A |                     |   |  | A |                     |   |   |  |
| 1000   |                     |   |   |   |                     |   |   |   |                     |   |  | A |                     |   |  | A |                     |   |   |  |
| 1200   |                     |   |   |   |                     |   |   |   |                     |   |  |   |                     |   |  | A |                     |   |   |  |
| 1500   |                     |   |   |   |                     |   |   |   |                     |   |  |   |                     |   |  | A |                     |   |   |  |
| 1800   |                     |   |   |   |                     |   |   |   |                     |   |  |   |                     |   |  | A |                     |   |   |  |
| 2200   |                     |   |   |   |                     |   |   |   |                     |   |  |   |                     |   |  | A |                     |   |   |  |
| 2700   |                     |   |   |   |                     |   |   |   |                     |   |  |   |                     |   |  | A |                     |   |   |  |

NB Figures in cells refer to size within ordering information

# High Voltage MLC Radials (SV Style)



## Application Information on High Voltage MLC Capacitors



High value, low leakage and small size are difficult parameters to obtain in capacitors for high voltage systems. AVX special high voltage MLC radial leaded capacitors meet these performance characteristics. The added advantage of these capacitors lies in special internal design minimizing the electric field stresses within the MLC. These special design criteria result in significant reduction of partial discharge activity within the dielectric and having, therefore, a major impact on long-term reliability of the product. The SV high voltage radial capacitors are conformally coated with high insulation resistance, high dielectric strength epoxy eliminating the possibility of arc flashover.

The SV high voltage radial MLC designs exhibit low ESRs at high frequency. The same criteria governing the high voltage design carries the added benefits of extremely low ESR in relatively low capacitance and small packages. These capacitors are designed and are ideally suited for applications such as snubbers in high frequency power converters, resonators in SMPS, and high voltage coupling/DC blocking.

## COG Dielectric General Specifications

### Capacitance Range

10 pF to .15  $\mu$ F  
(+25°C, 1.0  $\pm$ 0.2 Vrms at 1kHz,  
for  $\leq$ 100 pF use 1 MHz)

### Capacitance Tolerances

$\pm$ 5%;  $\pm$ 10%;  $\pm$ 20%

### Operating Temperature Range

-55°C to +125°C

### Temperature Characteristic

0  $\pm$  30 ppm/°C

### Voltage Ratings

1000 VDC thru 5000 VDC (+125°C)

### Dissipation Factor

0.15% max.  
(+25°C, 1.0  $\pm$ 0.2 Vrms at 1kHz,  
for  $\leq$ 100 pF use 1 MHz)

### Insulation Resistance (+25°C, at 500V)

100K M $\Omega$  min. or 1000 M $\Omega$ - $\mu$ F min.,  
whichever is less

### Insulation Resistance (+125°C, at 500V)

10K M $\Omega$  min., or 100 M $\Omega$ - $\mu$ F min.,  
whichever is less

### Dielectric Strength

120% rated voltage, 5 seconds

### Life Test

100% rated and +125°C

## X7R Dielectric General Specifications

### Capacitance Range

100 pF to 2.2  $\mu$ F  
(+25°C, 1.0  $\pm$ 0.2 Vrms at 1kHz)

### Capacitance Tolerances

$\pm$ 10%;  $\pm$ 20%; +80%, -20%

### Operating Temperature Range

-55°C to +125°C

### Temperature Characteristic

$\pm$ 15% (0 VDC)

### Voltage Ratings

1000 VDC thru 5000 VDC (+125°C)

### Dissipation Factor

2.5% max.  
(+25°C, 1.0  $\pm$ 0.2 Vrms at 1kHz)

### Insulation Resistance (+25°C, at 500V)

100K M $\Omega$  min., or 1000 M $\Omega$ - $\mu$ F min.,  
whichever is less

### Insulation Resistance (+125°C, at 500V)

10K M $\Omega$  min., or 100 M $\Omega$ - $\mu$ F min.,  
whichever is less

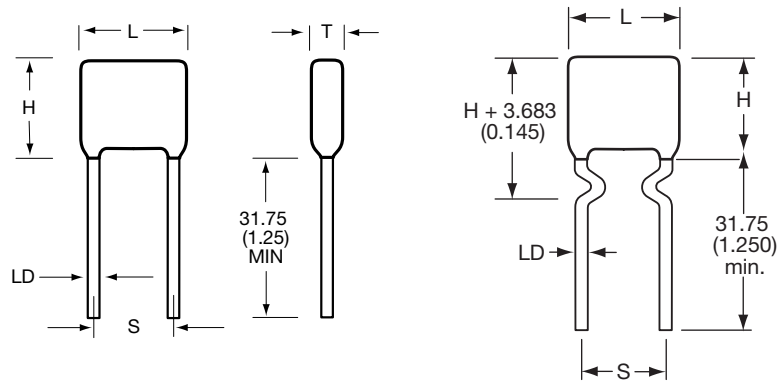
### Dielectric Strength

120% rated voltage, 5 seconds

### Life Test

100% rated and +125°C

# High Voltage MLC Radials (SV Style)



SV01 thru SV17

SV52 thru SV59 and SV63 thru SV67

## HIGH VOLTAGE RADIAL LEAD

### HOW TO ORDER

### AVX Styles: SV01 THRU SV16

| SV01                                                                                                                                                                   | A                                                                                       | A                       | 102                                                                                                                                                           | K                                                                                                          | A                           | A         | *            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------|-----------|--------------|
| AVX Style                                                                                                                                                              | Voltage                                                                                 | Temperature Coefficient | Capacitance Code                                                                                                                                              | Capacitance Tolerance                                                                                      | Test Level                  | Leads     | Packaging    |
|                                                                                                                                                                        | 1000V = A<br>1500V = S<br>2000V = G<br>2500V = W<br>3000V = H<br>4000V = J<br>5000V = K | COG = A<br>X7R = C      | (2 significant digits + no. of zeros)<br>Examples:<br>10 pF = 100<br>100 pF = 101<br>1,000 pF = 102<br>22,000 pF = 223<br>220,000 pF = 224<br>1 $\mu$ F = 105 | COG: J = $\pm$ 5%<br>K = $\pm$ 10%<br>M = $\pm$ 20%<br>X7R: K = $\pm$ 10%<br>M = $\pm$ 20%<br>Z = +80 -20% | A = Standard<br>B = Hi-Rel* | A = Leads | (See Note 1) |
| <b>Note 1:</b> No suffix signifies bulk packaging which is AVX standard packaging. Use suffix "TR1" if tape and reel is required. Parts are reel packaged per EIA-468. |                                                                                         |                         |                                                                                                                                                               |                                                                                                            |                             |           |              |

Note: Capacitors with X7R dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations.

\*Hi-Rel screening consists of 100% Group A, Subgroup 1 per MIL-PRF-49467. (Except partial discharge testing is not performed and DWV is at 120% rated voltage).

## DIMENSIONS

millimeters (inches)

| AVX Style | Length (L)<br>max | Height (H)<br>max | Thickness (T)<br>max | Lead Spacing<br>$\pm$ .762 (.030) (S) | LD (Nom)     |
|-----------|-------------------|-------------------|----------------------|---------------------------------------|--------------|
| SV01      | 6.35 (0.250)      | 5.59 (0.220)      | 5.08 (0.200)         | 4.32 (0.170)                          | 0.64 (0.025) |
| SV02/SV52 | 8.13 (0.320)      | 7.11 (0.280)      | 5.08 (0.200)         | 5.59 (0.220)                          | 0.64 (0.025) |
| SV03/SV53 | 9.40 (0.370)      | 7.62 (0.300)      | 5.08 (0.200)         | 6.99 (0.275)                          | 0.64 (0.025) |
| SV04/SV54 | 11.4 (0.450)      | 5.59 (0.220)      | 5.08 (0.200)         | 7.62 (0.300)                          | 0.64 (0.025) |
| SV05/SV55 | 11.9 (0.470)      | 10.2 (0.400)      | 5.08 (0.200)         | 9.52 (0.375)                          | 0.64 (0.025) |
| SV06/SV56 | 14.0 (0.550)      | 7.11 (0.280)      | 5.08 (0.200)         | 10.16 (0.400)                         | 0.64 (0.025) |
| SV07/SV57 | 14.5 (0.570)      | 12.7 (0.500)      | 5.08 (0.200)         | 12.1 (0.475)                          | 0.64 (0.025) |
| SV08/SV58 | 17.0 (0.670)      | 15.2 (0.600)      | 5.08 (0.200)         | 14.6 (0.575)                          | 0.64 (0.025) |
| SV09/SV59 | 19.6 (0.770)      | 18.3 (0.720)      | 5.08 (0.200)         | 17.1 (0.675)                          | 0.64 (0.025) |
| SV10      | 26.7 (1.050)      | 12.7 (0.500)      | 5.08 (0.200)         | 22.9 (0.900)                          | 0.64 (0.025) |
| SV11      | 31.8 (1.250)      | 15.2 (0.600)      | 5.08 (0.200)         | 27.9 (1.100)                          | 0.64 (0.025) |
| SV12      | 36.8 (1.450)      | 18.3 (0.720)      | 5.08 (0.200)         | 33.0 (1.300)                          | 0.64 (0.025) |
| SV13/SV63 | 7.62 (0.300)      | 9.14 (0.360)      | 5.08 (0.200)         | 5.08 (0.200)                          | 0.51 (0.020) |
| SV14/SV64 | 10.2 (0.400)      | 11.7 (0.460)      | 5.08 (0.200)         | 5.08 (0.200)                          | 0.51 (0.020) |
| SV15/SV65 | 12.7 (0.500)      | 14.2 (0.560)      | 5.08 (0.200)         | 10.2 (0.400)                          | 0.64 (0.025) |
| SV16/SV66 | 22.1 (0.870)      | 16.8 (0.660)      | 5.08 (0.200)         | 20.1 (0.790)                          | 0.81 (0.032) |
| SV17/SV67 | 23.6 (0.930)      | 19.8 (0.780)      | 6.35 (0.250)         | 20.3 (0.800)                          | 0.81 (0.032) |

| TAPE & REEL QUANTITY |        |
|----------------------|--------|
| Part                 | Pieces |
| SV01/SV51            | 1000   |
| SV02/SV52            | 1000   |
| SV03/SV53            | 1000   |
| SV04/SV54            | 1000   |
| SV05/SV55            | 1000   |
| SV06/SV56            | 500    |
| SV07/SV57            | 500    |
| SV08/SV58            | 500    |
| SV09/SV59            | 500    |
| SV10                 | 400    |
| SV11                 | 400    |
| SV12                 | 300    |
| SV13/SV63            | 1000   |
| SV14/SV64            | 1000   |
| SV15/SV65            | 500    |
| SV16/SV66            | 500    |
| SV17/SV67            | 400    |

# High Voltage MLC Radials (SV Style)



## CAPACITANCE VALUE

| C0G       |                    |                    |                    |                    |                    |                    |                    |
|-----------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Style     | 1000V<br>min./max. | 1500V<br>min./max. | 2000V<br>min./max. | 2500V<br>min./max. | 3000V<br>min./max. | 4000V              | 5000V              |
| SV01      | 100 pF / 1000 pF   | 10 pF / 330 pF     | 10 pF / 180 pF     | 10 pF / 120 pF     | 10 pF / 82 pF      | —                  | —                  |
| SV02/SV52 | 100 pF / 3300 pF   | 100 pF / 1200 pF   | 10 pF / 680 pF     | 10 pF / 470 pF     | 10 pF / 270 pF     | 10 pF / 150 pF     | 10 pF / 100 pF     |
| SV03/SV53 | 100 pF / 5600 pF   | 100 pF / 2200 pF   | 100 pF / 1200 pF   | 10 pF / 820 pF     | 10 pF / 470 pF     | 10 pF / 270 pF     | 10 pF / 180 pF     |
| SV04/SV54 | 100 pF / 2200 pF   | 10 pF / 820 pF     | 10 pF / 470 pF     | 10 pF / 270 pF     | 10 pF / 180 pF     | 10 pF / 100 pF     | 10 pF / 68 pF      |
| SV05/SV55 | 1000 pF / 0.015 µF | 100 pF / 5600 pF   | 100 pF / 3300 pF   | 100 pF / 2200 pF   | 100 pF / 1200 pF   | 10 pF / 680 pF     | 10 pF / 470 pF     |
| SV06/SV56 | 100 pF / 6800 pF   | 100 pF / 2700 pF   | 100 pF / 1500 pF   | 10 pF / 820 pF     | 10 pF / 560 pF     | 10 pF / 330 pF     | 10 pF / 220 pF     |
| SV07/SV57 | 1000 pF / 0.027 µF | 1000 pF / 0.012 µF | 100 pF / 5600 pF   | 100 pF / 3900 pF   | 100 pF / 2200 pF   | 100 pF / 1200 pF   | 10 pF / 820 pF     |
| SV08/SV58 | 1000 pF / 0.039 µF | 1000 pF / 0.018 µF | 1000 pF / 0.01 µF  | 100 pF / 6800 pF   | 100 pF / 3900 pF   | 100 pF / 2200 pF   | 100 pF / 1500 pF   |
| SV09/SV59 | 1000 pF / 0.068 µF | 1000 pF / 0.027 µF | 1000 pF / 0.015 µF | 1000 pF / 0.010 µF | 100 pF / 6800 pF   | 100 pF / 3900 pF   | 100 pF / 2700 pF   |
| SV10      | 1000 pF / 0.056 µF | 1000 pF / 0.022 µF | 1000 pF / 0.012 µF | 100 pF / 8200 pF   | 100 pF / 5600 pF   | 100 pF / 3300 pF   | 100 pF / 2200 pF   |
| SV11      | 1000 pF / 0.082 µF | 1000 pF / 0.039 µF | 1000 pF / 0.022 µF | 1000 pF / 0.015 µF | 100 pF / 8200 pF   | 100 pF / 4700 pF   | 100 pF / 3300 pF   |
| SV12      | 0.01 µF / 0.15 µF  | 1000 pF / 0.056 µF | 1000 pF / 0.033 µF | 1000 pF / 0.022 µF | 1000 pF / 0.015 µF | 100 pF / 8200 pF   | 100 pF / 5600 pF   |
| SV13/SV63 | 100 pF / 8200 pF   | 100 pF / 3300 pF   | 100 pF / 1800 pF   | 100 pF / 1200 pF   | 100 pF / 820 pF    | 10 pF / 390 pF     | 10 pF / 270 pF     |
| SV14/SV64 | 1000 pF / 0.015 µF | 100 pF / 6800 pF   | 100 pF / 4700 pF   | 100 pF / 2700 pF   | 100 pF / 1500 pF   | 10 pF / 820 pF     | 10 pF / 560 pF     |
| SV15/SV65 | 1000 pF / 0.033 µF | 1000 pF / 0.015 µF | 100 pF / 0.01 µF   | 100 pF / 5600 pF   | 100 pF / 2700 pF   | 100 pF / 1800 pF   | 100 pF / 1200 pF   |
| SV16/SV66 | 1000 pF / 0.068 µF | 1000 pF / 0.027 µF | 1000 pF / 0.018 µF | 1000 pF / 0.010 µF | 100 pF / 6800 pF   | 100 pF / 3900 pF   | 100 pF / 2700 pF   |
| SV17/SV67 | 1000 pF / 0.10 µF  | 1000 pF / 0.056 µF | 1000 pF / 0.039 µF | 1000 pF / 0.022 µF | 1000 pF / 0.012 µF | 100 pF / 6800 pF   | 100 pF / 4700 pF   |
| X7R       |                    |                    |                    |                    |                    |                    |                    |
| SV01      | 1000 pF / 0.012 µF | 100 pF / 3900 pF   | 100 pF / 1500 pF   | —                  | —                  | —                  | —                  |
| SV02/SV52 | 1000 pF / 0.047 µF | 1000 pF / 0.015 µF | 100 pF / 5600 pF   | 100 pF / 3900 pF   | 100 pF / 2700 pF   | —                  | —                  |
| SV03/SV53 | 1000 pF / 0.082 µF | 1000 pF / 0.018 µF | 1000 pF / 0.01 µF  | 100 pF / 6800 pF   | 100 pF / 4700 pF   | 100 pF / 1800 pF   | —                  |
| SV04/SV54 | 1000 pF / 0.033 µF | 100 pF / 6800 pF   | 100 pF / 3900 pF   | 100 pF / 2200 pF   | 100 pF / 1800 pF   | 100 pF / 820 pF    | —                  |
| SV05/SV55 | 0.01 µF / 0.22 µF  | 1000 pF / 0.056 µF | 1000 pF / 0.027 µF | 1000 pF / 0.018 µF | 1000 pF / 0.012 µF | 100 pF / 4700 pF   | —                  |
| SV06/SV56 | 0.01 µF / 0.10 µF  | 1000 pF / 0.033 µF | 1000 pF / 0.012 µF | 100 pF / 8200 pF   | 100 pF / 6800 pF   | 100 pF / 2700 pF   | 100 pF / 1200 pF   |
| SV07/SV57 | 0.01 µF / 0.39 µF  | 0.01 µF / 0.10 µF  | 1000 pF / 0.047 µF | 1000 pF / 0.033 µF | 1000 pF / 0.027 µF | 1000 pF / 0.01 µF  | 100 pF / 6800 pF   |
| SV08/SV58 | 0.01 µF / 0.68 µF  | 0.01 µF / 0.18 µF  | 1000 pF / 0.082 µF | 1000 pF / 0.068 µF | 1000 pF / 0.047 µF | 1000 pF / 0.018 µF | 1000 pF / 0.012 µF |
| SV09/SV59 | 0.10 µF / 1.00 µF  | 0.01 µF / 0.27 µF  | 0.01 µF / 0.12 µF  | 0.01 µF / 0.10 µF  | 1000 pF / 0.068 µF | 1000 pF / 0.027 µF | 1000 pF / 0.018 µF |
| SV10      | 0.01 µF / 0.82 µF  | 0.01 µF / 0.22 µF  | 0.01 µF / 0.10 µF  | 1000 pF / 0.082 µF | 1000 pF / 0.056 µF | 1000 pF / 0.022 µF | 1000 pF / 0.018 µF |
| SV11      | 0.10 µF / 1.2 µF   | 0.01 µF / 0.39 µF  | 0.01 µF / 0.18 µF  | 0.01 µF / 0.15 µF  | 0.01 µF / 0.10 µF  | 1000 pF / 0.039 µF | 1000 pF / 0.027 µF |
| SV12      | 0.10 µF / 2.20 µF  | 0.01 µF / 0.56 µF  | 0.01 µF / 0.27 µF  | 0.01 µF / 0.22 µF  | 0.01 µF / 0.15 µF  | 1000 pF / 0.056 µF | 1000 pF / 0.033 µF |
| SV13/SV63 | 0.01 µF / 0.10 µF  | 1000 pF / 0.033 µF | 1000 pF / 0.012 µF | 1000 pF / 0.01 µF  | 100 pF / 6800 pF   | 100 pF / 2700 pF   | —                  |
| SV14/SV64 | 0.01 µF / 0.18 µF  | 1000 pF / 0.068 µF | 1000 pF / 0.022 µF | 1000 pF / 0.018 µF | 1000 pF / 0.015 µF | 100 pF / 5600 pF   | —                  |
| SV15/SV65 | 0.01 µF / 0.27 µF  | 0.01 µF / 0.10 µF  | 1000 pF / 0.033 µF | 1000 pF / 0.027 µF | 1000 pF / 0.022 µF | 1000 pF / 8200 pF  | 100 pF / 4700 pF   |
| SV16/SV66 | 0.01 µF / 1.0 µF   | 0.01 µF / 0.27 µF  | 0.01 µF / 0.12 µF  | 0.01 µF / 0.10 µF  | 1000 pF / 0.068 µF | 1000 pF / 0.027 µF | 1000 pF / 0.018 µF |
| SV17/SV67 | 0.01 µF / 1.2 µF   | 0.01 µF / 0.39 µF  | 0.01 µF / 0.15 µF  | 0.01 µF / 0.12 µF  | 1000 pF / 0.082 µF | 1000 pF / 0.039 µF | 1000 pF / 0.027 µF |

Note: Contact factory for other voltage ratings or values.

