

# MULTILAYER CERAMIC CAPACITORS/AXIAL & RADIAL LEADED

Multilayer ceramic capacitors are available in a variety of physical sizes and configurations, including leaded devices and surface mounted chips. Leaded styles include molded and conformally coated parts with axial and radial leads. However, the basic capacitor element is similar for all styles. It is called a chip and consists of formulated dielectric materials which have been cast into thin layers, interspersed with metal electrodes alternately exposed on opposite

Ceramic dielectric materials can be formulated with a wide range of characteristics. The EIA standard for ceramic dielectric capacitors (RS-198) divides ceramic dielectrics into the following classes:

**Class I:** Temperature compensating capacitors, suitable for resonant circuit application or other applications where high Q and stability of capacitance characteristics are required. Class I capacitors have predictable temperature coefficients and are not affected by voltage, frequency or time. They are made from materials which are not ferro-electric, yielding superior stability but low volumetric efficiency. Class I capacitors are the most stable type available, but have the lowest volumetric efficiency.

**Class II:** Stable capacitors, suitable for bypass or coupling applications or frequency discriminating circuits where Q and stability of capacitance characteristics are not of major importance. Class II capacitors have temperature characteristics of  $\pm$  15% or less. They are made from materials which are ferro-electric, yielding higher volumetric efficiency but less stability. Class II capacitors are affected by temperature, voltage, frequency and time. edges of the laminated structure. The entire structure is fired at high temperature to produce a monolithic block which provides high capacitance values in a small physical volume. After firing, conductive terminations are applied to opposite ends of the chip to make contact with the exposed electrodes. Termination materials and methods vary depending on the intended use.

### **TEMPERATURE CHARACTERISTICS**

**Class III:** General purpose capacitors, suitable for by-pass coupling or other applications in which dielectric losses, high insulation resistance and stability of capacitance characteristics are of little or no importance. Class III capacitors are similar to Class II capacitors except for temperature characteristics, which are greater than  $\pm$  15%. Class III capacitors have the highest volumetric efficiency and poorest stability of any type.

KEMET leaded ceramic capacitors are offered in the three most popular temperature characteristics:

**C0G:** Class I, with a temperature coefficient of  $0 \pm 30$  ppm per degree C over an operating temperature range of - 55°C to + 125°C (Also known as "NP0").

**X7R:** Class II, with a maximum capacitance change of  $\pm$  15% over an operating temperature range of - 55°C to + 125°C.

**Z5U:** Class III, with a maximum capacitance change of + 22% - 56% over an operating temperature range of  $+ 10^{\circ}$ C to  $+ 85^{\circ}$ C.

Specified electrical limits for these three temperature characteristics are shown in Table 1.

Parameter	Temp	erature Characte	ristics
i didineter	C0G	X7R	Z5U
Dissipation Factor: Measured at following conditions. COG – 1 kHz and 1 vrms if capacitance >1000pF 1 MHz and 1 vrms if capacitance ≤ 1000 pF X7R – 1 kHz and 1 vrms* or if extended cap range 0.5 vrms Z5U – 1 kHz and 0.5 vrms	0.10%	2.5% (3.5% @ 25V)	4.0%
Dielectric Stength: 2.5 times rated DC voltage.	Р	ass Subsequent IR T	est
Insulation Resistance (IR): At rated DC voltage, whichever of the two is smaller	1,000 MΩ–μF or 100 GΩ	1,000 MΩ–μF or 100 GΩ	1,000 MΩ–μF or 10 GΩ
Temperature Characteristics: Range, °C Capacitance Change without DC voltage	-55 to +125 0 ± 30 ppm/°C	-55 to +125 ± 15%	+ 10 to +85 +22%,-56%

## SPECIFIED ELECTRICAL LIMITS

\* MHz and 1 vrms if capacitance  $\leq$  100 pF on military product.

### **ELECTRICAL CHARACTERISTICS**

The fundamental electrical properties of multilayer ceramic capacitors are as follows:

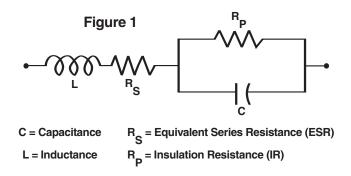
**Polarity:** Multilayer ceramic capacitors are not polar, and may be used with DC voltage applied in either direction.

**Rated Voltage:** This term refers to the maximum continuous DC working voltage permissible across the entire operating temperature range. Multilayer ceramic capacitors are not extremely sensitive to voltage, and brief applications of voltage above rated will not result in immediate failure. However, reliability will be reduced by exposure to sustained voltages above rated.

**Capacitance:** The standard unit of capacitance is the farad. For practical capacitors, it is usually expressed in microfarads (10<sup>-6</sup> farad), nanofarads (10<sup>-9</sup> farad), or picofarads (10<sup>-12</sup> farad). Standard measurement conditions are as follows:

Class I (up to 1,000 pF):	1MHz and 1.2 VRMS maximum.
Class I (over 1,000 pF):	1kHz and 1.2 VRMS maximum.
Class II:	1 kHz and 1.0 $\pm$ 0.2 VRMS.
Class III:	1 kHz and 0.5 $\pm$ 0.1 VRMS.

Like all other practical capacitors, multilayer ceramic capacitors also have resistance and inductance. A simplified schematic for the equivalent circuit is shown in Figure 1. Other significant electrical characteristics resulting from these additional properties are as follows:



**Impedance:** Since the parallel resistance (Rp) is normally very high, the total impedance of the capacitor is:

 $Z = \sqrt{R_{S}^{2} + (X_{C} - X_{L})^{2}}$ 

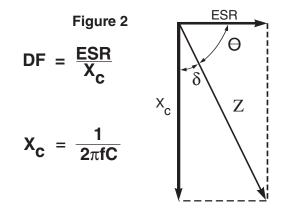
Where Z = Total Impedance

RS = Equivalent Series Resistance  $X_{c}$  = Capacitive Reactance =  $\frac{1}{2\pi fC}$ 

$$X_{L} =$$
Inductive Reactance =  $2\pi fL$ 

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

**Dissipation Factor:** Dissipation Factor (DF) is a measure of the losses in a capacitor under AC application. It is the ratio of the equivalent series resistance to the capacitive reactance, and is usually expressed in percent. It is usually measured simultaneously with capacitance, and under the same conditions. The vector diagram in Figure 2 illustrates the relationship between DF, ESR, and impedance. The reciprocal of the dissipation factor is called the "Q", or quality factor. For convenience, the "Q" factor is often used for very low values of dissipation factor. DF is sometimes called the "loss tangent" or "tangent  $\delta$ ", as derived from this diagram.



Insulation Resistance: Insulation Resistance (IR) is the DC resistance measured across the terminals of a capacitor, represented by the parallel resistance (Rp) shown in Figure 1. For a given dielectric type, electrode area increases with capacitance, resulting in a decrease in the insulation resistance. Consequently, insulation resistance is usually specified as the "RC" (IR x C) product, in terms of ohm-farads or megohm-microfarads. The insulation resistance for a specific capacitance value is determined by dividing this product by the capacitance. However, as the nominal capacitance values become small, the insulation resistance calculated from the RC product reaches values which are impractical. Consequently, IR specifications usually include both a minimum RC product and a maximum limit on the IR calculated from that value. For example, a typical IR specification might read "1,000 megohm-microfarads or 100 gigohms, whichever is less."

Insulation Resistance is the measure of a capacitor to resist the flow of DC leakage current. It is sometimes referred to as "leakage resistance." The DC leakage current may be calculated by dividing the applied voltage by the insulation resistance (Ohm's Law).

**Dielectric Withstanding Voltage:** Dielectric withstanding voltage (DWV) is the peak voltage which a capacitor is designed to withstand for short periods of time without damage. All KEMET multilayer ceramic capacitors will withstand a test voltage of 2.5 x the rated voltage for 60 seconds.

KEMET specification limits for these characteristics at standard measurement conditions are shown in Table 1 on page 4. Variations in these properties caused by changing conditions of temperature, voltage, frequency, and time are covered in the following sections.