## AVX IS QUALIFIED TO THE FOLLOWING DSCC DRAWINGS

| Specification # | Description  | Capacitance Range |
|-----------------|--------------|-------------------|
| 87046           | C0G-1000 VDC | 10 pF - 0.025 µF  |
| 87043           | X7R-1000 VDC | 100 pF - 0.47 µF  |
| 87040           | X7R-2000 VDC | 100 pF - 0.22 µF  |
| 87114           | C0G-3000 VDC | 10 pF - 8200 pF   |
| 87047           | X7R-3000 VDC | 100 pF - 0.1 µF   |
| 87076           | C0G-4000 VDC | 10 pF - 6800 pF   |
| 89044           | X7R-4000 VDC | 100 pF - 0.056 µF |
| 87077           | C0G-5000 VDC | 10 pF - 5600 pF   |
| 87070           | X7R-5000 VDC | 100 pF - 0.033 µF |

These specifications require group A and B testing per MIL-PRF-49467



# MLC Chip Capacitors



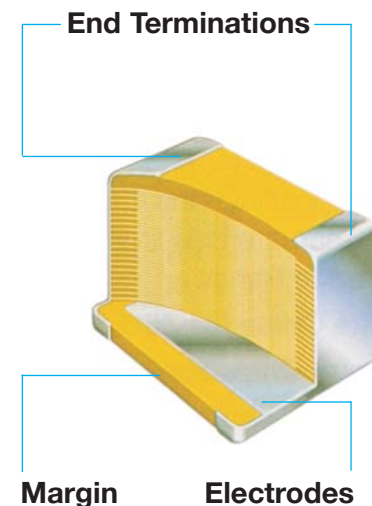
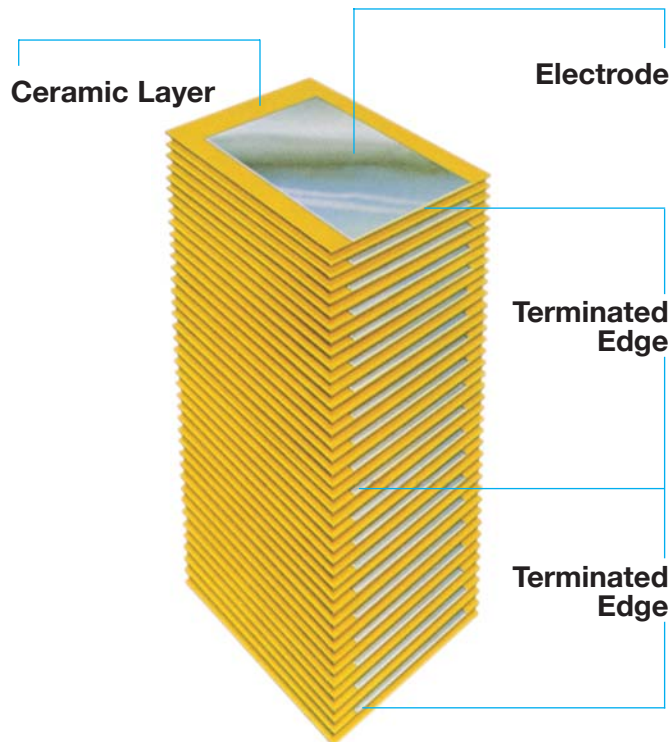
## Basic Construction

A multilayer ceramic (MLC) capacitor is a monolithic block of ceramic containing two sets of offset, interleaved planar electrodes that extend to two opposite surfaces of the ceramic dielectric. This simple structure requires a

considerable amount of sophistication, both in material and in manufacture, to produce it in the quality and quantities needed in today's electronic equipment.

## Terminations

- Standard Nickel Barrier  
T = Lead Free Tin Plate  
J = 5% minimum Lead Plated
- Leach resistance to 90 seconds at 260°C
- Solderable plated for dimensional control
- Special materials as required



## QUALITY STATEMENT

AVX focus is customer satisfaction – Customer satisfaction in the broadest sense: Products, service, price, delivery, technical support, and all the aspects of a business that impact you, the customer.

Our long term strategy is for continuous improvement which is defined by our Quality Vision 2000. This is a total quality management system developed by and supported by AVX corporate management. The foundation of QV2000 is built

upon military and commercial standards and systems including ISO9001. QV2000 is a natural extension of past quality efforts with world class techniques for ensuring a total quality environment to satisfy our customers during this decade and into the 21st century.

As your components supplier, we invite you to experience the quality, service, and commitment of AVX.

**Table 1: EIA and MIL Temperature Stable and General Application Codes**

| <b>EIA CODE</b>                                                                                                                                                            |                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| <b>Percent Capacity Change Over Temperature Range</b>                                                                                                                      |                                |
| <b>RS198</b>                                                                                                                                                               | <b>Temperature Range</b>       |
| X7                                                                                                                                                                         | -55°C to +125°C                |
| X5                                                                                                                                                                         | -55°C to +85°C                 |
| Y5                                                                                                                                                                         | -30°C to +85°C                 |
| Z5                                                                                                                                                                         | +10°C to +85°C                 |
| <b>Code</b>                                                                                                                                                                | <b>Percent Capacity Change</b> |
| D                                                                                                                                                                          | ±3.3%                          |
| E                                                                                                                                                                          | ±4.7%                          |
| F                                                                                                                                                                          | ±7.5%                          |
| P                                                                                                                                                                          | ±10%                           |
| R                                                                                                                                                                          | ±15%                           |
| S                                                                                                                                                                          | ±22%                           |
| T                                                                                                                                                                          | +22%, -33%                     |
| U                                                                                                                                                                          | +22%, -56%                     |
| V                                                                                                                                                                          | +22%, -82%                     |
| EXAMPLE – A capacitor is desired with the capacitance value at 25°C to increase no more than 7.5% or decrease no more than 7.5% from -30°C to +85°C. EIA Code will be Y5F. |                                |

| <b>MIL CODE</b>                                                                                                                                                                                       |                               |                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|--------------------------------|
| <b>Symbol</b>                                                                                                                                                                                         | <b>Temperature Range</b>      |                                |
| A                                                                                                                                                                                                     | -55°C to +85°C                |                                |
| B                                                                                                                                                                                                     | -55°C to +125°C               |                                |
| C                                                                                                                                                                                                     | -55°C to +150°C               |                                |
| <b>Symbol</b>                                                                                                                                                                                         | <b>Cap. Change Zero Volts</b> | <b>Cap. Change Rated Volts</b> |
| Q                                                                                                                                                                                                     | +15%, -15%                    | +15%, -50%                     |
| R                                                                                                                                                                                                     | +15%, -15%                    | +15%, -40%                     |
| W                                                                                                                                                                                                     | +22%, -56%                    | +22%, -66%                     |
| X                                                                                                                                                                                                     | +15%, -15%                    | +15%, -25%                     |
| Y                                                                                                                                                                                                     | +30%, -70%                    | +30%, -80%                     |
| Z                                                                                                                                                                                                     | +20%, -20%                    | +20%, -30%                     |
| Temperature characteristic is specified by combining range and change symbols, for example BR or AW. Specification slash sheets indicate the characteristic applicable to a given style of capacitor. |                               |                                |

In specifying capacitance change with temperature for Class 2 materials, EIA expresses the capacitance change over an operating temperature range by a 3 symbol code. The first symbol represents the cold temperature end of the temperature range, the second represents the upper limit of the operating temperature range and the third symbol represents the capacitance change allowed over the operating temperature range. Table 1 provides a detailed explanation of the EIA system.

**Effects of Voltage** – Variations in voltage have little effect on Class 1 dielectric but does affect the capacitance and dissipation factor of Class 2 dielectrics. The application of DC voltage reduces both the capacitance and dissipation factor while the application of an AC voltage within a reasonable range tends to increase both capacitance and dissipation factor readings. If a high enough AC voltage is applied, eventually it will reduce capacitance just as a DC voltage will. Figure 2 shows the effects of AC voltage.

**Cap. Change vs. A.C. Volts**  
**X7R**



Figure 2

Capacitor specifications specify the AC voltage at which to measure (normally 0.5 or 1 VAC) and application of the wrong voltage can cause spurious readings.

**Typical Cap. Change vs. Temperature**  
**X7R**

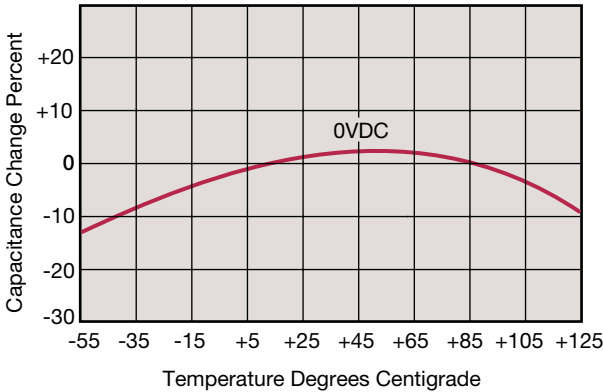


Figure 3

**Effects of Time** – Class 2 ceramic capacitors change capacitance and dissipation factor with time as well as temperature, voltage and frequency. This change with time is known as aging. Aging is caused by a gradual re-alignment of the crystalline structure of the ceramic and produces an exponential loss in capacitance and decrease in dissipation factor versus time. A typical curve of aging rate for semi-stable ceramics is shown in Figure 4.

If a Class 2 ceramic capacitor that has been sitting on the shelf for a period of time, is heated above its curie point, (125°C for 4 hours or 150°C for ½ hour will suffice) the part will de-age and return to its initial capacitance and dissipation factor readings. Because the capacitance changes rapidly, immediately after de-aging, the basic capacitance measurements are normally referred to a time period some-time after the de-aging process. Various manufacturers use different time bases but the most popular one is one day or twenty-four hours after “last heat.” Change in the aging curve can be caused by the application of voltage and other stresses. The possible changes in capacitance due to de-aging by heating the unit explain why capacitance changes are allowed after test, such as temperature cycling, moisture resistance, etc., in MIL specs. The application of high voltages such as dielectric withstanding voltages also tends to de-age capacitors and is why re-reading of capacitance after 12 or 24 hours is allowed in military specifications after dielectric strength tests have been performed.

**Effects of Frequency** – Frequency affects capacitance and impedance characteristics of capacitors. This effect is much more pronounced in high dielectric constant ceramic formulation than in low K formulations. AVX’s SpiCalci software generates impedance, ESR, series inductance, series resonant frequency and capacitance all as functions of frequency, temperature and DC bias for standard chip sizes and styles. It is available free from AVX and can be downloaded for free from AVX website: [www.avx.com](http://www.avx.com).

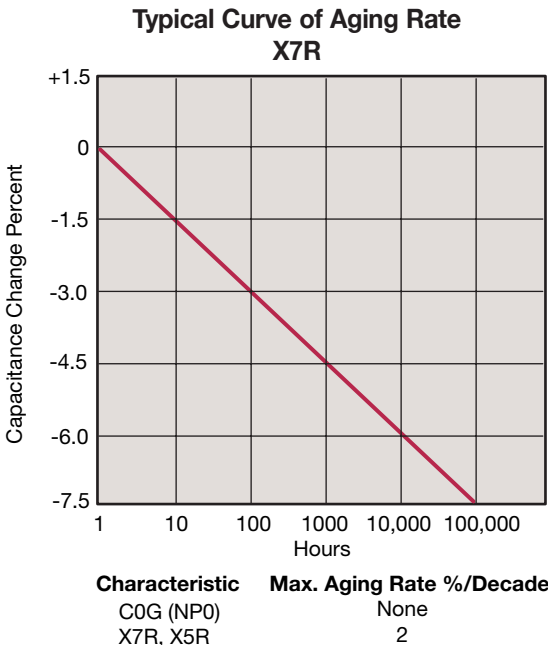


Figure 4

**Effects of Mechanical Stress** – High “K” dielectric ceramic capacitors exhibit some low level piezoelectric reactions under mechanical stress. As a general statement, the piezo-electric output is higher, the higher the dielectric constant of the ceramic. It is desirable to investigate this effect before using high “K” dielectrics as coupling capacitors in extremely low level applications.

**Reliability** – Historically ceramic capacitors have been one of the most reliable types of capacitors in use today. The approximate formula for the reliability of a ceramic capacitor is:

$$\frac{L_o}{L_t} = \left(\frac{V_t}{V_o}\right)^X \left(\frac{T_t}{T_o}\right)^Y$$

where

|                           |                               |
|---------------------------|-------------------------------|
| $L_o$ = operating life    | $T_t$ = test temperature and  |
| $L_t$ = test life         | $T_o$ = operating temperature |
| $V_t$ = test voltage      | in °C                         |
| $V_o$ = operating voltage | <b>X,Y</b> = see text         |

Historically for ceramic capacitors exponent X has been considered as 3. The exponent Y for temperature effects typically tends to run about 8.

A capacitor is a component which is capable of storing electrical energy. It consists of two conductive plates (electrodes) separated by insulating material which is called the dielectric. A typical formula for determining capacitance is:

$$C = \frac{.224 KA}{t}$$

**C** = capacitance (picofarads)

**K** = dielectric constant (Vacuum = 1)

**A** = area in square inches

**t** = separation between the plates in inches  
(thickness of dielectric)

**.224** = conversion constant

(.0884 for metric system in cm)

**Capacitance** – The standard unit of capacitance is the farad. A capacitor has a capacitance of 1 farad when 1 coulomb charges it to 1 volt. One farad is a very large unit and most capacitors have values in the micro ( $10^{-6}$ ), nano ( $10^{-9}$ ) or pico ( $10^{-12}$ ) farad level.

**Dielectric Constant** – In the formula for capacitance given above the dielectric constant of a vacuum is arbitrarily chosen as the number 1. Dielectric constants of other materials are then compared to the dielectric constant of a vacuum.

**Dielectric Thickness** – Capacitance is indirectly proportional to the separation between electrodes. Lower voltage requirements mean thinner dielectrics and greater capacitance per volume.

**Area** – Capacitance is directly proportional to the area of the electrodes. Since the other variables in the equation are usually set by the performance desired, area is the easiest parameter to modify to obtain a specific capacitance within a material group.

**Energy Stored** – The energy which can be stored in a capacitor is given by the formula:

$$E = \frac{1}{2}CV^2$$

**E** = energy in joules (watts-sec)

**V** = applied voltage

**C** = capacitance in farads

**Potential Change** – A capacitor is a reactive component which reacts against a change in potential across it. This is shown by the equation for the linear charge of a capacitor:

$$I_{ideal} = C \frac{dV}{dt}$$

where

**I** = Current

**C** = Capacitance

**dV/dt** = Slope of voltage transition across capacitor

Thus an infinite current would be required to instantly change the potential across a capacitor. The amount of current a capacitor can “sink” is determined by the above equation.

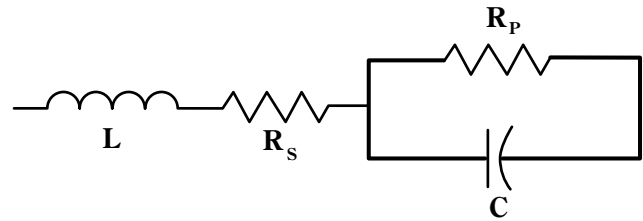
**Equivalent Circuit** – A capacitor, as a practical device, exhibits not only capacitance but also resistance and inductance. A simplified schematic for the equivalent circuit is:

**C** = Capacitance

**L** = Inductance

**R<sub>s</sub>** = Series Resistance

**R<sub>p</sub>** = Parallel Resistance



**Reactance** – Since the insulation resistance ( $R_p$ ) is normally very high, the total impedance of a capacitor is:

$$Z = \sqrt{R_s^2 + (X_c - X_L)^2}$$

where

**Z** = Total Impedance

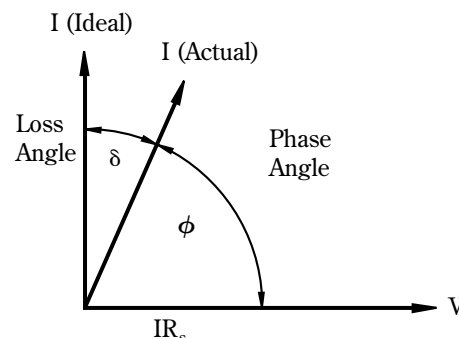
**R<sub>s</sub>** = Series Resistance

**X<sub>c</sub>** = Capacitive Reactance =  $\frac{1}{2\pi fC}$

**X<sub>L</sub>** = Inductive Reactance =  $2\pi fL$

The variation of a capacitor's impedance with frequency determines its effectiveness in many applications.