### TABLE 1 EIA TEMPERATURE CHARACTERISTIC CODES FOR CLASS I DIELECTRICS

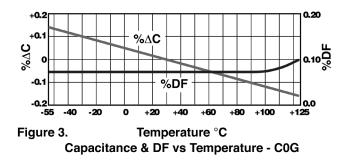
Significar of Temp Coeffi	erature	to Temp	r Applied perature ficient	Toleran Temper Coeffic	rature
PPM per Degree C	Letter Symbol	Multi- plier	Number Symbol	PPM per Degree C	Letter Symbol
0.0	С	-1	0	±30	G
0.3	В	-10	1	±60	Н
0.9	А	-100	2	±120	J
1.0	М	-1000	3	±250	K
1.5	Р	-100000	4	±500	L
2.2	R	+1	5	±1000	М
3.3	S	+10	6	±2500	Ν
4.7	Т	+100	7		
7.5	U	+1000	8		
		+10000	9		

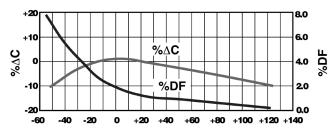
\* These symetrical tolerances apply to a two-point measurement of temperature coefficient: one at 25°C and one at 85°C. Some deviation is permitted at lower temperatures. For example, the PPM tolerance for C0G at -55°C is +30 / -72 PPM.

### TABLE 2 EIA TEMPERATURE CHARACTERISTIC CODES FOR CLASS II & III DIELECTRICS

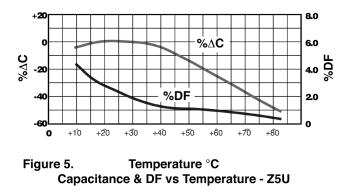
Low Tem Rati		High Tem Rat		laximum Ca Shif	
Degree Celcius	Letter Symbol	Degree Celcius	Number Symbol	Percent	Letter Symbol
+10C	Z	+45C	2	±1.0%	A
-30C	Y	+65C	4	±1.5%	В
-55C	Х	+85C	5	±2.2%	С
		+105C	6	±3.3%	D
		+125C	7	±4.7%	E
		+150C	8	±7.5%	F
		+200C	9	±10.0%	Р
				±15.0%	R
				±22.0%	S
			+	22/-33%	Т
			+	22/-56%	U
			+	-22/-82%	V

### **EFFECT OF TEMPERATURE**

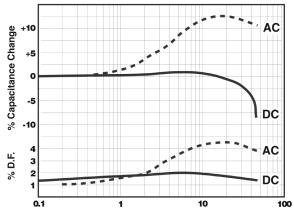


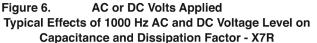






### **EFFECT OF APPLIED VOLTAGE**





Note: COG Dielectric capacitance and dissipation factor are stable with voltage.

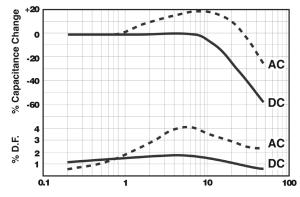


Figure 7. AC or DC Volts Applied Typical Effects of 1000 Hz AC and DC Voltage Level on Capacitance and Dissipation Factor - Z5U

Note: COG Dielectric capacitance and dissipation factor are stable with voltage.

**Effect of Temperature:** Both capacitance and dissipation factor are affected by variations in temperature. The maximum capacitance change with temperature is defined by the temperature characteristic. However, this only defines a "box" bounded by the upper and lower operating temperatures and the minimum and maximum capacitance values. Within this "box", the variation with temperature depends upon the specific dielectric formulation. Typical curves for KEMET capacitors are shown in Figures 3, 4, and 5. These figures also include the typical change in dissipation factor for KEMET capacitors.

Insulation resistance decreases with temperature. Typically, the insulation resistance at maximum rated temperature is 10% of the  $25^{\circ}$ C value.

**Effect of Voltage:** Class I ceramic capacitors are not affected by variations in applied AC or DC voltages. For Class II and III ceramic capacitors, variations in voltage affect only the capacitance and dissipation factor. The application of DC voltage higher than 5 vdc reduces both the capacitance and dissipation factor. The application of AC voltages up to 10-20 Vac tends to increase both capacitance and dissipation factor.

At higher AC voltages, both capacitance and dissipation factor begin to decrease.

Typical curves showing the effect of applied AC and DC voltage are shown in Figure 6 for KEMET X7R capacitors and Figure 7 for KEMET Z5U capacitors.

**Effect of Frequency:** Frequency affects both capacitance and dissipation factor. Typical curves for KEMET multilayer ceramic capacitors are shown in Figures 8 and 9.

The variation of impedance with frequency is an important consideration in the application of multilayer ceramic capacitors. Total impedance of the capacitor is the vector of the capacitive reactance, the inductive reactance, and the ESR, as illustrated in Figure 2. As frequency increases, the capacitive reactance decreases. However, the series inductance (L) shown in Figure 1 produces inductive reactance, which increases with frequency. At some frequency, the impedance ceases to be capacitive and becomes inductive. This point, at the bottom of the V-shaped impedance versus frequency curves, is the self-resonant frequency. At the self-resonant frequency, the reactance is zero, and the impedance consists of the ESR only.

Typical impedance versus frequency curves for KEMET multilayer ceramic capacitors are shown in Figures 10, 11, and 12. These curves apply to KEMET capacitors in chip form, without leads. Lead configuration and lead length have a significant impact on the series inductance. The lead inductance is approximately 10nH/inch, which is large compared to the inductance of the chip. The effect of this additional inductance is a decrease in the self-resonant frequency, and an increase in impedance in the inductive region above the self-resonant frequency.

**Effect of Time:** The capacitance of Class II and III dielectrics change with time as well as with temperature, voltage and frequency. This change with time is known as "aging." It is caused by gradual realignment of the crystalline structure of the ceramic dielectric material as it is cooled below its Curie temperature, which produces a loss of capacitance with time. The aging process is predictable and follows a logarithmic decay. Typical aging rates for C0G, X7R, and Z5U dielectrics are as follows:

C0G	None
X7R	2.0% per decade of time
Z5U	5.0% per decade of time

Typical aging curves for X7R and Z5U dielectrics are shown in Figure 13.

The aging process is reversible. If the capacitor is heated to a temperature above its Curie point for some period of time, de-aging will occur and the capacitor will regain the capacitance lost during the aging process. The amount of deaging depends on both the elevated temperature and the length of time at that temperature. Exposure to 150°C for onehalf hour or 125°C for two hours is usually sufficient to return the capacitor to its initial value.

Because the capacitance changes rapidly immediately after de-aging, capacitance measurements are usually delayed for at least 10 hours after the de-aging process, which is often referred to as the "last heat." In addition, manufacturers utilize the aging rates to set factory test limits which will bring the capacitance within the specified tolerance at some future time, to allow for customer receipt and use. Typically, the test limits are adjusted so that the capacitance will be within the specified tolerance after either 1,000 hours or 100 days, depending on the manufacturer and the product type.



### POWER DISSIPATION

Power dissipation has been empirically determined for two representative KEMET series: C052 and C062. Power dissipation capability for various mounting configurations is shown in Table 3. This table was extracted from Engineering Bulletin F-2013, which provides a more detailed treatment of this subject.

Note that no significant difference was detected between the two sizes in spite of a 2 to 1 surface area ratio. Due to the materials used in the construction of multilayer ceramic capacitors, the power dissipation capability does not depend greatly on the surface area of the capacitor body, but rather on how well heat is conducted out of the capacitor lead wires. Consequently, this power dissipation capability is applicable to other leaded multilayer styles and sizes.

### TABLE 3 POWER DISSIPATION CAPABILITY (Rise in Celsius degrees per Watt)

Mounting Configuration	Power Dissipation of C052 & C062
1.00" leadwires attached to binding post of GR-1615 bridge (excellent heat sink)	90 Celsius degrees rise per Watt ±10%
0.25" leadwires attached to binding post of GR-1615 bridge	55 Celsius degrees rise per Watt ±10%
Capacitor mounted flush to 0.062" glass- epoxy circuit board with small copper traces	77 Celsius degrees rise per Watt ±10%
Capacitor mounted flush to 0.062" glass- epoxy circuit board with four square inches of copper land area as a heat sink	53 Celsius degrees rise per Watt ±10%

As shown in Table 3, the power dissipation capability of the capacitor is very sensitive to the details of its use environment. The temperature rise due to power dissipation should not exceed 20°C. Using that constraint, the maximum permissible power dissipation may be calculated from the data provided in Table 3.