**Phase Angle** – Power Factor and Dissipation Factor are often confused since they are both measures of the loss in a capacitor under AC application and are often almost identical in value. In a “perfect” capacitor the current in the capacitor will lead the voltage by  $90^\circ$ .



In practice the current leads the voltage by some other phase angle due to the series resistance  $R_s$ . The complement of this angle is called the loss angle and:

Power Factor (P.F.) =  $\cos \phi$  or  $\sin \delta$

Dissipation Factor (D.F.) =  $\tan \delta$

for small values of  $\delta$  the tan and sine are essentially equal which has led to the common interchangeability of the two terms in the industry.

**Equivalent Series Resistance** – The term E.S.R. or Equivalent Series Resistance combines all losses both series and parallel in a capacitor at a given frequency so that the equivalent circuit is reduced to a simple R-C series connection.



**Dissipation Factor** – The DF/PF of a capacitor tells what percent of the apparent power input will turn to heat in the capacitor.

$$\text{Dissipation Factor} = \frac{\text{E.S.R.}}{X_c} = (2 \pi fC) (\text{E.S.R.})$$

The watts loss are:

$$\text{Watts loss} = (2 \pi fCV^2) (\text{D.F.})$$

Very low values of dissipation factor are expressed as their reciprocal for convenience. These are called the “Q” or Quality factor of capacitors.

**Parasitic Inductance** – The parasitic inductance of capacitors is becoming more and more important in the decoupling of today’s high speed digital systems. The relationship between the inductance and the ripple voltage induced on the DC voltage line can be seen from the simple inductance equation:

$$V = L \frac{di}{dt}$$

The  $\frac{di}{dt}$  seen in current microprocessors can be as high as 0.3 A/ns, and up to 10A/ns. At 0.3 A/ns, 100pH of parasitic inductance can cause a voltage spike of 30mV. While this does not sound very drastic, with the Vcc for microprocessors decreasing at the current rate, this can be a fairly large percentage.

Another important, often overlooked, reason for knowing the parasitic inductance is the calculation of the resonant frequency. This can be important for high frequency, by-pass capacitors, as the resonant point will give the most signal attenuation. The resonant frequency is calculated from the simple equation:

$$f_{res} = \frac{1}{2\pi\sqrt{LC}}$$

**Insulation Resistance** – Insulation Resistance is the resistance measured across the terminals of a capacitor and consists principally of the parallel resistance  $R_P$  shown in the equivalent circuit. As capacitance values and hence the area of dielectric increases, the I.R. decreases and hence the product ( $C \times IR$  or  $RC$ ) is often specified in ohm farads or more commonly megohm-microfarads. Leakage current is determined by dividing the rated voltage by IR (Ohm’s Law).

**Dielectric Strength** – Dielectric Strength is an expression of the ability of a material to withstand an electrical stress. Although dielectric strength is ordinarily expressed in volts, it is actually dependent on the thickness of the dielectric and thus is also more generically a function of volts/mil.

**Dielectric Absorption** – A capacitor does not discharge instantaneously upon application of a short circuit, but drains gradually after the capacitance proper has been discharged. It is common practice to measure the dielectric absorption by determining the “reappearing voltage” which appears across a capacitor at some point in time after it has been fully discharged under short circuit conditions.

**Corona** – Corona is the ionization of air or other vapors which causes them to conduct current. It is especially prevalent in high voltage units but can occur with low voltages as well where high voltage gradients occur. The energy discharged degrades the performance of the capacitor and can in time cause catastrophic failures.

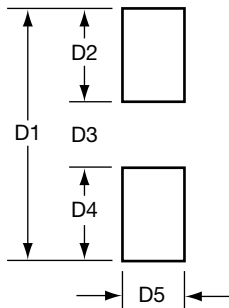
# Surface Mounting Guide

## MLC Chip Capacitors



### SOLDER PAD DESIGN

millimeters (inches)



| Case Size | D1            | D2           | D3           | D4           | D5            |
|-----------|---------------|--------------|--------------|--------------|---------------|
| 0805      | 3.00 (0.120)  | 1.00 (0.040) | 1.00 (0.040) | 1.00 (0.040) | 1.25 (0.050)  |
| 1206      | 4.00 (0.160)  | 1.00 (0.040) | 2.00 (0.090) | 1.00 (0.040) | 1.60 (0.060)  |
| 1210      | 4.00 (0.160)  | 1.00 (0.040) | 2.00 (0.090) | 1.00 (0.040) | 2.50 (0.100)  |
| *1808     | 5.60 (0.220)  | 1.00 (0.040) | 3.60 (0.140) | 1.00 (0.040) | 2.00 (0.080)  |
| *1812     | 5.60 (0.220)  | 1.00 (0.040) | 3.60 (0.140) | 1.00 (0.040) | 3.00 (0.120)  |
| *1825     | 5.60 (0.220)  | 1.00 (0.040) | 3.60 (0.140) | 1.00 (0.040) | 6.35 (0.250)  |
| *2220     | 6.60 (0.260)  | 1.00 (0.040) | 4.60 (0.180) | 1.00 (0.040) | 5.00 (0.200)  |
| *2225     | 6.60 (0.260)  | 1.00 (0.040) | 4.60 (0.180) | 1.00 (0.040) | 6.35 (0.250)  |
| *HQCC     | 6.60 (0.260)  | 1.00 (0.040) | 4.60 (0.180) | 1.00 (0.040) | 6.35 (0.250)  |
| *3640     | 10.67 (0.427) | 1.52 (0.060) | 7.62 (0.300) | 1.52 (0.060) | 10.16 (0.400) |
| *HQCE     | 10.67 (0.427) | 1.52 (0.060) | 7.62 (0.300) | 1.52 (0.060) | 10.16 (0.400) |

\*AVX recommends reflow soldering only.

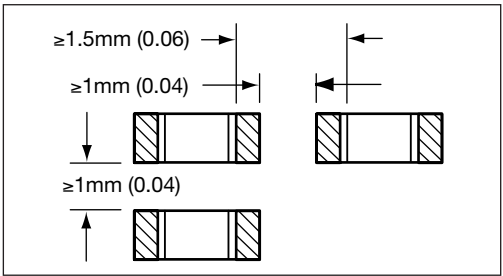
### Component Pad Design

Component pads should be designed to achieve good solder fillets and minimize component movement during reflow soldering. Pad designs are given for the most common sizes of multilayer ceramic capacitors for both wave and reflow soldering. The basis of these designs is:

- Pad width equal to component width. It is permissible to decrease this to as low as 85% of component width but it is not advisable to go below this.
- Pad overlap 0.5mm beneath component.
- Pad extension 0.5mm beyond components for reflow and 1.0mm for wave soldering.

### Component Spacing

For wave soldering components, must be spaced sufficiently far apart to avoid bridging or shadowing (inability of solder to penetrate properly into small spaces). This is less important for reflow soldering but sufficient space must be allowed to enable rework should it be required.



### Preheat & Soldering

The rate of preheat should not exceed 4°C/second to prevent thermal shock. A better maximum figure is about 2°C/second.

For capacitors size 1206 and below, with a maximum thickness of 1.25mm, it is generally permissible to allow a temperature differential from preheat to soldering of 150°C. In all other cases this differential should not exceed 100°C.

For further specific application or process advice, please consult AVX.

### Cleaning

Care should be taken to ensure that the capacitors are thoroughly cleaned of flux residues especially the space beneath the capacitor. Such residues may otherwise become conductive and effectively offer a low resistance bypass to the capacitor.

Ultrasonic cleaning is permissible, the recommended conditions being 8 Watts/litre at 20-45 kHz, with a process cycle of 2 minutes vapor rinse, 2 minutes immersion in the ultrasonic solvent bath and finally 2 minutes vapor rinse.

# Surface Mounting Guide



## MLC Chip Capacitors

### APPLICATION NOTES

#### Storage

Good solderability is maintained for at least twelve months, provided the components are stored in their "as received" packaging at less than 40°C and 70% RH.

#### Solderability

Terminations to be well soldered after immersion in a 60/40 tin/lead solder bath at  $235 \pm 5^\circ\text{C}$  for  $2 \pm 1$  seconds.

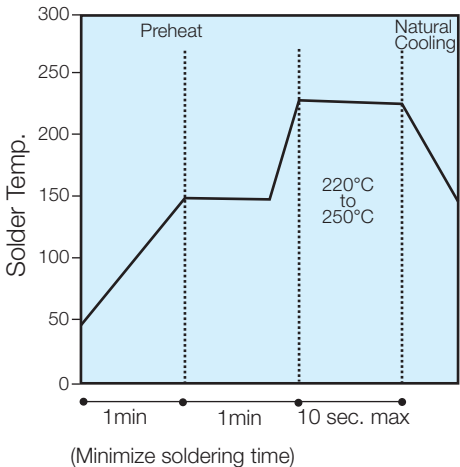
#### Leaching

Terminations will resist leaching for at least the immersion times and conditions shown below.

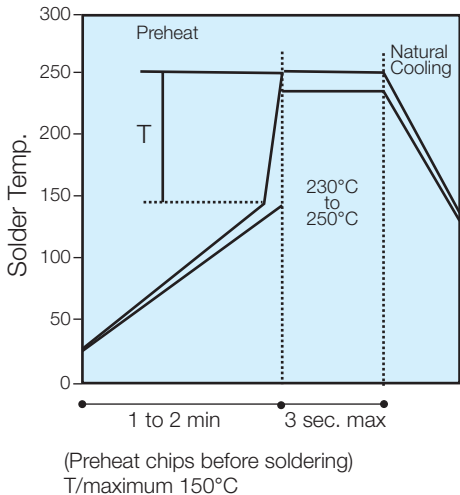
| Termination Type | Solder Tin/Lead/Silver | Solder Temp. °C | Immersion Time Seconds |
|------------------|------------------------|-----------------|------------------------|
| Nickel Barrier   | 60/40/0                | $260 \pm 5$     | $30 \pm 1$             |

### Recommended Soldering Profiles

#### Reflow



#### Wave



### General

Surface mounting chip multilayer ceramic capacitors are designed for soldering to printed circuit boards or other substrates. The construction of the components is such that they will withstand the time/temperature profiles used in both wave and reflow soldering methods.

### Handling

Chip multilayer ceramic capacitors should be handled with care to avoid damage or contamination from perspiration and skin oils. The use of tweezers or vacuum pick ups is strongly recommended for individual components. Bulk handling should ensure that abrasion and mechanical shock are minimized. Taped and reeled components provides the ideal medium for direct presentation to the placement machine. Any mechanical shock should be minimized during handling chip multilayer ceramic capacitors.

### Preheat

It is important to avoid the possibility of thermal shock during soldering and carefully controlled preheat is therefore required. The rate of preheat should not exceed  $4^\circ\text{C}/\text{second}$  and a target figure  $2^\circ\text{C}/\text{second}$  is recommended. Although an  $80^\circ\text{C}$  to  $120^\circ\text{C}$  temperature differential is preferred, recent developments allow a temperature differential between the component surface and the soldering temperature of  $150^\circ\text{C}$  (Maximum) for capacitors of 1210 size and below with a maximum thickness of 1.25mm. The user is cautioned that the risk of thermal shock increases as chip size or temperature differential increases.

### Soldering

Mildly activated rosin fluxes are preferred. The minimum amount of solder to give a good joint should be used. Excessive solder can lead to damage from the stresses caused by the difference in coefficients of expansion between solder, chip and substrate. AVX terminations are suitable for all wave and reflow soldering systems. If hand soldering cannot be avoided, the preferred technique is the utilization of hot air soldering tools.

### Cooling

Natural cooling in air is preferred, as this minimizes stresses within the soldered joint. When forced air cooling is used, cooling rate should not exceed  $4^\circ\text{C}/\text{second}$ . Quenching is not recommended but if used, maximum temperature differentials should be observed according to the preheat conditions above.

### Cleaning

Flux residues may be hygroscopic or acidic and must be removed. AVX MLC capacitors are acceptable for use with all of the solvents described in the specifications MIL-STD-202 and EIA-RS-198. Alcohol based solvents are acceptable and properly controlled water cleaning systems are also acceptable. Many other solvents have been proven successful, and most solvents that are acceptable to other components on circuit assemblies are equally acceptable for use with ceramic capacitors.

## MLC Chip Capacitors

### POST SOLDER HANDLING

Once SMP components are soldered to the board, any bending or flexure of the PCB applies stresses to the soldered joints of the components. For leaded devices, the stresses are absorbed by the compliancy of the metal leads and generally don't result in problems unless the stress is large enough to fracture the soldered connection.

Ceramic capacitors are more susceptible to such stress because they don't have compliant leads and are brittle in nature. The most frequent failure mode is low DC resistance or short circuit. The second failure mode is significant loss of capacitance due to severing of contact between sets of the internal electrodes.

Cracks caused by mechanical flexure are very easily identified and generally take one of the following two general forms:



Type A:

Angled crack between bottom of device to top of solder joint.



Type B:

Fracture from top of device to bottom of device.

Mechanical cracks are often hidden underneath the termination and are difficult to see externally. However, if one end termination falls off during the removal process from PCB, this is one indication that the cause of failure was excessive mechanical stress due to board warping.

### COMMON CAUSES OF MECHANICAL CRACKING

The most common source for mechanical stress is board depanelization equipment, such as manual breakapart, v-cutters and shear presses. Improperly aligned or dull cutters may cause torqueing of the PCB resulting in flex stresses being transmitted to components near the board edge. Another common source of flexural stress is contact during parametric testing when test points are probed. If the PCB is allowed to flex during the test cycle, nearby ceramic capacitors may be broken.

A third common source is board to board connections at vertical connectors where cables or other PCBs are connected to the PCB. If the board is not supported during the plug/unplug cycle, it may flex and cause damage to nearby components.

Special care should also be taken when handling large (>6" on a side) PCBs since they more easily flex or warp than smaller boards.

### REWORKING OF MLCs

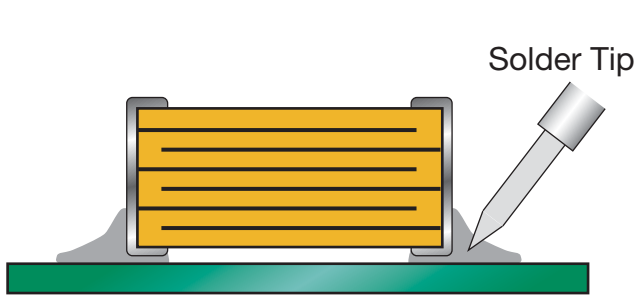
Thermal shock is common in MLCs that are manually attached or reworked with a soldering iron. *AVX strongly recommends that any reworking of MLCs be done with hot air reflow rather than soldering irons.* It is practically impossible to cause any thermal shock in ceramic capacitors when using hot air reflow.

However direct contact by the soldering iron tip often causes thermal cracks that may fail at a later date. If rework by soldering iron is absolutely necessary, it is recommended that the wattage of the iron be less than 30 watts and the tip temperature be <300°C. *Rework should be performed by applying the solder iron tip to the pad and not directly contacting any part of the ceramic capacitor.*

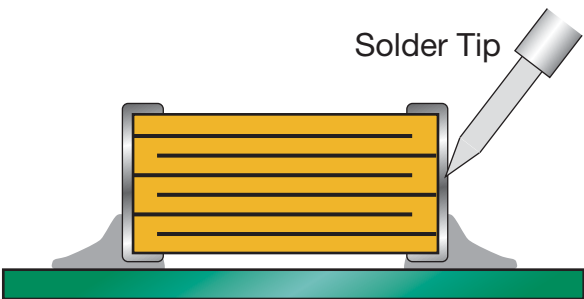
# Surface Mounting Guide



## MLC Chip Capacitors



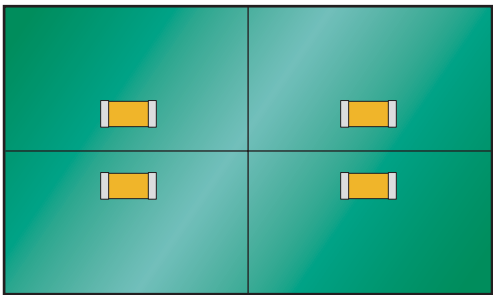
Preferred Method - No Direct Part Contact



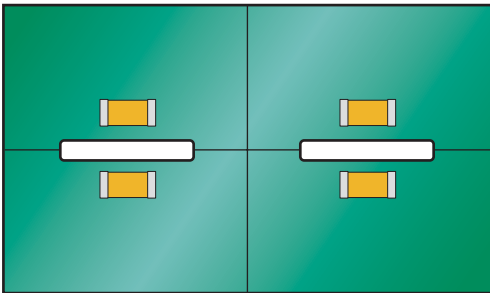
Poor Method - Direct Contact with Part

### PCB BOARD DESIGN

To avoid many of the handling problems, AVX recommends that MLCs be located at least .2" away from nearest edge of board. However when this is not possible, AVX recommends that the panel be routed along the cut line, adjacent to where the MLC is located.



No Stress Relief for MLCs



Routed Cut Line Relieves Stress on MLC

# High Voltage MLC Chips



For 600V to 5000V Application



High value, low leakage and small size are difficult parameters to obtain in capacitors for high voltage systems. AVX special high voltage MLC chips capacitors meet these performance characteristics and are designed for applications such as snubbers in high frequency power converters, resonators in SMPS, and high voltage coupling/DC blocking. These high voltage chip designs exhibit low ESRs at high frequencies.

Larger physical sizes than normally encountered chips are used to make high voltage chips. These larger sizes require that special precautions be taken in applying these chips in surface mount assemblies. This is due to differences in the coefficient of thermal expansion (CTE) between the substrate materials and chip capacitors. Apply heat at less than 4°C per second during the preheat. The preheat temperature must be within 50°C of the peak temperature reached by the ceramic bodies through the soldering process. Chips 1808 and larger to use reflow soldering only.

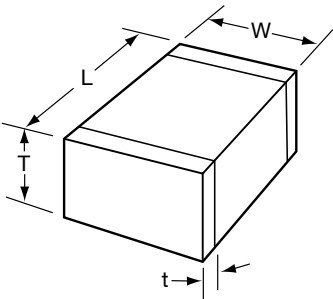
Capacitors may require protective surface coating to prevent external arcing.

## HOW TO ORDER

| 1808      | A         | A                       | 271                                   | K                     | A            | 1             | 1            | A            |
|-----------|-----------|-------------------------|---------------------------------------|-----------------------|--------------|---------------|--------------|--------------|
| AVX Style | Voltage   | Temperature Coefficient | Capacitance Code                      | Capacitance Tolerance | Test Level   | Termination*  | Packaging    | Special Code |
| 1206      | 600V = C  |                         | (2 significant digits + no. of zeros) | COG: J = ±5%          | A = Standard | 1 = Pd/Ag     | 1 = 7" Reel  | A = Standard |
| 1210      | 1000V = A | COG = A                 | Examples:                             | K = ±10%              |              | T = Plated    | 3 = 13" Reel |              |
| 1808      | 1500V = S | X7R = C                 | 10 pF = 100                           | M = ±20%              |              | Ni and Sn     | 9 = Bulk     |              |
| 1812      | 2000V = G |                         | 100 pF = 101                          | X7R: K = ±10%         |              | J = 5% Min Pb |              |              |
| 1825      | 2500V = W |                         | 1,000 pF = 102                        | M = ±20%              |              |               |              |              |
| 2220      | 3000V = H |                         | 22,000 pF = 223                       | Z = +80%, -20%        |              |               |              |              |
| 2225      | 4000V = J |                         | 220,000 pF = 224                      |                       |              |               |              |              |
| 3640      | 5000V = K |                         | 1 μF = 105                            |                       |              |               |              |              |

**\*Note:** Leaded terminations are available.  
 Styles 1825, 2225, & 3640 are available with "N", "L" or "J" leads as seen on page 9.  
 "V" denotes uncoated leaded units similar to SM0 product.  
 "W" denotes leaded epoxy coated units similar to SM5 product.  
 IE 1825AA103KAV00J would be uncoated leaded part with "J" style leads.

Note: Capacitors with X7R dielectrics are not intended for applications across AC supply mains or AC line filtering with polarity reversal. Contact plant for recommendations.



## DIMENSIONS

DIMENSIONS

|                       |              | millimeters (inches)          |                               |                                |                               |                               |                              |                                |                                |
|-----------------------|--------------|-------------------------------|-------------------------------|--------------------------------|-------------------------------|-------------------------------|------------------------------|--------------------------------|--------------------------------|
| SIZE                  |              | 1206                          | 1210                          | 1808*                          | 1812*                         | 1825*                         | 2220*                        | 2225*                          | 3640*                          |
| (L) Length            |              | 3.20 ± 0.2<br>(0.126 ± 0.008) | 3.20 ± 0.2<br>(0.126 ± 0.008) | 4.57 ± 0.25<br>(0.180 ± 0.010) | 4.50 ± 0.3<br>(0.177 ± 0.012) | 4.50 ± 0.3<br>(0.177 ± 0.012) | 5.7 ± 0.4<br>(0.224 ± 0.016) | 5.72 ± 0.25<br>(0.225 ± 0.010) | 9.14 ± 0.25<br>(0.360 ± 0.010) |
| (W) Width             |              | 1.60 ± 0.2<br>(0.063 ± 0.008) | 2.50 ± 0.2<br>(0.098 ± 0.008) | 2.03 ± 0.25<br>(0.080 ± 0.010) | 3.20 ± 0.2<br>(0.126 ± 0.008) | 6.40 ± 0.3<br>(0.252 ± 0.012) | 5.0 ± 0.4<br>(0.197 ± 0.016) | 6.35 ± 0.25<br>(0.250 ± 0.010) | 10.2 ± 0.25<br>(0.400 ± 0.010) |
| (T) Thickness<br>Max. |              | 1.52<br>(0.060)               | 1.70<br>(0.067)               | 2.03<br>(0.080)                | 2.54<br>(0.100)               | 2.54<br>(0.100)               | 3.3<br>(0.130)               | 2.54<br>(0.100)                | 2.54<br>(0.100)                |
| (t) terminal          | min.<br>max. | 0.25 (0.010)<br>0.75 (0.030)  | 0.25 (0.010)<br>0.75 (0.030)  | 0.25 (0.010)<br>1.02 (0.040)   | 0.25 (0.010)<br>1.02 (0.040)  | 0.25 (0.010)<br>1.02 (0.040)  | 0.25 (0.010)<br>1.02 (0.040) | 0.25 (0.010)<br>1.02 (0.040)   | 0.76 (0.030)<br>1.52 (0.060)   |

\*Reflow Soldering Only



# High Voltage MLC Chips



For 600V to 5000V Applications

## C0G Dielectric Performance Characteristics

|                                            |                                                                                            |
|--------------------------------------------|--------------------------------------------------------------------------------------------|
| Capacitance Range                          | 10 pF to 0.047 $\mu$ F<br>(25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz, for $\leq$ 1000 pF use 1 MHz) |
| Capacitance Tolerances                     | $\pm$ 5%, $\pm$ 10%, $\pm$ 20%                                                             |
| Dissipation Factor                         | 0.1% max. (+25°C, 1.0 $\pm$ 0.2 Vrms, 1kHz, for $\leq$ 1000 pF use 1 MHz)                  |
| Operating Temperature Range                | -55°C to +125°C                                                                            |
| Temperature Characteristic                 | 0 $\pm$ 30 ppm/°C (0 VDC)                                                                  |
| Voltage Ratings                            | 600, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C)                                |
| Insulation Resistance (+25°C, at 500 VDC)  | 100K M $\Omega$ min. or 1000 M $\Omega$ - $\mu$ F min., whichever is less                  |
| Insulation Resistance (+125°C, at 500 VDC) | 10K M $\Omega$ min. or 100 M $\Omega$ - $\mu$ F min., whichever is less                    |
| Dielectric Strength                        | 120% rated voltage for 5 seconds at 50 mA max. current                                     |

## HIGH VOLTAGE C0G CAPACITANCE VALUES

| VOLTAGE   | 1206   | 1210    | 1808    | 1812    | 1825          | 2220          | 2225          | 3640          |
|-----------|--------|---------|---------|---------|---------------|---------------|---------------|---------------|
| 600 min.  | 10 pF  | 100 pF  | 100 pF  | 100 pF  | 1000 pF       | 1000 pF       | 1000 pF       | 1000 pF       |
| 600 max.  | 680 pF | 1500 pF | 2700 pF | 5600 pF | 0.012 $\mu$ F | 0.012 $\mu$ F | 0.015 $\mu$ F | 0.047 $\mu$ F |
| 1000 min. | 10 pF  | 10 pF   | 100 pF  | 100 pF  | 100 pF        | 1000 pF       | 1000 pF       | 1000 pF       |
| 1000 max. | 470 pF | 820 pF  | 1500 pF | 2700 pF | 6800 pF       | 0.010 $\mu$ F | 0.010 $\mu$ F | 0.018 $\mu$ F |
| 1500 min. | 10 pF  | 10 pF   | 10 pF   | 10 pF   | 100 pF        | 100 pF        | 100 pF        | 100 pF        |
| 1500 max. | 150 pF | 330 pF  | 470 pF  | 1000 pF | 2700 pF       | 2700 pF       | 3300 pF       | 8200 pF       |
| 2000 min. | 10 pF  | 10 pF   | 10 pF   | 10 pF   | 100 pF        | 100 pF        | 100 pF        | 100 pF        |
| 2000 max. | 68 pF  | 150 pF  | 270 pF  | 680 pF  | 1800 pF       | 2200 pF       | 2200 pF       | 5600 pF       |
| 2500 min. | —      | —       | 10 pF   | 10 pF   | 10 pF         | 100 pF        | 100 pF        | 100 pF        |
| 2500 max. | —      | —       | 150 pF  | 390 pF  | 1000 pF       | 1000 pF       | 1200 pF       | 3900 pF       |
| 3000 min. | —      | —       | 10 pF   | 10 pF   | 10 pF         | 10 pF         | 10 pF         | 100 pF        |
| 3000 max. | —      | —       | 100 pF  | 330 pF  | 680 pF        | 680 pF        | 820 pF        | 2200 pF       |
| 4000 min. | —      | —       | 10 pF   | 10 pF   | 10 pF         | 10 pF         | 10 pF         | 100 pF        |
| 4000 max. | —      | —       | 39 pF   | 100 pF  | 220 pF        | 220 pF        | 330 pF        | 1000 pF       |
| 5000 min. | —      | —       | —       | —       | —             | —             | —             | 10 pF         |
| 5000 max. | —      | —       | —       | —       | —             | —             | —             | 680 pF        |

## X7R Dielectric Performance Characteristics

|                                            |                                                                           |
|--------------------------------------------|---------------------------------------------------------------------------|
| Capacitance Range                          | 10 pF to 0.56 $\mu$ F (25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz)                  |
| Capacitance Tolerances                     | $\pm$ 10%; $\pm$ 20%; +80%, -20%                                          |
| Dissipation Factor                         | 2.5% max. (+25°C, 1.0 $\pm$ 0.2 Vrms, 1kHz)                               |
| Operating Temperature Range                | -55°C to +125°C                                                           |
| Temperature Characteristic                 | $\pm$ 15% (0 VDC)                                                         |
| Voltage Ratings                            | 600, 1000, 1500, 2000, 2500, 3000, 4000 & 5000 VDC (+125°C)               |
| Insulation Resistance (+25°C, at 500 VDC)  | 100K M $\Omega$ min. or 1000 M $\Omega$ - $\mu$ F min., whichever is less |
| Insulation Resistance (+125°C, at 500 VDC) | 10K M $\Omega$ min. or 100 M $\Omega$ - $\mu$ F min., whichever is less   |
| Dielectric Strength                        | 120% rated voltage for 5 seconds at 50 mA max. current                    |

## HIGH VOLTAGE X7R MAXIMUM CAPACITANCE VALUES

| VOLTAGE   | 1206          | 1210          | 1808          | 1812          | 1825          | 2220          | 2225          | 3640          |
|-----------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 600 min.  | 1000 pF       | 1000 pF       | 1000 pF       | 1000 pF       | 0.01 $\mu$ F  | 0.01 $\mu$ F  | 0.01 $\mu$ F  | 0.01 $\mu$ F  |
| 600 max.  | 0.015 $\mu$ F | 0.033 $\mu$ F | 0.056 $\mu$ F | 0.10 $\mu$ F  | 0.18 $\mu$ F  | 0.22 $\mu$ F  | 0.22 $\mu$ F  | 0.56 $\mu$ F  |
| 1000 min. | 100 pF        | 1000 pF       | 1000 pF       | 1000 pF       | 1000 pF       | 1000 pF       | 1000 pF       | 0.01 $\mu$ F  |
| 1000 max. | 5600 pF       | 0.015 $\mu$ F | 0.018 $\mu$ F | 0.027 $\mu$ F | 0.10 $\mu$ F  | 0.10 $\mu$ F  | 0.10 $\mu$ F  | 0.22 $\mu$ F  |
| 1500 min. | 100 pF        | 100 pF        | 100 pF        | 100 pF        | 1000 pF       | 1000 pF       | 1000 pF       | 1000 pF       |
| 1500 max. | 1800 pF       | 3900 pF       | 6800 pF       | 0.012 $\mu$ F | 0.033 $\mu$ F | 0.039 $\mu$ F | 0.047 $\mu$ F | 0.068 $\mu$ F |
| 2000 min. | 10 pF         | 100 pF        | 100 pF        | 100 pF        | 100 pF        | 1000 pF       | 1000 pF       | 1000 pF       |
| 2000 max. | 1000 pF       | 2200 pF       | 2700 pF       | 4700 pF       | 0.01 $\mu$ F  | 0.01 $\mu$ F  | 0.015 $\mu$ F | 0.027 $\mu$ F |
| 2500 min. | —             | —             | 10 pF         | 10 pF         | 100 pF        | 100 pF        | 100 pF        | 1000 pF       |
| 2500 max. | —             | —             | 1800 pF       | 3300 pF       | 6800 pF       | 8200 pF       | 0.01 $\mu$ F  | 0.022 $\mu$ F |
| 3000 min. | —             | —             | 10 pF         | 10 pF         | 100 pF        | 100 pF        | 100 pF        | 1000 pF       |
| 3000 max. | —             | —             | 1500 pF       | 2200 pF       | 4700 pF       | 4700 pF       | 6800 pF       | 0.018 $\mu$ F |
| 4000 min. | —             | —             | —             | —             | —             | —             | —             | 100 pF        |
| 4000 max. | —             | —             | —             | —             | —             | —             | —             | 6800 pF       |
| 5000 min. | —             | —             | —             | —             | —             | —             | —             | 100 pF        |
| 5000 max. | —             | —             | —             | —             | —             | —             | —             | 3300 pF       |

# Hi-Q® High RF Power MLC Surface Mount Capacitors

For 600V to 4000V Application



## PRODUCT OFFERING

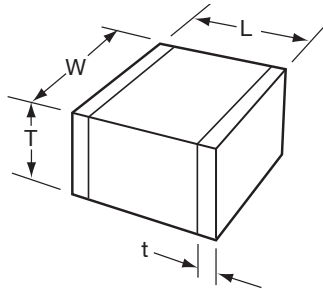
Hi-Q®, high RF power, surface mount MLC capacitors from AVX Corporation are characterized with ultra-low ESR and dissipation factor at high frequencies. They are designed to handle high power and high voltage levels for applications in RF power amplifiers, inductive heating, high magnetic field environments (MRI coils), medical and industrial electronics.

## HOW TO ORDER

| <b>HQCC</b>      | <b>A</b>                                                                               | <b>A</b>                       | <b>271</b>                                                                                                                                     | <b>J</b>                                                                                                                                                                                                                                | <b>A</b>                          | <b>T</b>                                                                 | <b>1</b>                                                    | <b>A</b>                            |
|------------------|----------------------------------------------------------------------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------|
| <b>AVX Style</b> | <b>Voltage</b>                                                                         | <b>Temperature Coefficient</b> | <b>Capacitance Code</b><br>(2 significant digits + no. of zeros)<br>Examples:<br>4.7 pF = 4R7<br>10 pF = 100<br>100 pF = 101<br>1,000 pF = 102 | <b>Capacitance Tolerance</b><br>C = $\pm 0.25\text{pF}$ (<13pF)<br>D = $\pm 0.50\text{pF}$ (<25pF)<br>F = $\pm 1\%$ ( $\geq 25\text{pF}$ )<br>G = $\pm 2\%$ ( $\geq 13\text{pF}$ )<br>J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$ | <b>Test Level</b><br>A = Standard | <b>Termination</b><br>1 = Pd/Ag<br>T = Plated Ni and Sn<br>J = 5% Min Pb | <b>Packaging</b><br>1 = 7" Reel<br>3 = 13" Reel<br>9 = Bulk | <b>Special Code</b><br>A = Standard |
| HQCC             | 600V = C<br>1000V = A<br>1500V = S<br>2000V = G<br>2500V = W<br>3000V = H<br>4000V = J | COG = A                        |                                                                                                                                                |                                                                                                                                                                                                                                         |                                   |                                                                          |                                                             |                                     |

## DIMENSIONS millimeters (inches)

| STYLE              | HQCC                                   | HQCE                                   |
|--------------------|----------------------------------------|----------------------------------------|
| (L) Length         | 5.84 $\pm$ 0.51<br>(0.230 $\pm$ 0.020) | 9.4 $\pm$ 0.51<br>(0.370 $\pm$ 0.020)  |
| (W) Width          | 6.35 $\pm$ 0.51<br>(0.250 $\pm$ 0.020) | 9.9 $\pm$ 0.51<br>(0.390 $\pm$ 0.020)  |
| (T) Thickness Max. | 3.3 max.<br>(0.130 max.)               | 3.3 max.<br>(0.130 max.)               |
| (t) terminal       | 0.64 $\pm$ 0.38<br>(0.025 $\pm$ 0.015) | 0.64 $\pm$ 0.38<br>(0.025 $\pm$ 0.015) |



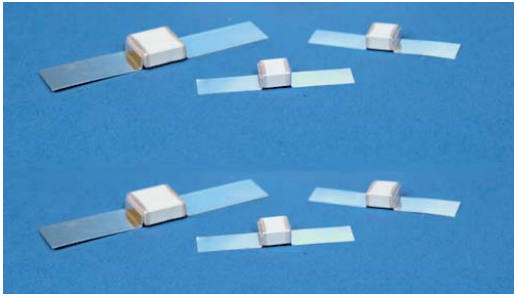
## DIELECTRIC PERFORMANCE CHARACTERISTICS

|                                    |                                                                                                         |
|------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>Capacitance Range</b>           | 4.7pF to 6,800pF<br>(25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz, for $\leq$ 1000 pF use 1MHz)                     |
| <b>Capacitance Tolerances</b>      | $\pm 0.25\text{pF}$ , $\pm 0.50\text{pF}$ , $\pm 1\%$ , $\pm 2\%$ , $\pm 5\%$ , $\pm 10\%$ , $\pm 20\%$ |
| <b>Dissipation Factor 25°C</b>     | 0.1% Max (+25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz, for $\leq$ 1000 pF use 1MHz)                               |
| <b>Operating Temperature Range</b> | -55°C to +125°C                                                                                         |
| <b>Temperature Characteristic</b>  | COG: 0 $\pm$ 30 ppm/°C (-55°C to +125°C)                                                                |
| <b>Voltage Ratings</b>             | 600, 1000, 1500, 2000, 2500, 3000, 4000VDC                                                              |
| <b>Insulation Resistance</b>       | 100K M $\Omega$ min. @ +25°C and 500VDC<br>10K M $\Omega$ min. @ +125°C and 500VDC                      |
| <b>Dielectric Strength</b>         | 120% of rated WVDC                                                                                      |

## HIGH VOLTAGE CAPACITANCE VALUES (pF)

| Style | 600 WDC min./max. | 1000 WVDC min./max. | 1500 WVDC min./max. | 2000 WVDC min./max. | 2500 WVDC min./max. | 3000 WVDC min./max. | 4000 WVDC min./max. |
|-------|-------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| HQCC  | 2,200 - 2,700     | 1,500 - 1,800       | 820 - 1,200         | 470 - 680           | 330 - 390           | 4.7 - 270           |                     |
| HQCE  | 5,600 - 6,800     | 3,300 - 4,700       | 2,200 - 2,700       | 1,200 - 1,800       | 820 - 1,000         | 470-680             | 4.7-390             |

# Hi-Q® High RF Power Ribbon Leaded MLC Capacitors



Hi-Q®, High RF Power, Ribbon Leaded MLC Capacitors from AVX Corporation are characterized with ultra-low ESR and dissipation factor at high frequencies. The HQL-style parts are constructed using non-magnetic materials. They are designed to handle high power and high voltage levels for applications in RF power amplifiers, inductive heating, high magnetic field environments (MRI coils), medical and industrial electronics.