It is often convenient to translate power dissipation capability into a permissible AC voltage rating. Assuming a sinusoidal wave form, the RMS "ripple voltage" may be calculated from the following formula:

$$E = Z x \sqrt{\frac{P_{MAX}}{R}}$$

Where E = RMS Ripple Voltage (volts)

**P** = Power Dissipation (watts)

Z = Impedance

R = ESR

The data necessary to make this calculation is included in Engineering Bulletin F-2013. However, the following criteria must be observed:

- 1. The temperature rise due to power dissipation should be limited to 20°C.
- 2. The peak AC voltage plus the DC voltage must not exceed the maximum working voltage of the capacitor.

Provided that these criteria are met, multilayer ceramic

capacitors may be operated with AC voltage applied without need for DC bias.

#### RELIABILITY

A well constructed multilayer ceramic capacitor is extremely reliable and, for all practical purposes, has an infinite life span when used within the maximum voltage and temperature ratings. Capacitor failure may be induced by sustained operation at voltages that exceed the rated DC voltage, voltage spikes or transients that exceed the dielectric withstanding voltage, sustained operation at temperatures above the maximum rated temperature, or the excessive temperature rise due to power dissipation.

Failure rate is usually expressed in terms of percent per 1,000 hours or in FITS (failure per billion hours). Some KEMET series are qualified under U.S. military established reliability specifications MIL-PRF-20, MIL-PRF-123, MIL-PRF-39014, and MIL-PRF-55681. Failure rates as low as 0.001% per 1,000 hours are available for all capacitance / voltage ratings covered by these specifications. These specifications and accompanying Qualified Products List should be consulted for details.

For series not covered by these military specifications, an internal testing program is maintained by KEMET Quality Assurance. Samples from each week's production are subjected to a 2,000 hour accelerated life test at 2 x rated voltage and maximum rated temperature. Based on the results of these tests, the average failure rate for all non-military series covered by this test program is currently 0.06% per 1,000 hours at maximum rated conditions. The failure rate would be much lower at typical use conditions. For example, using MIL-HDBK-217D this failure rate translates to 0.9 FITS at 50% rated voltage and 50°C.

Current failure rate details for specific KEMET multilayer ceramic capacitor series are available on request.

### **MISAPPLICATION**

Ceramic capacitors, like any other capacitors, may fail if they are misapplied. Typical misapplications include exposure to excessive voltage, current or temperature. If the dielectric layer of the capacitor is damaged by misapplication the electrical energy of the circuit can be released as heat, which may damage the circuit board and other components as well.

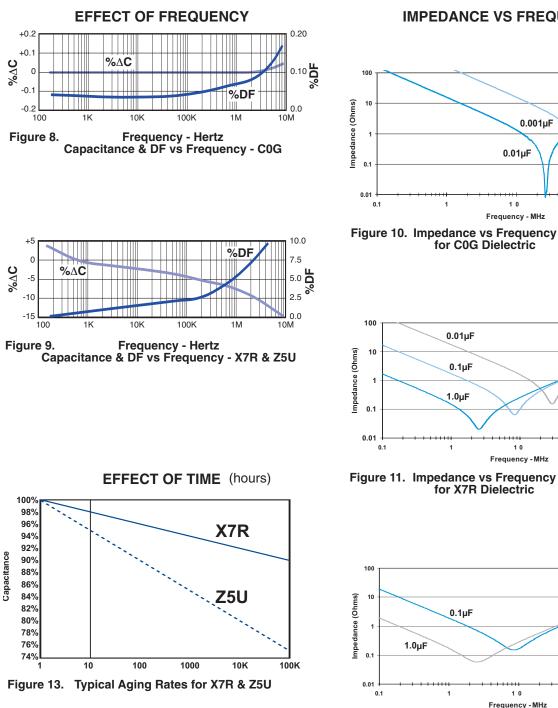
If potential for misapplication exists, it is recommended that precautions be taken to protect personnel and equipment during initial application of voltage. Commonly used precautions include shielding of personnel and sensing for excessive power drain during board testing.

### STORAGE AND HANDLING

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature – reels may soften or warp, and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40° C, and maximum storage humidity not exceed 70% relative humidity. In addition, temperature fluctuations should be minimized to avoid condensation on the parts, and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability, chip stock should be used promptly, preferably within 1.5 years of receipt.