## HOW TO ORDER

| <b>HQLC</b>                      | <b>A</b>                                                                                                 | <b>A</b>                                  | <b>271</b>                                                                                                                                     | <b>J</b>                                                                                                                                            | <b>A</b>                          | <b>A</b>                                                |
|----------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|---------------------------------------------------------|
| <b>AVX Style</b><br>HQLC<br>HQLE | <b>Voltage</b><br>600V = C<br>1000V = A<br>1500V = S<br>2000V = G<br>2500V = W<br>3000V = H<br>4000V = J | <b>Temperature Coefficient</b><br>C0G = A | <b>Capacitance Code</b><br>(2 significant digits + no. of zeros)<br>Examples:<br>4.7 pF = 4R7<br>10 pF = 100<br>100 pF = 101<br>1,000 pF = 102 | <b>Capacitance Tolerance</b><br>C = ±0.25pF (<13pF)<br>D = ±0.50pF (<25pF)<br>F = ±1% (≥25pF)<br>G = ±2% (≥13pF)<br>J = ±5%<br>K = ±10%<br>M = ±20% | <b>Test Level</b><br>A = Standard | <b>Lead Style</b><br>A = Axial Ribbon<br>M = Microstrip |

## Capacitance Range (pF)

| Style | 600 WVDC<br>min./max. | 1000 WVDC<br>min./max. | 1500 WVDC<br>min./max. | 2000 WVDC<br>min./max. | 2500 WVDC<br>min./max. | 3000 WVDC<br>min./max. | 4000 WVDC<br>min./max. |
|-------|-----------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| HQLC  | 2200 - 2700           | 1500 - 1800            | 820 - 1200             | 470 - 680              | 330 - 390              | 4.7 - 270              |                        |
| HQLE  | 5600 - 6800           | 3300 - 4700            | 2200 - 2700            | 1200 - 1800            | 820 - 1000             | 470 - 680              | 4.7 - 390              |

## DIELECTRIC PERFORMANCE CHARACTERISTICS

|                                    |                                                                          |
|------------------------------------|--------------------------------------------------------------------------|
| <b>Capacitance Range</b>           | 4.7pF to 6,800pF<br>(25°C, 1.0 ±0.2 Vrms at 1kHz, for ≤ 1000pF use 1MHz) |
| <b>Capacitance Tolerances</b>      | ±0.25pF, ±0.50pF, ±1%, ±2%, ±5%, ±10%, ±20%                              |
| <b>Dissipation Factor</b>          | 0.1% Max (+25°C, 1.0 ±0.2 Vrms at 1kHz, for ≤ 1000pF use 1MHz)           |
| <b>Operating Temperature Range</b> | -55°C to +125°C                                                          |
| <b>Temperature Characteristics</b> | C0G: 0 ± 30 ppm/°C (-55°C to +125°C)                                     |
| <b>Voltage Ratings</b>             | 600, 1000, 1500, 2000, 2500, 3000, 4000                                  |
| <b>Insulation Resistance</b>       | 100K MΩ min. @ +25°C and 500VDC<br>10K MΩ min. @ +125°C and 500VDC       |
| <b>Dielectric Strength</b>         | 120% of rated WVDC                                                       |

# Hi-Q® High RF Power Ribbon Leaded MLC Capacitors



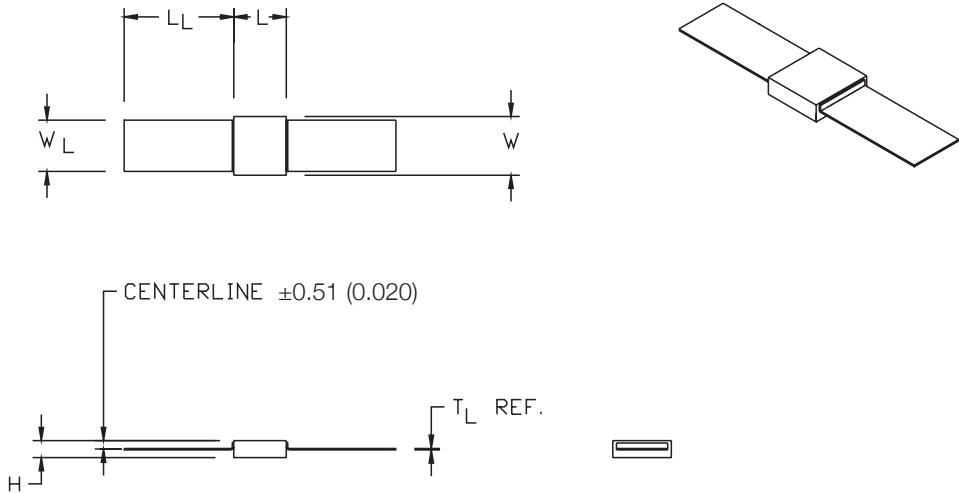
## Microstrip Leads (Lead Style “M”)



| DIMENSIONS millimeters (inches) |                    |                        |                    |                                 |                    |                                 |                        |
|---------------------------------|--------------------|------------------------|--------------------|---------------------------------|--------------------|---------------------------------|------------------------|
| Unit Size                       | L<br>±0.51 (0.020) | L <sub>L</sub><br>Min. | W<br>±0.64 (0.025) | W <sub>L</sub><br>±0.38 (0.015) | H<br>±0.64 (0.025) | H <sub>L</sub><br>±0.38 (0.015) | T <sub>L</sub><br>Ref. |
| HQLC                            | 5.72 (0.225)       | 12.7 (0.500)           | 6.35 (0.250)       | 6.10 (0.240)                    | 3.68 (0.145)       | 0.64 (0.025)                    | 0.10 (0.004)           |
| HQLE                            | 9.40 (0.370)       | 19.1 (0.750)           | 10.2 (0.400)       | 8.89 (0.350)                    | 3.68 (0.145)       | 0.64 (0.025)                    | 0.25 (0.010)           |

Note: Side to side lead alignment shall be within ±0.25 (0.010)

## Axial Ribbon Leads (Lead Style “A”)



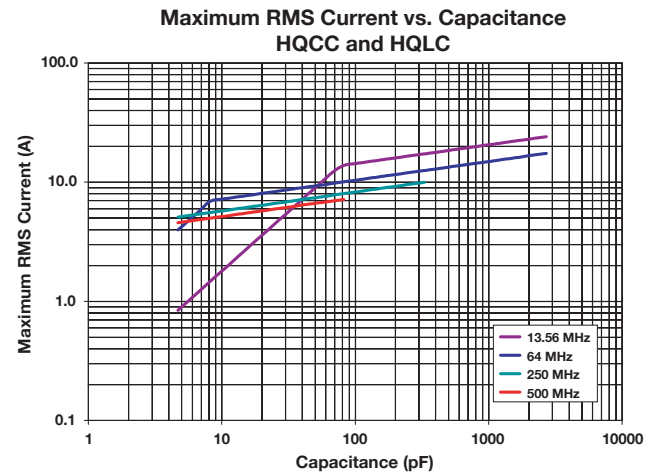
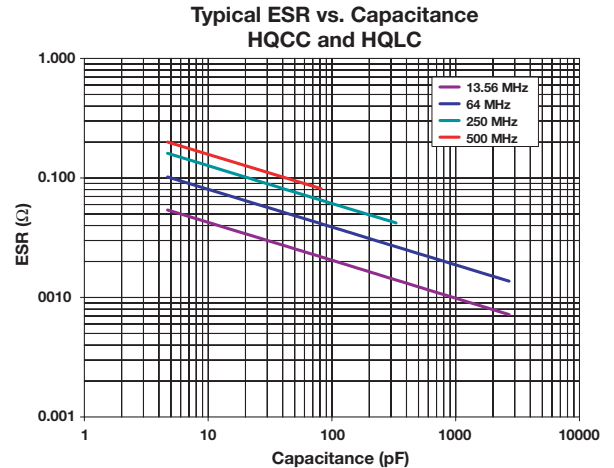
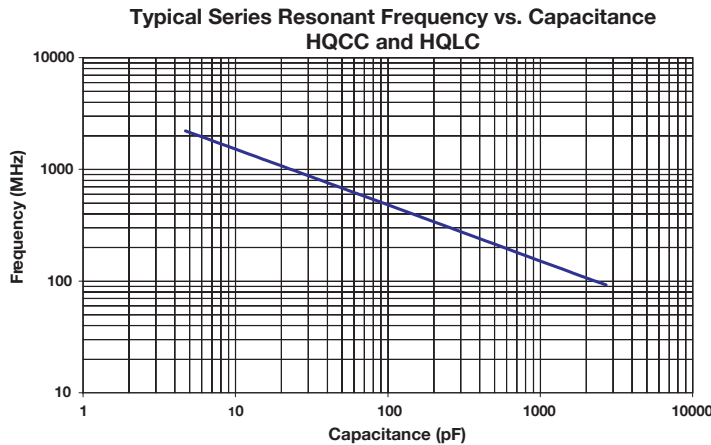
| DIMENSIONS millimeters (inches) |                    |                        |                    |                                 |                    |                        |
|---------------------------------|--------------------|------------------------|--------------------|---------------------------------|--------------------|------------------------|
| Unit Size                       | L<br>±0.51 (0.020) | L <sub>L</sub><br>Min. | W<br>±0.64 (0.025) | W <sub>L</sub><br>±0.38 (0.015) | H<br>±0.64 (0.025) | T <sub>L</sub><br>Ref. |
| HQLC                            | 5.72 (0.225)       | 12.7 (0.500)           | 6.35 (0.250)       | 6.10 (0.240)                    | 3.18 (0.125)       | 0.10 (0.004)           |
| HQLE                            | 9.40 (0.370)       | 19.1 (0.750)           | 10.2 (0.400)       | 8.89 (0.350)                    | 3.18 (0.125)       | 0.25 (0.010)           |

Note: Side to side lead alignment shall be within ±0.25 (0.010)

# Hi-Q® High RF Power MLC Capacitors



## PERFORMANCE CHARACTERISTICS

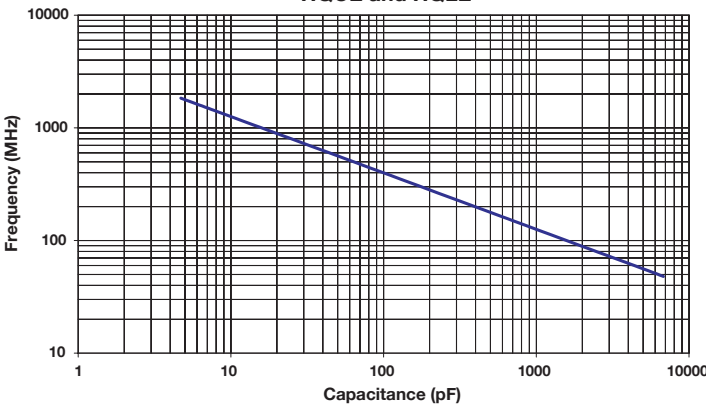


# Hi-Q® High RF Power MLC Capacitors

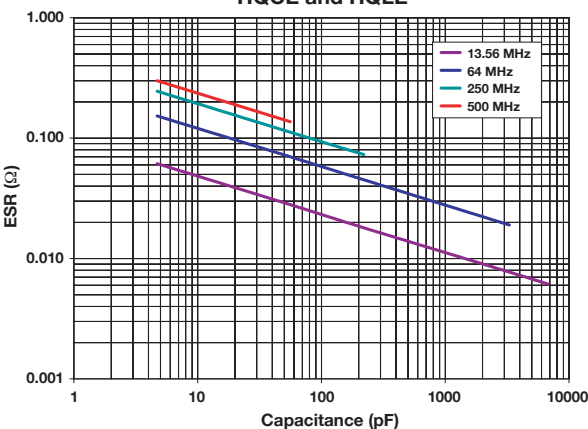


## PERFORMANCE CHARACTERISTICS

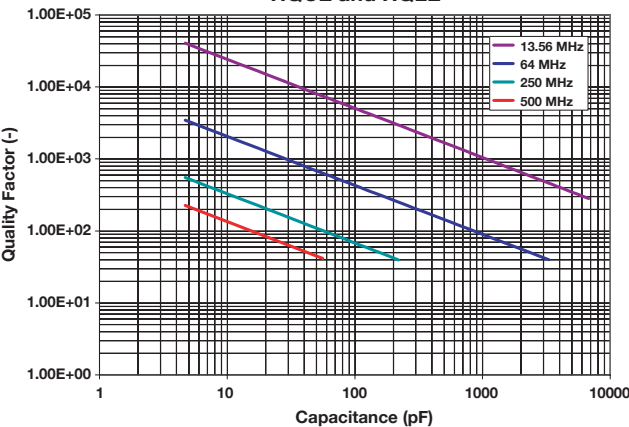
Typical Series Resonant Frequency vs. Capacitance  
HQCE and HQLE



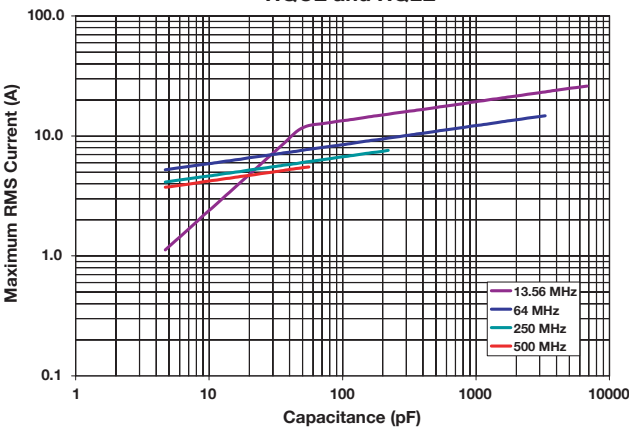
Typical ESR vs. Capacitance  
HQCE and HQLE



Typical Quality Factor vs. Capacitance  
HQCE and HQLE



Maximum RMS Current vs. Capacitance  
HQCE and HQLE

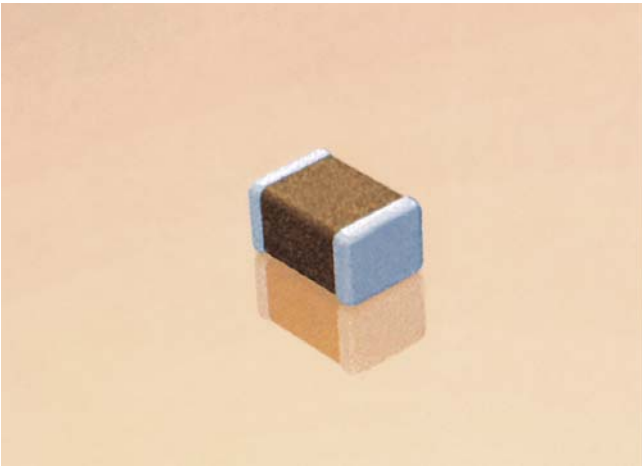


# Tip & Ring

## Multilayer Ceramic Chip Capacitors

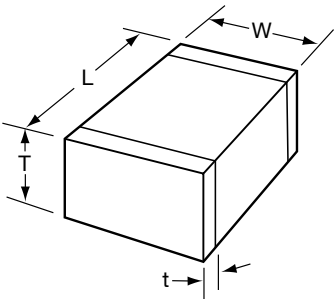
AVX “Tip & Ring” or “ring detector” Multilayer Ceramic Chip Capacitors are designed as a standard telecom filter to block -48 Volts DC telephone line voltage and pass subscriber’s AC signal pulse (16 to 25Hz, 70 to 90Vrms). The typical ringing signal is seen on figure on page 77. The ringer capacitors replace large leaded film capacitors and are ideal for telecom/modem applications. Using AVX “Tip & Ring” capacitors not only saves valuable real estate on the board and reduces the weight of overall product, but also features standard surface mounting capabilities, so critical to new and compact designs.

The AVX “Tip & Ring” capacitors are offered in standard EIA sizes and standard values. They offer excellent high frequency performance, low ESR and improved temperature performance over film capacitors.