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8



**IMPEDANCE VS FREQUENCY** 

100

100

100

Figure 12. Impedance vs Frequency for Z5U Dielectric

1000

1000

1000



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# CERAMIC CONFORMALLY COATED/AXIAL

"AXIMAX"

### **GENERAL SPECIFICATIONS**

### Working Voltage:

 Axial (ŴVDC)

 C0G
 50, 100, 200

 X7R
 25, 50, 100, 200, 250

 Z5U
 50, 100

 Radial (WVDC)
 COG

 COG
 50, 100, 200, 500, 1k, 1.5k, 2k, 2.5k, 3k

 X7R
 25, 50, 100, 200, 500, 1k, 1.5k, 2k, 2.5k, 3k

 X7R
 25, 50, 100, 200, 250, 500, 1k, 1.5k, 2k, 2.5k, 3k

 X5U
 50, 100

#### Temperature Characteristics:

COG 0 ±30 PPM / °C from -55°C to +125°C (1) X7R ± 15% from -55°C to +125°C Z5U + 22%, -56% from +10°C to +85°C

#### Capacitance Tolerance:

C0G ±0.5pF, ±1%, ±2%, ±5%, ±10%, ±20% X7R ±10%, ±20%, +80% / -20% Z5U ±20%, 80% / -20%

#### Construction:

# Epoxy encapsulated – meets flame test requirements of UL Standard 94V-0.

High-temperature solder – meets EIA RS-198, Method 302, Condition B ( $260^{\circ}$ C for 10 seconds)

#### Lead Material:

Standard: 100% matte tin (Sn) with nickel (Ni) underplate and steel core ( "TA" designation). Alternative 1: 60% Tin (Sn)/40% Lead (Pb) finish with copperclad steel core ( "HA" designation). Alternative 2: 60% Tin (Sn)/40% Lead (Pb) finish with 100% copper core (available with "HA" termination code with c-spec)

#### Solderability:

EIA RS-198, Method 301, Solder Temperature: 230°C  $\pm$ 5°C. Dwell time in solder = 7  $\pm$  ½ seconds.

Terminal Strength: EIA RS-198, Method 303, Condition A (2.2kg)

#### **ELECTRICAL**

Capacitance @ 25°C: Within specified tolerance and following test conditions. COG - >1000pF with 1.0 vrms @ 1 kHz  $\leq 1000pF$  with 1.0 vrms @ 1 MHz X7R - with 1.0 vrms @ 1 kHz (Referee Time: 1,000 hours) Z5U - with 1.0 vrms @ 1 kHz

#### Dissipation Factor @25°C:

Same test conditions as capacitance. COG – 0.10% maximum X7R – 2.5% maximum (3.5% for 25V) Z5U – 4.0% maximum

### Insulation Resistance @25°C:

EIA RS-198, Method 104, Condition A <1kV C0G – 100 GΩ or 1000 MΩ – μF, whichever is less. ≤500V test @ rated voltage, >500V test @ 500V X7R – 100 GΩ or 1000 MΩ – μF, whichever is less. ≤500V test @ rated voltage, >500V test @ 500V Z5U – 10 GΩ or 1000 MΩ – μF, whichever is less.

### Dielectric Withstanding Voltage:

EIA RS-198, Method 103 ≤250V test @ 250% of rated voltage for 5 seconds with current limited to 50mA.

- 500V test @ 150% of rated voltage for 5 seconds with current limited to 50mA.
- ≥1000V test @ 120% of rated voltage for 5 seconds with current limited to 50mA.

### ENVIRONMENTAL

Vibration: EIA RS-198, Method 304, Condition D (10-2000Hz; 20g) Shock: EIA RS-198, Method 305, Condition I (100g) Life Test:

### EIA RS-198, Method 201, Condition D.

<200V C0G - 200% of rated voltage @ +125°C X7R - 200% of rated voltage @ +125°C Z5U - 200% of rated voltage @ +85°C >500V