### HOW TO ORDER

| 1812                                                         | P                          | C                       | 104                                                                                                                            | K                                | A                 | T                                        | 1                                       | A                   |
|--------------------------------------------------------------|----------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------|------------------------------------------|-----------------------------------------|---------------------|
| <b>AVX Style</b>                                             | <b>Voltage</b>             | <b>Temp Coefficient</b> | <b>Capacitance Code</b>                                                                                                        | <b>Capacitance Tolerance</b>     | <b>Test Level</b> | <b>Termination</b>                       | <b>Packaging</b>                        | <b>Special Code</b> |
| 0805<br>1206<br>1210<br>1808<br>1812<br>1825<br>2220<br>2225 | 250 VDC<br>Telco<br>Rating | X7R                     | (2 significant digits + no. of zeros)<br>Examples:<br>1,000 pF = 102<br>22,000 pF = 223<br>220,000 pF = 224<br>1 $\mu$ F = 105 | K = $\pm 10\%$<br>M = $\pm 20\%$ | A = Standard      | T = Plated<br>Ni and Sn<br>J = 5% Min Pb | 1 = 7" Reel<br>3 = 13" Reel<br>9 = Bulk | A = Standard        |



### DIMENSIONS

millimeters (inches)

| Style         | 0805                                   | 1206                                   | 1210                                   | 1808*                                  | 1812*                                  | 1825*                                  | 2220*                                  | 2225*                                  |
|---------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|----------------------------------------|
| (L) Length    | 2.01 $\pm$ 0.20<br>(0.079 $\pm$ 0.008) | 3.20 $\pm$ 0.20<br>(0.126 $\pm$ 0.008) | 3.2 $\pm$ 0.20<br>(0.126 $\pm$ 0.008)  | 4.57 $\pm$ 0.25<br>(0.180 $\pm$ 0.010) | 4.50 $\pm$ 0.30<br>(0.177 $\pm$ 0.012) | 4.50 $\pm$ 0.30<br>(0.177 $\pm$ 0.012) | 5.60 $\pm$ 0.30<br>(0.220 $\pm$ 0.012) | 5.60 $\pm$ 0.25<br>(0.220 $\pm$ 0.010) |
| (W)Width      | 1.25 $\pm$ 0.20<br>(0.049 $\pm$ 0.008) | 1.60 $\pm$ 0.20<br>(0.063 $\pm$ 0.008) | 2.50 $\pm$ 0.20<br>(0.098 $\pm$ 0.008) | 2.03 $\pm$ 0.25<br>(0.080 $\pm$ 0.010) | 3.2 $\pm$ 0.20<br>(0.126 $\pm$ 0.008)  | 6.34 $\pm$ 0.30<br>(0.252 $\pm$ 0.012) | 5.10 $\pm$ 0.40<br>(0.200 $\pm$ 0.016) | 6.35 $\pm$ 0.25<br>(0.250 $\pm$ 0.010) |
| (T) Thickness | 1.30 max.<br>(0.051 max.)              | 1.50 max.<br>(0.059 max.)              | 1.70 max.<br>(0.067 max.)              | 1.52 max.<br>(0.60 max.)               | 2.00 max.<br>(0.080 max.)              | 2.00max.<br>(0.080 max.)               | 2.00 max.<br>(0.080 max.)              | 2.00 max.<br>(0.080 max.)              |
| (t) terminal  | 0.50 $\pm$ 0.25<br>(0.020 $\pm$ 0.010) | 0.50 $\pm$ 0.25<br>(0.020 $\pm$ 0.010) | 0.50 $\pm$ 0.25<br>(0.020 $\pm$ 0.010) | 0.63 $\pm$ 0.38<br>(0.025 $\pm$ 0.015) | 0.63 $\pm$ 0.38<br>(0.025 $\pm$ 0.015) | 0.63 $\pm$ 0.38<br>(0.025 $\pm$ 0.015) | 0.63 $\pm$ 0.38<br>(0.025 $\pm$ 0.015) | 0.63 $\pm$ 0.38<br>(0.025 $\pm$ 0.015) |

\*Reflow Soldering Only

# Tip & Ring

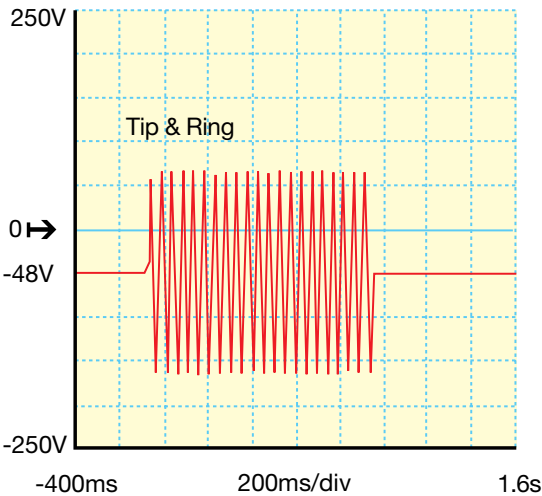


## Multilayer Ceramic Chip Capacitors

### CAPACITANCE RANGE ( $\mu\text{F}$ )

| Size | 0805   | 1206   | 1210   | 1808  | 1812 | 1825 | 2220 | 2225 |
|------|--------|--------|--------|-------|------|------|------|------|
| min. | 0.0010 | 0.0010 | 0.0010 | 0.010 | 0.10 | 0.33 | 0.47 | 0.47 |
| max. | 0.022  | 0.056  | 0.1    | 0.22  | 0.47 | 1.0  | 1.0  | 1.2  |

### “TIP & RING” GRAPH



### PERFORMANCE CHARACTERISTICS

|                                          |                                                        |                                    |
|------------------------------------------|--------------------------------------------------------|------------------------------------|
| Capacitance Range                        | 1000 pF to 1.2 $\mu\text{F}$                           | (25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz) |
| Capacitance Tolerances                   | $\pm$ 10%, $\pm$ 20%                                   |                                    |
| Dissipation Factor                       | 2.5% max. (25°C, 1.0 $\pm$ 0.2 Vrms at 1kHz)           |                                    |
| Temperature Characteristic               | X7R $\pm$ 15% (0 VDC)                                  |                                    |
| Voltage Rating                           | 250 VDC Telco rating                                   |                                    |
| Insulation Resistance (25°C, at 250 VDC) | 1000 megohm-microfarad min.                            |                                    |
| Dielectric Strength                      | 250% rated voltage for 5 seconds at 50 mA max. current |                                    |

## Packaging of Chip Components

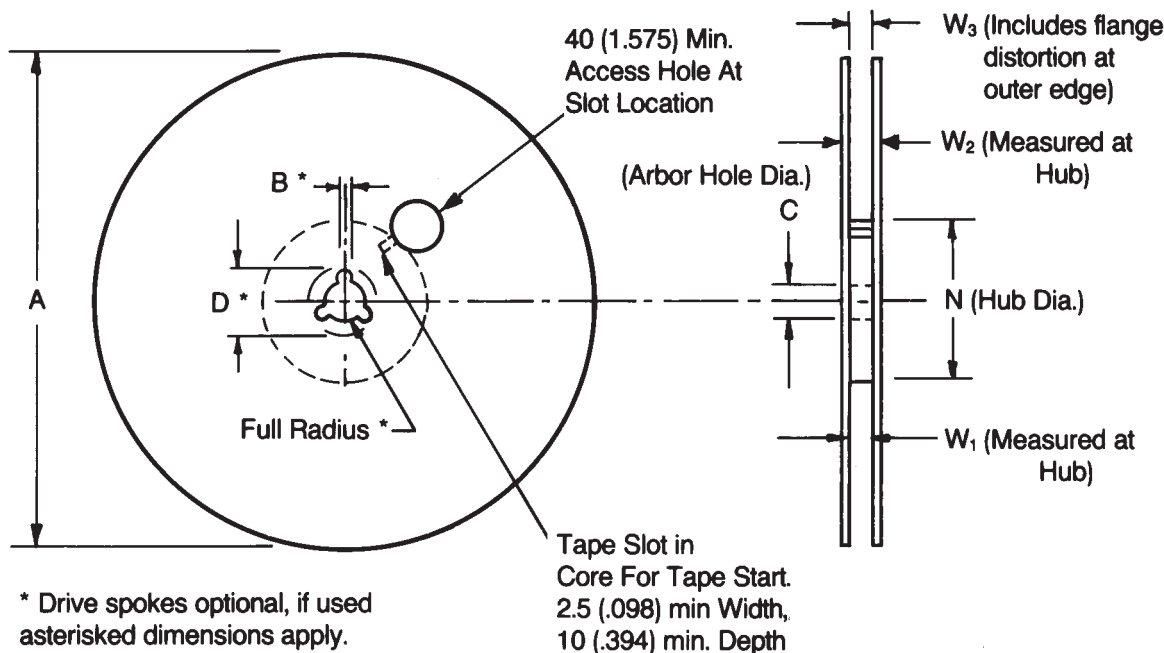
### AUTOMATIC INSERTION PACKAGING

#### TAPE & REEL QUANTITIES

All tape and reel specifications are in compliance with EIA481 or IEC-286-3.

|                        | 8mm                  | 12mm |                                | 24mm         |
|------------------------|----------------------|------|--------------------------------|--------------|
|                        | 0805<br>1206<br>1210 | 1808 | 1812, 1825<br>2220, 2225, HQCC | 3640<br>HQCE |
| Qty. per Reel/7" Reel  | 2000                 | 2000 | 1000                           | N/A          |
| Qty. per Reel/13" Reel | 10,000               | 4000 | 4000                           | 1000         |

#### REEL DIMENSIONS



#### DIMENSIONS

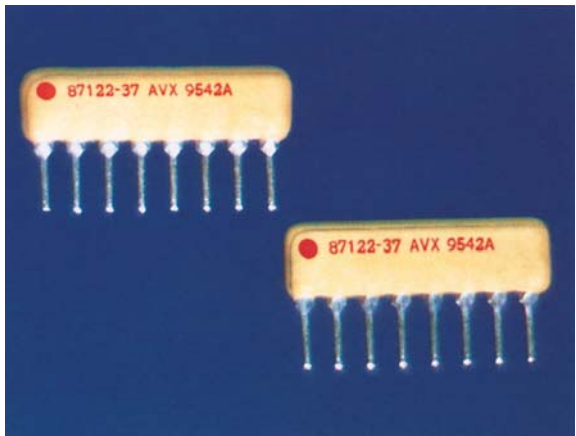
millimeters (inches)

| Tape Size | A Max.          | B* Min.        | C                                                                                    | D* Min.         | N Min.        | W <sub>1</sub>                                                                     | W <sub>2</sub> Max. | W <sub>3</sub>                               |
|-----------|-----------------|----------------|--------------------------------------------------------------------------------------|-----------------|---------------|------------------------------------------------------------------------------------|---------------------|----------------------------------------------|
| 8mm       | 330<br>(12.992) | 1.5<br>(0.059) | 13.0±0.20<br>(0.512±0.008)                                                           | 20.2<br>(0.795) | 50<br>(1.969) | 8.4 <sup>+1.5</sup> <sub>-0.0</sub><br>(0.331 <sup>+0.060</sup> <sub>-0.0</sub> )  | 14.4<br>(0.567)     | 7.9 Min.<br>(0.311)<br>10.9 Max.<br>(0.429)  |
| 12mm      | 330<br>(12.992) | 1.5<br>(0.059) | 13.0±0.20<br>(0.512±0.008)                                                           | 20.2<br>(0.795) | 50<br>(1.969) | 12.4 <sup>+2.0</sup> <sub>-0.0</sub><br>(0.488 <sup>+0.079</sup> <sub>-0.0</sub> ) | 18.4<br>(0.724)     | 11.9 Min.<br>(0.469)<br>15.4 Max.<br>(0.607) |
| 24mm      | 360<br>(14.173) | 1.5<br>(0.059) | 13.0 <sup>+0.5</sup> <sub>-0.2</sub><br>(0.512 <sup>+0.020</sup> <sub>-0.008</sub> ) | 20.2<br>(0.795) | 60<br>(2.362) | 24.4 <sup>+2.0</sup> <sub>-0.0</sub><br>(0.961 <sup>+0.079</sup> <sub>-0.0</sub> ) | 30.4<br>(1.197)     | 23.9 Min.<br>(0.941)<br>27.4 Max.<br>(1.079) |

# Single-In-Line Packages (SIP)

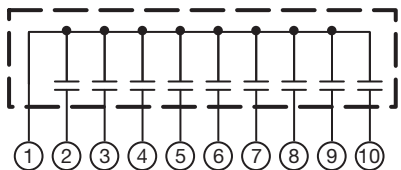
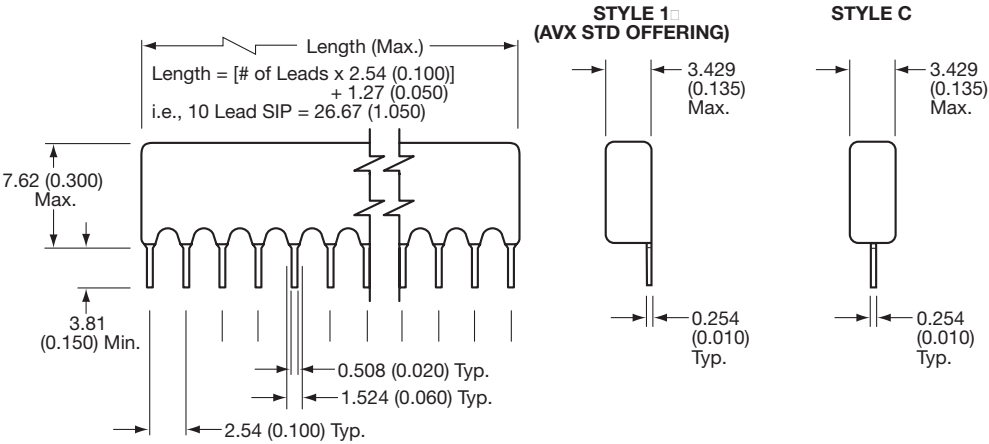


## Capacitor Arrays

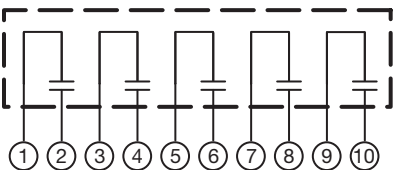


SIP-style, MLC ceramic capacitor arrays are Single-In-Line, conformally coated packages. These capacitor networks incorporate multiple capacitors into a single substrate and, therefore, offer excellent TC tracking. The utilization of SIP capacitor arrays minimizes board real estate and reduces component count in the assembly. Various circuit configurations and capacitance/voltage values are available.

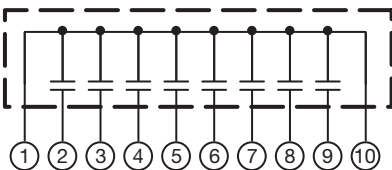
Dimensions in millimeters (inches)



**CIRCUIT CONFIGURATION "A"**  
ONE END LEAD GROUND



**CIRCUIT CONFIGURATION "B"**  
ADJACENT LEAD PAIR CAPS



**CIRCUIT CONFIGURATION "C"**  
BOTH END LEADS GROUND

# Single-In-Line Packages (SIP)



## Capacitor Arrays

### HOW TO ORDER

| SP        | A                                   | 1                                        | 1                              | A                                                        | 561                                                                                                                                                                                                          | K                                                                                                                                                                                            | A                          | A                                                                                                                                         |
|-----------|-------------------------------------|------------------------------------------|--------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| AVX Style | Circuit<br>See Page 79<br>(A, B, C) | Lead Style<br>Offset = 1<br>Centered = C | Voltage<br>50V = 5<br>100V = 1 | Temperature Coefficient<br>C0G = A<br>X7R = C<br>Z5U = E | Capacitance Code<br>(2 significant digits + no. of zero)<br>10 pF = 100<br>100 pF = 101<br>1,000 pF = 102<br>22,000 pF = 223<br>220,000 pF = 224<br>1 $\mu$ F = 105<br>10 $\mu$ F = 106<br>100 $\mu$ F = 107 | Capacitance Tolerance<br>C0G: K = $\pm 10\%$<br>M = $\pm 20\%$<br>X7R: K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z = +80%, -20%<br>Z5U: M = $\pm 20\%$<br>Z = +80%, -20%<br>P = GMV<br>(+100, -0%) | Test Level<br>A = Standard | Number of Leads<br>2 = 2<br>3 = 3<br>4 = 4<br>5 = 5<br>6 = 6<br>7 = 7<br>8 = 8<br>9 = 9<br>A = 10<br>B = 11<br>C = 12<br>D = 13<br>E = 14 |

\*For dimensions, voltages, or capacitance values not specified, please contact factory.

| Maximum Capacitance* |              |               |
|----------------------|--------------|---------------|
|                      | 50V          | 100V          |
| <b>C0G</b>           | 2200 pF      | 1500 pF       |
| <b>X7R</b>           | 0.10 $\mu$ F | 0.033 $\mu$ F |
| <b>Z5U</b>           | 0.39 $\mu$ F | 0.10 $\mu$ F  |

### AVX IS QUALIFIED TO THE FOLLOWING DSCC DRAWINGS

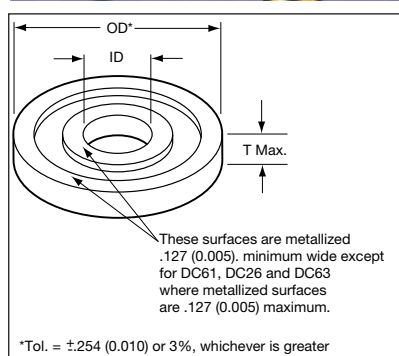
| SPECIFICATION # | DESCRIPTION | CIRCUIT | LEADS | CAPACITANCE RANGE     |
|-----------------|-------------|---------|-------|-----------------------|
| <b>87112</b>    | BX-100 VDC  | A       | 8     | 1000 pF - 0.1 $\mu$ F |
| <b>87116</b>    | C0G-100 VDC | A       | 8     | 10 pF - 820 pF        |
| <b>87119</b>    | BX-100 VDC  | C       | 10    | 1000 pF - 0.1 $\mu$ F |
| <b>87120</b>    | C0G-100 VDC | C       | 10    | 10 pF - 1000 pF       |
| <b>87122</b>    | BX-100 VDC  | B       | 8     | 1000 pF - 0.1 $\mu$ F |
| <b>88019</b>    | BX-100 VDC  | A       | 10    | 1000 pF - 0.1 $\mu$ F |
| <b>89086</b>    | C0G-100 VDC | B       | 8     | 10 pF - 820 pF        |

# Discoidal MLC Feed-Through Capacitors and Filters



DC Style (US Preferred Sizes) / XB Style (European Preferred Sizes)  
XF Style (Feed-Through Discoidal)

## APPLICATION INFORMATION ON DISCOIDAL



### LOWEST CAPACITANCE IMPEDANCES TO GROUND

A discoidal MLC capacitor has very low impedance associated with its ground path since the signal is presented with a multi-directional path. These electrode paths, which can be as many as 100, allow for low ESR and ESL which are the major elements in impedance at high frequencies.

The assembled discoidal element or feed-thru allows signal to be fed in through a chassis or bulkhead, conditioned as it passes through the discoidal, and isolated by the chassis and discoidal from the original signal. An example of this application would be in an AFT circuit where the AC noise signal would be required to be stripped from the DC control signal. Other applications include single line EMI/RFI suppression, L-C filter construction, and coaxial shield bypass filtering.

The shape of the discoidal lends itself to filter construction. The short length allows compact construction where L-C construction is desired.

The size freedom associated with this element allows almost any inside/outside diameter combination. By allowing the inside diameter to equal the center insulator diameter of a coaxial signal line and special termination techniques, this device will allow bypass filtering of a floating shield to ground.

Discoidal capacitors are available in three temperature coefficients (C0G, X7R, Z5U) and a variety of sizes, the most standard of which appear in this catalog.

AVX's DC Series 50V, 100V, 200V, C0G and X7R parts are capable of meeting the requirements of MIL-PRF-31033.



## ELECTRICAL SPECIFICATIONS

### Temperature Coefficient

C0G: A Temperature Coefficient -  $0 \pm 30$  ppm/°C, -55° to +125°C

X7R: C Temperature Coefficient -  $\pm 15\%$ , -55° to +125°C

Z5U: E Temperature Coefficient - +22, -56%, +10° to +85°C

### Capacitance Test (MIL-STD-202 Method 305)

C0G: 25°C,  $1.0 \pm 0.2$  Vrms at 1KHz, for  $\leq 100$  pF use 1 MHz

X7R: 25°C,  $1.0 \pm 0.2$  Vrms at 1KHz

Z5U: 25°C, 0.5 Vrms max at 1KHz

### Dissipation Factor 25°C

C0G: 0.15% Max @ 25°C,  $1.0 \pm 0.2$  Vrms at 1KHz, for  $\leq 100$  pF use 1 MHz

X7R: 2.5% Max @ 25°C,  $1.0 \pm 0.2$  Vrms at 1KHz

Z5U: 3.0% Max @ 25°C, 0.5 Vrms max at 1KHz

### Insulation Resistance 25°C (MIL-STD-202 Method 302)

C0G and X7R: 100K M $\Omega$  or 1000 M $\Omega$ - $\mu$ F, whichever is less.

Z5U: 10K M $\Omega$  or 1000 M $\Omega$ - $\mu$ F, whichever is less.

### Insulation Resistance 125°C (MIL-STD-202 Method 302)

C0G and X7R: 10K M $\Omega$  or 100 M $\Omega$ - $\mu$ F, whichever is less.

Z5U: 1K M $\Omega$  or 100 M $\Omega$ - $\mu$ F, whichever is less.

### Dielectric Withstanding Voltage 25°C (Flash Test)\*

C0G and X7R: 250% rated voltage for 5 seconds with 50 mA max

charging current. 500V rated units will be tested at 750 VDC

Z5U: 200% rated voltage for 5 seconds with 50 mA max charging current.

### Life Test (1000 hrs)

C0G and X7R: 200% rated voltage at +125°C (500 Volt units @ 600 VDC)

Z5U: 150% rated voltage at +85°C

### Moisture Resistance (MIL-STD-202 Method 106)

C0G, X7R, Z5U: Ten cycles with no voltage applied.

### Thermal Shock (MIL-STD-202 Method 107, Condition A)

### Immersion Cycling (MIL-STD-202 Method 104, Condition B)

## HOW TO ORDER

| DC61            | 5                                           | A                             | 561                                                                                                                                                           | K                                                                                                                                                 | A            | 5                         | 1               | 06                                     |
|-----------------|---------------------------------------------|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------|-----------------|----------------------------------------|
| AVX Style       | Voltage                                     | Temperature Coefficient       | Capacitance Code                                                                                                                                              | Capacitance Tolerance                                                                                                                             | Test Level   | Termination               | Inside Diameter | Maximum Thickness                      |
| See Pages 82-84 | 50V = 5<br>100V = 1<br>200V = 2<br>500V = 7 | C0G = A<br>X7R = C<br>Z5U = E | (2 significant digits + no. of zeros)<br>Examples:<br>10 pF = 100<br>100 pF = 101<br>1,000 pF = 102<br>22,000 pF = 223<br>220,000 pF = 224<br>1 $\mu$ F = 105 | C0G: J = $\pm 5\%$<br>K = $\pm 10\%$<br>M = $\pm 20\%$<br>X7R: K = $\pm 10\%$<br>M = $\pm 20\%$<br>Z5U: M = $\pm 20\%$<br>Z = +80 -20%<br>P = GMV | A = Standard | 5 = Silver (AVX Standard) | See Pages 82-84 | 06 = 1.52 (0.060)<br>10 = 2.54 (0.100) |

For dimensions, voltages or values not specified, please consult factory.



# Discoidal MLC Feed-Through Capacitors and Filters



## DC Style

### SIZE AND CAPACITANCE SPECIFICATIONS

Dimensions: millimeters (inches)

| EIA Characteristic       |                               | C0G                     |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|--------------------------|-------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| AVX Style                |                               | DC61                    | DC26                    | DC63                    | DC04                    | DC65                    | DC66                    | DC67                    | DC69                    | DC32                    | DC70                    | DC02                    | DC71                    | DC05                    | DC73                    | DC72                    |
| Outside Diameter (OD)*   |                               | 2.54<br>(0.100)         | 3.43<br>(0.135)         | 3.81<br>(0.150)         | 4.83<br>(0.190)         | 5.33<br>(0.210)         | 5.97<br>(0.235)         | 6.73<br>(0.265)         | 8.13<br>(0.320)         | 8.51<br>(0.335)         | 8.89<br>(0.350)         | 9.40<br>(0.370)         | 9.78<br>(0.385)         | 12.70<br>(0.500)        | 15.24<br>(0.600)        | 16.26<br>(0.640)        |
| Thickness Maximum (T)    |                               | 1.52<br>(0.060)         | 1.52<br>(0.060)         | 1.52<br>(0.060)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         |
| Inside Diameter No. (ID) |                               | 1,2                     | 1,2,3                   | 1,2,3,4                 | 1,2,3                   | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        |
| Voltage                  |                               | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 |
| cap. in pF               | 10<br>12<br>15                |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 18<br>22<br>27                |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 33<br>39<br>47                |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 56<br>68<br>82                |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 100<br>120<br>150             |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 180<br>220<br>270             |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 330<br>390<br>470             |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 560<br>680<br>820             |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 1000<br>1200<br>1500          |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 1800<br>2200<br>2700          |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 3300<br>3900<br>4700          |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 5600<br>6800<br>8200          |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 10,000<br>12,000<br>15,000    |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 18,000<br>22,000<br>27,000    |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 33,000<br>39,000<br>47,000    |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 56,000<br>68,000<br>82,000    |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 100,000<br>120,000<br>150,000 |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 180,000<br>220,000<br>270,000 |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 330,000<br>390,000<br>470,000 |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |
|                          | 560,000<br>680,000            |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |                         |

\*Outside Diameter:  
Tolerance is  $\pm 0.254$  (0.010) or 3%  
whichever is greater

| Inside Diameter:                                      |                                                       |                                         |
|-------------------------------------------------------|-------------------------------------------------------|-----------------------------------------|
| 1 = $.635^{+.127}_{-.051}$ (.025 $^{+.005}_{-.002}$ ) | 3 = $.914^{+.127}_{-.051}$ (.036 $^{+.005}_{-.002}$ ) | 5 = $1.27 \pm .127$ (0.050 $\pm .005$ ) |
| 2 = $.762^{+.127}_{-.051}$ (.030 $^{+.005}_{-.002}$ ) | 4 = $1.07^{+.127}_{-.051}$ (.042 $^{+.005}_{-.002}$ ) | 6 = $1.52 \pm .127$ (0.060 $\pm .005$ ) |
|                                                       |                                                       | 7 = $1.73 \pm .127$ (0.068 $\pm .005$ ) |



# Discoidal MLC Feed-Through Capacitors and Filters



## DC Style

### SIZE AND CAPACITANCE SPECIFICATIONS

Dimensions: millimeters (inches)

| EIA<br>Characteristic    | X7R                     |                         |                         |                         |                         |                         |                         |                         |                         |                            |                            |                            |                            |                               |                               |                               |                               |                            |                            |                            |
|--------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|----------------------------|----------------------------|----------------------------|----------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|----------------------------|----------------------------|----------------------------|
|                          | AVX Style               | DC61                    | DC26                    | DC63                    | DC04                    | DC65                    | DC66                    | DC67                    | DC69                    | DC32                       | DC70                       | DC02                       | DC71                       | DC05                          | DC73                          | DC72                          |                               |                            |                            |                            |
| Outside Diameter (OD)*   | 2.54<br>(0.100)         | 3.43<br>(0.135)         | 3.81<br>(0.150)         | 4.83<br>(0.190)         | 5.33<br>(0.210)         | 5.97<br>(0.235)         | 6.73<br>(0.265)         | 8.13<br>(0.320)         | 8.51<br>(0.335)         | 8.89<br>(0.350)            | 9.40<br>(0.370)            | 9.78<br>(0.385)            | 12.70<br>(0.500)           | 15.24<br>(0.600)              | 16.26<br>(0.640)              |                               |                               |                            |                            |                            |
| Thickness Maximum (T)    | 1.52<br>(0.060)         | 1.52<br>(0.060)         | 1.52<br>(0.060)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)         | 2.54<br>(0.100)            | 2.54<br>(0.100)            | 2.54<br>(0.100)            | 2.54<br>(0.100)            | 2.54<br>(0.100)               | 2.54<br>(0.100)               |                               |                               |                            |                            |                            |
| Inside Diameter No. (ID) | 1,2                     | 1,2,3                   | 1,2,3,4                 | 1,2,3                   | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4        | 5,6,7<br>1,2,3,4           | 5,6,7<br>1,2,3,4           | 5,6,7<br>1,2,3,4           | 5,6,7<br>1,2,3,4           | 5,6,7<br>1,2,3,4              | 5,6,7<br>1,2,3,4              |                               |                               |                            |                            |                            |
| Voltage                  | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50 | 500<br>200<br>100<br>50    | 500<br>200<br>100<br>50    | 500<br>200<br>100<br>50    | 500<br>200<br>100<br>50    | 500<br>200<br>100<br>50       | 500<br>200<br>100<br>50       |                               |                               |                            |                            |                            |
| cap. in pF               | 56<br>68<br>82          | 100<br>120<br>150       | 180<br>220<br>270       | 330<br>390<br>470       | 560<br>680<br>820       | 1000<br>1200<br>1500    | 1800<br>2200<br>2700    | 3300<br>3900<br>4700    | 5600<br>6800<br>8200    | 10,000<br>12,000<br>15,000 | 18,000<br>22,000<br>27,000 | 33,000<br>39,000<br>47,000 | 56,000<br>68,000<br>82,000 | 100,000<br>120,000<br>150,000 | 180,000<br>220,000<br>270,000 | 330,000<br>390,000<br>470,000 | 560,000<br>680,000<br>820,000 | 1.0 µF<br>1.2 µF<br>1.5 µF | 1.8 µF<br>2.2 µF<br>2.7 µF | 3.3 µF<br>3.9 µF<br>6.8 µF |

\*Outside Diameter:  
Tolerance is ±0.254 (0.010) or 3%  
whichever is greater

| Inside Diameter:                                                                     |                                                                                      |                            |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------|
| 1 = .635 <sup>+.127</sup> <sub>-.051</sub> (.025 <sup>+.005</sup> <sub>-.002</sub> ) | 3 = .914 <sup>+.127</sup> <sub>-.051</sub> (.036 <sup>+.005</sup> <sub>-.002</sub> ) | 5 = 1.27±.127 (0.050±.005) |
| 2 = .762 <sup>+.127</sup> <sub>-.051</sub> (.030 <sup>+.005</sup> <sub>-.002</sub> ) | 4 = 1.07 <sup>+.127</sup> <sub>-.051</sub> (.042 <sup>+.005</sup> <sub>-.002</sub> ) | 6 = 1.52±.127 (0.060±.005) |
|                                                                                      |                                                                                      | 7 = 1.73±.127 (0.068±.005) |



# Discoidal MLC Feed-Through Capacitors and Filters



## DC Style

### SIZE AND CAPACITANCE SPECIFICATIONS

Dimensions: millimeters (inches)

| EIA<br>Characteristic    |                               | Z5U              |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|--------------------------|-------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|--|
| AVX Style                |                               | DC61             | DC26             | DC63             | DC04             | DC65             | DC66             | DC67             | DC69             | DC32             | DC70             | DC02             | DC71             | DC05             | DC73             | DC72             |  |
| Outside Diameter (OD)*   |                               | 2.54<br>(0.100)  | 3.43<br>(0.135)  | 3.81<br>(0.150)  | 4.83<br>(0.190)  | 5.33<br>(0.210)  | 5.97<br>(0.235)  | 6.73<br>(0.265)  | 8.13<br>(0.320)  | 8.51<br>(0.335)  | 8.89<br>(0.350)  | 9.40<br>(0.370)  | 9.78<br>(0.385)  | 12.70<br>(0.500) | 15.24<br>(0.600) | 16.26<br>(0.640) |  |
| Thickness Maximum (T)    |                               | 1.52<br>(0.060)  | 1.52<br>(0.060)  | 1.52<br>(0.060)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  | 2.54<br>(0.100)  |  |
| Inside Diameter No. (ID) |                               | 1,2              | 1,2,3            | 1,2,3,4          | 1,2,3            | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 | 5,6,7<br>1,2,3,4 |  |
| Voltage                  |                               | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 | 200<br>100<br>50 |  |
| cap. in pF               | 1800<br>2200<br>2700          |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 3300<br>3900<br>4700          |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 5600<br>6800<br>8200          |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 10,000<br>12,000<br>15,000    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 18,000<br>22,000<br>27,000    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 33,000<br>39,000<br>47,000    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 56,000<br>68,000<br>82,000    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 100,000<br>120,000<br>150,000 |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 180,000<br>220,000<br>270,000 |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 330,000<br>390,000<br>470,000 |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 560,000<br>680,000<br>820,000 |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 1.0 µF<br>1.2 µF<br>1.5 µF    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 1.8 µF<br>2.2 µF<br>2.7 µF    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 3.3 µF<br>3.9 µF<br>4.7 µF    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 5.6 µF<br>6.8 µF<br>8.2 µF    |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |
|                          | 10.0 µF<br>12.0 µF<br>15.0 µF |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |  |

\*Outside Diameter:  
Tolerance is ±0.254 (0.010) or 3%  
whichever is greater

| Inside Diameter:                                                                     |                                                                                      |                            |
|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------|
| 1 = .635 <sup>+.127</sup> <sub>-.051</sub> (.025 <sup>+.005</sup> <sub>-.002</sub> ) | 3 = .914 <sup>+.127</sup> <sub>-.051</sub> (.036 <sup>+.005</sup> <sub>-.002</sub> ) | 5 = 1.27±.127 (0.050±.005) |
| 2 = .762 <sup>+.127</sup> <sub>-.051</sub> (.030 <sup>+.005</sup> <sub>-.002</sub> ) | 4 = 1.07 <sup>+.127</sup> <sub>-.051</sub> (.042 <sup>+.005</sup> <sub>-.002</sub> ) | 6 = 1.52±.127 (0.060±.005) |
|                                                                                      |                                                                                      | 7 = 1.73±.127 (0.068±.005) |



# Discoidal MLC Feed-Through Capacitors and Filters



## Discoidal XB / Feed-through XF – C0G

### HOW TO ORDER

| <b>XB</b>        | <b>06</b>                                          | <b>Z</b>           | <b>G</b>                                                                 | <b>0104</b>                     | <b>K</b>                     | <b>--</b>        |
|------------------|----------------------------------------------------|--------------------|--------------------------------------------------------------------------|---------------------------------|------------------------------|------------------|
| <b>AVX Style</b> | <b>Size</b>                                        | <b>Class</b>       | <b>Voltage</b>                                                           | <b>Capacitance</b>              | <b>Tolerance</b>             | <b>Packaging</b> |
| XB<br>XF         | 03<br>04<br>06<br>07<br>08<br>09<br>10<br>14<br>15 | C = NP0<br>Z = X7R | D = 63<br>E = 100<br>F = 160<br>G = 250<br>I = 400<br>J = 500 (optional) | EIA code<br>on 3 or 4<br>digits | J = 5%<br>K = 10%<br>M = 20% | -- : bulk        |

### REFERENCES

| Type | Terminations            | Reference      | Mechanical Characteristics                                     |
|------|-------------------------|----------------|----------------------------------------------------------------|
|      | Silver palladium        | XB..C•....• -- | CECC 30600<br>MIL 11015 D<br>Conformance<br>to<br>CK12<br>TYPE |
|      | Tinned silver palladium | XB..C•....• MB |                                                                |
|      | Silver palladium        | XF..C•....• -- |                                                                |
|      | Tinned silver palladium | XF..C•....• MB |                                                                |

### DIMENSIONS

| Size | OD                           |                              | ID                            |                    | bm<br>min      | Ø<br>(XF)      | e<br>min max |            |
|------|------------------------------|------------------------------|-------------------------------|--------------------|----------------|----------------|--------------|------------|
|      | XB/XF                        | XB/XF...MB                   | XB                            | XB...MB            |                |                | min          | max        |
| 03   | 3.8 ± 0.3<br>(0.150 ± 0.012) | 4.1 ± 0.4<br>(0.161 ± 0.016) | 0.7 ± 0.15<br>(0.028 ± 0.006) | > 0.4<br>(> 0.016) | 0.1<br>(0.004) | 0.5<br>(0.020) | 1            | See table  |
| 04   | 3.8 ± 0.3<br>(0.150 ± 0.012) | —                            | 1.2 ± 0.15<br>(0.047 ± 0.006) | —                  | 0.1<br>(0.004) | —              | 1            | on page 86 |
| 08   | 7.9 ± 0.3<br>(0.311 ± 0.012) | 8.2 ± 0.4<br>(0.323 ± 0.016) | 0.8 ± 0.15<br>(0.031 ± 0.006) | > 0.5<br>(> 0.020) | 0.2<br>(0.008) | 0.6<br>(0.024) | 1            |            |

### ELECTRICAL CHARACTERISTICS

|                                    |                                                      |
|------------------------------------|------------------------------------------------------|
| Dielectric Class                   | C0G                                                  |
| Temperature Coefficient            | 0 ± 30 ppm/°C                                        |
| Climatic Category                  | -55 / 125 / 56                                       |
| Operating Temperature              | -55 +125°C                                           |
| Rated Voltage (UR)                 | 50 to 400V                                           |
| Test Voltage (Ue)                  | 2.5 UR                                               |
| Tangent of Loss Angle<br>C < 50 pF | tg δ < 1.5 $\left(\frac{150}{C_R} + 7\right)10^{-4}$ |
| C ≥ 50 pF                          | tg δ < 15(10 <sup>-4</sup> )                         |
| Insulation Resistance              | Ri ≥ 100 GΩ                                          |



# Discoidal MLC Feed-Through Capacitors and Filters



Discoidal XB / Feed-through XF – C0G

## RATED VOLTAGE – RATED CAPACITANCES

| Capacitance<br>$C_R$               | Size                              |             |             |
|------------------------------------|-----------------------------------|-------------|-------------|
|                                    | 03                                | 04          | 08          |
|                                    | Rated Voltage - $U_R$ (V)/Ur code |             |             |
|                                    | 50/63                             | 50/63       | 160         |
|                                    | D                                 | D           | F           |
| 10 pF                              |                                   |             |             |
| 15 pF                              |                                   |             |             |
| 22 pF                              |                                   |             |             |
| 33 pF                              |                                   |             |             |
| 47 pF                              |                                   |             |             |
| 68 pF                              |                                   |             |             |
| 100 pF                             |                                   |             |             |
| 150 pF                             |                                   |             |             |
| 220 pF                             |                                   |             |             |
| 330 pF                             |                                   |             |             |
| 470 pF                             |                                   |             |             |
| 680 pF                             |                                   |             |             |
| 1000 pF                            |                                   |             |             |
| 1500 pF                            |                                   |             |             |
| 2200 pF                            |                                   |             |             |
| 3300 pF                            |                                   |             |             |
| 4700 pF                            |                                   |             |             |
| 6800 pF                            |                                   |             |             |
| 10 nF                              |                                   |             |             |
| 15 nF                              |                                   |             |             |
| 22 nF                              |                                   |             |             |
| 33 nF                              |                                   |             |             |
| 47 nF                              |                                   |             |             |
| 68 nF                              |                                   |             |             |
| 100 nF                             |                                   |             |             |
| Thickness $e_{max}$<br>mm (inches) | 1.4 (0.055)                       | 1.4 (0.055) | 1.8 (0.071) |

- other values, please contact us
- for tinned types, add 0.5 (0.020) to  $e_{max}$



# Discoidal MLC Feed-Through Capacitors and Filters



## Discoidal XB / Feed-through XF – X7R

### REFERENCES

| Type | Terminations            | Reference     | Mechanical Characteristics                                                  |
|------|-------------------------|---------------|-----------------------------------------------------------------------------|
|      | Silver palladium        | XB..Z•.... -- | CECC 30700<br>MIL 11015 D<br>Conformance<br>to<br>CK12, CK13, CK14<br>TYPES |
|      | Tinned silver palladium | XB..Z•.... MB |                                                                             |
|      | Silver palladium        | XF..Z•.... -- |                                                                             |
|      | Tinned silver palladium | XF..Z•.... MB |                                                                             |

### DIMENSIONS

| Size | OD                            |                               | ID                            | bm min             | Ø (XF)         | e              |                |
|------|-------------------------------|-------------------------------|-------------------------------|--------------------|----------------|----------------|----------------|
|      | XB/XF                         | XB/XF...MB                    |                               |                    |                | min            | max            |
| 03   | 3.8 ± 0.3<br>(0.150 ± 0.012)  | 4.1 ± 0.4<br>(0.161 ± 0.016)  | 0.7 ± 0.15<br>(0.028 ± 0.006) | > 0.4<br>(> 0.016) | 0.1<br>(0.004) | 0.5<br>(0.020) | 1.0<br>(0.039) |
| 04   | 3.8 ± 0.3<br>(0.150 ± 0.012)  | —                             | 1.2 ± 0.15<br>(0.047 ± 0.006) | —                  | 0.1<br>(0.004) | —              | 1.0<br>(0.039) |
| 06   | 6.4 ± 0.3<br>(0.252 ± 0.012)  | 6.7 ± 0.4<br>(0.264 ± 0.016)  | 1.7 ± 0.15<br>(0.067 ± 0.006) | > 0.5<br>(> 0.020) | 0.2<br>(0.008) | 0.6<br>(0.024) | 1.0<br>(0.039) |
| 07   | 7.3 ± 0.3<br>(0.287 ± 0.012)  | 7.6 ± 0.4<br>(0.299 ± 0.016)  | 1.7 ± 0.15<br>(0.067 ± 0.006) | > 0.5<br>(> 0.020) | 0.2<br>(0.008) | 0.6<br>(0.024) | 1.0<br>(0.039) |
| 08   | 7.9 ± 0.3<br>(0.311 ± 0.012)  | 8.2 ± 0.4<br>(0.323 ± 0.016)  | 0.8 ± 0.15<br>(0.031 ± 0.006) | > 0.5<br>(> 0.020) | 0.2<br>(0.008) | 0.6<br>(0.024) | 1.0<br>(0.039) |
| 09   | 8.4 ± 0.4<br>(0.331 ± 0.016)  | 8.7 ± 0.5<br>(0.343 ± 0.020)  | 1.6 ± 0.3<br>(0.063 ± 0.012)  | > 0.5<br>(> 0.020) | 0.2<br>(0.008) | 0.6<br>(0.024) | 1.0<br>(0.039) |
| 10   | 9.6 ± 0.4<br>(0.378 ± 0.016)  | 9.9 ± 0.5<br>(0.390 ± 0.020)  | 1.2 ± 0.15<br>(0.047 ± 0.006) | > 0.9<br>(> 0.035) | 0.2<br>(0.008) | 1.0<br>(0.039) | 1.0<br>(0.039) |
| 14   | 14.0 ± 0.5<br>(0.551 ± 0.020) | 14.3 ± 0.6<br>(0.563 ± 0.024) | 1.7 ± 0.3<br>(0.067 ± 0.012)  | > 0.9<br>(> 0.035) | 0.2<br>(0.008) | 1.0<br>(0.039) | 1.0<br>(0.039) |
| 15   | 15.0 ± 0.5<br>(0.591 ± 0.020) | 15.3 ± 0.6<br>(0.602 ± 0.024) | 2.3 ± 0.3<br>(0.091 ± 0.012)  | > 0.9<br>(> 0.035) | 0.2<br>(0.008) | 1.0<br>(0.039) | 1.0<br>(0.039) |

### ELECTRICAL CHARACTERISTICS

|                         |                                         |
|-------------------------|-----------------------------------------|
| Dielectric Class        | X7R                                     |
| Temperature Coefficient | $\Delta C/C \leq \pm 15\%$ (-55 +125°C) |
| Climatic Category       | -55 / 125 / 56                          |
| Operating Temperature   | -55 +125°C                              |
| Rated Voltage ( $U_R$ ) | 50 to 400V                              |
| Test Voltage ( $U_e$ )  | 2.5 $U_R$                               |
| Tangent of Loss Angle   | $\text{tg } \delta \leq 250(10^{-4})$   |
| Insulation Resistance   |                                         |
| $C \leq 10$ nF          | $R_i \geq 100$ GΩ                       |
| $C > 10$ nF             | $R_i \times C \geq 1000$ s              |



## RATED VOLTAGE – RATED CAPACITANCES

- other values, please contact us
- for tinned types, add 0.5 (0.020) to  $e_{\max}$

# Filtered Arrays



## XD... Type

### FEATURES

- To be used beneath a connector
- Provide an EMI filtered signal line between electronic modules
- Effective insertion loss from 1MHz up to ~ 1GHz
- Surface mount compatible

### HOW TO ORDER

| <b>XD</b>              | <b>06</b>                     | <b>Z</b>                           | <b>F</b>                             | <b>0153</b>                                           | <b>K</b>                                                                                                 | <b>--</b>                                                                                        |
|------------------------|-------------------------------|------------------------------------|--------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| <b>AVX Style</b><br>XD | <b>Size</b><br>03<br>06<br>07 | <b>Class</b><br>C = NP0<br>Z = X7R | <b>Voltage</b><br>F = 200<br>J = 500 | <b>Capacitance</b><br>EIA code<br>on 3 or 4<br>digits | <b>Tolerance</b><br>NP0 F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10%<br>X7R J = ±5%<br>K = ±10%<br>M = ±20% | <b>Packaging</b><br>SUFFIX<br>Burn-in 100% 168H = T5<br>Burn-in 100% 48H = T3<br>No burn-in = -- |

### STYLE & DIMENSIONS

| millimeters (inches) |                        |                                               |                 |                                |                                 |         |                |
|----------------------|------------------------|-----------------------------------------------|-----------------|--------------------------------|---------------------------------|---------|----------------|
|                      | TYPES                  | L                                             | P               | D                              | d                               | bm maxi | Thickness maxi |
|                      | XD07<br>(4 capacitors) | 7.00 ± 0.15<br>(0.275 ± 0.006)                | 2.54<br>(0.100) | 1.70 ± 0.15<br>(0.067 ± 0.006) | 1.00 ± 0.10<br>(0.039 ± 0.0039) | 0.3     | 2mm            |
|                      | XD06<br>(4 capacitors) | 6.00 ± 0.15<br>(0.236 ± 0.006)                | 2.54<br>(0.100) | 1.70 ± 0.15<br>(0.067 ± 0.006) | 1.00 ± 0.10<br>(0.039 ± 0.0039) | 0.3     | 2mm            |
|                      | XD03<br>(2 capacitors) | 6.00 x 3.00 ± 0.15<br>(0.236 x 0.118 ± 0.006) | 2.54<br>(0.100) | 1.70 ± 0.15<br>(0.067 ± 0.006) | 1.0 ± 0.10<br>(0.039 ± 0.0039)  | 0.3     | 1.5mm          |

Terminations: Silver – Palladium – Platinum, on 4 or only 2 sides of the array

### CAPACITANCE vs VOLTAGE TABLE

| Cap. Range<br>(each cap.) | X7R          |              | NP0            |               |
|---------------------------|--------------|--------------|----------------|---------------|
|                           | 200VDC       | 500VDC       | 200VDC         | 500VDC        |
| XD07...                   | 33nF → 120nF | 4.7nF → 18nF | 470pF → 1500pF | 220pF → 620pF |
| XD06...                   | 15nF → 68nF  | 2.2nF → 10nF | 220pF → 750pF  | 120pF → 330pF |
| XD03...                   | 8.2nF → 39nF | 1nF → 4.7nF  | 180pF → 390pF  | 82pF → 180pF  |

### ELECTRICAL CHARACTERISTICS

|                            |                                                                                                           |                                       |
|----------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------|
| Dielectric Class           | X7R                                                                                                       | NP0                                   |
| Temperature Coefficient    | $\Delta C/C \leq \pm 15\% (-55 +125^{\circ}\text{C})$                                                     | $0 \pm 30\text{ppm}/^{\circ}\text{C}$ |
| Climatic Category          | 55 / 125 / 56                                                                                             | 55 / 125 / 56                         |
| Rated Voltage ( $U_R$ )    | 200 VDC                                                                                                   | 500VDC                                |
| Test Voltage ( $U_e$ )     | $2 \times U_R$                                                                                            | $1.5 \times U_R$                      |
| Tangent of Loss Angle - DF | $\text{tg } \delta \leq 250(10^{-4})$                                                                     | $\text{tg } \delta \leq 15(10^{-4})$  |
| Insulation Resistance      | $C \leq 10\text{nF} = R_i \geq 100 \text{ G}\Omega$<br>$C > 10\text{nF} = R_i \times C \geq 1000\text{s}$ | $R_i \geq 100 \text{ G}\Omega$        |

## FEATURES

High Reliability CECC Ceramic Chips Capacitors for Military & Avionics applications

## HOW TO ORDER

| AN                                                                                | 13                                                                           | Z                                  | E                                                 | 0104                                                  | J                                                                                                        | T3                                                                                               |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------|---------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| <b>AVX Style</b><br>AN = Nickel Barrier<br>+ SnPb finish<br>AC = Silver Palladium | <b>Size</b><br>12 = 0805<br>20 = 1206<br>13 = 1210<br>14 = 1812<br>15 = 2220 | <b>Class</b><br>C = NP0<br>Z = X7R | <b>Voltage</b><br>D = 50/63<br>E = 100<br>F = 200 | <b>Capacitance</b><br>EIA code<br>on 3 or 4<br>digits | <b>Tolerance</b><br>NP0 F = ±1%<br>G = ±2%<br>J = ±5%<br>K = ±10%<br>X7R J = ±5%<br>K = ±10%<br>M = ±20% | <b>Packaging</b><br>SUFFIX<br>Burn-in 100% 168H = T5<br>Burn-in 100% 48H = T3<br>No burn-in = -- |

## QUALIFIED VS CECC 32101-801

Class: NP0 + X7R (2C1/BX available on request)

Sizes: 0805, 1206, 1210, 1812, 2220 (0603 qualification pending)

Voltages: 50, 100, 200 (500V on request)

Terminations: Silver Palladium or Nickel barrier + tin lead finish

## CAPACITANCE vs VOLTAGE TABLE

| Size | NP0*         |              |              | X7R**       |             |              |
|------|--------------|--------------|--------------|-------------|-------------|--------------|
|      | 50V          | 100V         | 200V         | 50V         | 100V        | 200V         |
| 0805 | 4.7 → 1500pF | 4.7 → 1500pF | 10 → 470pF   | 0.47 → 68nF | 0.47 → 39nF | 0.33 → 18nF  |
| 1206 | 10 → 4700pF  | 10 → 4700pF  | 10 → 1500pF  | 1 → 180nF   | 1 → 100nF   | 0.1 → 39nF   |
| 1210 | 10 → 8200pF  | 10 → 8200pF  | 22 → 2700pF  | 10 → 330nF  | 4.7 → 220nF | 0.47 → 100nF |
| 1812 | 0.1 → 18nF   | 0.1 → 18nF   | 0.47 → 5.6nF | 47 → 680nF  | 10 → 470nF  | 1 → 180nF    |
| 2220 | 0.47 → 39nF  | 0.47 → 39nF  | 0.1 → 12nF   | 0.1 → 1.5μF | 0.047 → 1μF | 4.7 → 390nF  |

\* NP0 Class (range available with tolerance: 1, 2, 5, 10%)

\*\* X7R Class (range available with tolerance: 5, 10, 20%)

### Available Reliability Levels:

Suffix: -- = qualified following CECC 32101-801 [no burn-in]

Suffix: T3 = according to CECC 32100-002 or 003; Established reliability level  
(Equivalent to MIL-R) [100% burn-in: 48H @ 2 x Ur]

Suffix: T5 = according to CECC 32100-002 or 003; Established reliability level  
(Equivalent to MIL-S) [100% burn-in: 168H @ 2 x Ur]

## A Dedicated Facility / BS9100 Requirements

### Baseline Products — A Selection of Options

As a matter of course, AVX maintains a level of quality control that is sufficient to guarantee whatever reliability specifications are needed. However, AVX goes further. There are over 65 quality control and inspection operations that are available as options to a customer. Any number may be requested and written into a baseline process. The abbreviated list that follows indicates the breadth and thoroughness of available Q.C. services at AVX:

Ultrasonic Scanning  
Destructive Physical Analysis (DPA)  
X-Ray  
Bondability Testing  
Sorting and Matching to  
Specification Limits  
Temperature and Immersion  
Cycling  
Load/Humidity Life Testing  
Dye Penetration Evaluation  
100% Ceramic Sheet Inspection  
Voltage Conditioning  
Termination Pull Testing  
Pre-encapsulation Inspection

Within the “specials” area, AVX accommodates a broad variety of customer needs. The AVX facilities are capable of developing and producing the most reliable and advanced MLCs available anywhere in the world today. Yet it is equally adept at making volume “custom” components that may differ only in

markings or lead placement from the standard catalog part.

### Stretching the Limits

Advanced Products are developed to meet the extraordinary needs of specific applications. Requirements may include: low ESR, low ESL, voltages up to 10's of thousands, advanced decoupling designs for frequencies up to 10's of megahertz, temperatures up to 200°C, extremely high current discharge, ability to perform in high radiation or toxic atmospheres, or minimizing piezoelectric effect in high vibration environments.

In addition, solving customer packaging problems, aside from addressing circuit problems, is available. Special lead frames for high current or special mounting requirements are examples. Multiple ceramic chip package designs per customer requirements are also available.

Advanced Products always begin with a joint development program involving AVX and the customer. In undersea cable components, for example, capacitance and impedance ratings had to be maintained within 1% over the multi-year life of the system. In this case, Advanced Products not only met the parametric requirements of the customer, but accelerated life testing of 3,500 units indicated an average life expectancy of over 100,000 years.

### Baseline Program Management

Baseline Program Management has been AVX's forte over the years. This is both a product and a service function designed to provide the customer the full capabilities of AVX in meeting their program requirements. AVX has had Baseline and Program Management in the following major systems:

—AT&T Undersea Cable  
—Minuteman  
—Peacekeeper  
—STC Undersea Cable  
—CIT Undersea Cable  
—Raytheon-Hawk Missile  
—Trident  
—Small Missile Program  
—Northrop - Peacekeeper  
—Sparrow Program  
—Space Station  
—European Space Agency (ESA)  
—Commercial Satellite Program  
—Arianne 4 & 5  
—EuroFighter (Typhoon)  
—EH101 (Merlin)

AVX technical personnel stand ready to answer any questions and provide any information required on your programs from the most exotic Hi-Rel part to the simplest variation on a standard. Put the experience, technology and facilities of the leading company in multilayer ceramics to work for you. No other source offers the unique combination of capability and commitment to advanced application specific components.

## PROCUREMENT OF COMPONENTS OF BS9100 (CH/CV RANGE 50-500V)

The manufacturing facilities have ISO9001 approval. Customers requiring BS9100 approved components are requested to follow these steps:

1. The customer shall submit a specification for the required components to AVX for approval. Once agreed a Customer Detail Specification (CDS) number will be allocated by AVX to this specification. This number with its current revision must be quoted at the time of order placement.
2. If the customer has no specification, then AVX will supply a copy of the standard CDS for the customer's approval and signature. As in 1 above, when agreed this CDS number must be quoted at order entry. In the event of agreement not being reached the component cannot be supplied to BS9100.

For assistance contact: EMAP Specification Engineering  
Dept. AVX Ltd. Coleraine, Northern Ireland  
Telephone ++44 (0)28703 44188, Fax ++44 (0)28703 55527

## PACKAGING

Unless otherwise stated in the appropriate data sheet parts are supplied in a waffle pack.

## Specific Products

### Examples of Special Packaging and Custom Lead Configurations from Advanced Products



#### Custom Lead Configurations. . .

optimum 3D packaging, high current applications and high reliability stress relief mounting.



#### Custom Packaging. . .

eliminate reliability concerns with multiple component assembly.

Many other innovations are available from Advanced Products. Let them apply these ideas to your application specific programs.

## PASSIVES

### Capacitors

Multilayer Ceramic  
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Glass  
Film  
Power Film  
Power Ceramic  
Ceramic Disc  
Trimmer  
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### Resistors

Arrays

### Timing Devices

Resonators  
Oscillators  
Crystals

### Filters

EMI  
SAW  
Dielectric

### Thin Film

Inductors  
Fuses  
Capacitors  
Couplers  
Baluns  
Filters

### Integrated Passive Components

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Custom IPCs

### Voltage Suppressors, Varistors and Thermistors

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SMT and Through-Hole

Card Edge

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Custom Designed Connectors

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DIN 41612 Connectors

FFC/FPC Connectors

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I/O Connectors

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MOBO™, I/O, Board to Board and  
Battery Connectors

Press-fit Connectors

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our website at**

**<http://www.avx.com>**

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