C0G – rated voltage @ +125°C X7R – rated voltage @ +125°C

### Post Test Limits @ 25°C are:

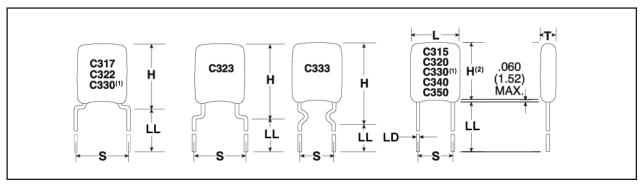
- Capacitance Change: C0G ( $\leq$  200V) – ±3% or 0.25pF, whichever is greater. COG ( $\geq$  500V) – ±3% or 0.50pF, whichever is greater. X7R - ± 20% of initial value (2) Z5U - ± 30% of initial value (2) **Dissipation Factor:** C0G - 0.10% maximum X7R - 2.5% maximum (3.5% for 25V) Z5U - 4.0% maximum Insulation Resistance:  $C0G - 10 G\Omega$  or  $100 M\Omega - \mu F$ , whichever is less. >1kV tested @ 500V. X7R – 10 G $\Omega$  or 100 M $\Omega$  –  $\mu$ F, whichever is less. >1kV tested @ 500V. Z5U – 1 G $\Omega$  or 100 M $\overline{\Omega}$  –  $\mu$ F, whichever is less. Moisture Resistance: EIA RS-198, Method 204, Condition A (10 cycles without applied voltage). Post Test Limits @ 25°C are: Capacitance Change:  $COG (\leq 200V) - \pm 3\%$  or  $\pm 0.25 pF$ , whichever is greater. COG ( $\ge$  500V) – ±3% or ± 0.50pF, whichever is greater. X7R - ± 20% of initial value (2)  $Z5U - \pm 30\%$  of initial value (2) **Dissipation Factor:** C0G – 0.10% maximum X7R – 2.5% maximum (3.5% for 25V) Z5U - 4.0% maximum Insulation Resistance:  $C0G-10~G\Omega$  or  $100~M\Omega-\mu Fwhichever is less.$ ≤500V test @ rated voltage, >500V test @ 500V.  $X7R - 10 G\Omega$  or  $100 M\Omega - \mu F$ , whichever is less.
- ≤500V test @ rated voltage, >500V test @ 500V. Z5U – 1k MΩ or 100 MΩ –  $\mu$ F, whichever is less.

#### Thermal Shock:

EIA RS-198, Method 202, Condition B (COG & X7R: -55°C to 125°C); Condition A (Z5U: -55°C to 85°C)

(1) +53 PPM -30 PPM/ °C from +25°C to -55°C, + 60 PPM below 10pF.
(2) X7R and Z5U dielectrics exhibit aging characteristics; therefore, it is highly recommended that capacitors be deaged for 2 hours at 150°C and stabilized at room temperature for 48 hours before capacitance measurements are made.

## STANDARD LEAD CONFIGURATION OUTLINE DRAWINGS



Drawings are not to scale. See table below for dimensions. See page 16 for optional lead configurations. (1) Lead configuration depends on capacitance value. (2) H dimensions does not include meniscus.

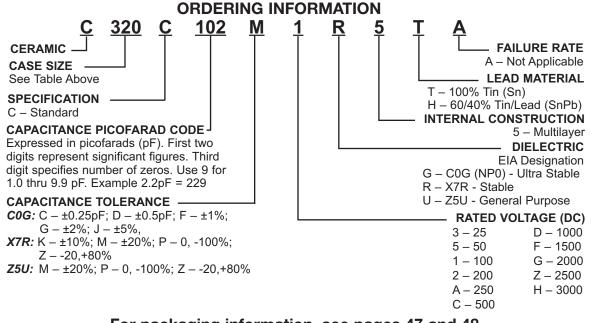
Case Size	L Max.	H. Max.	Standard T Max.	High Voltage T Max.	S <sup>(1)</sup> ±.030 (.78)	LD +.004(.10) 001(.025)	LL Min.
C315	0.150 (3.81)	0.210 (5.33)	0.100 (2.54)	0.150 (3.81)	0.100 (2.54)	0.020 (.51)	0.276 (7.00)
C317	0.150 (3.81)	0.230 (5.84)	0.100 (2.54)	0.150 (3.81)	0.200 (5.08)	0.020 (.51)	0.276 (7.00)
C320	0.200 (5.08)	0.260 (6.60)	0.125 (3.18) <sup>(2)</sup>	0.200 (5.08)	0.100 (2.54)	0.020 (.51)	0.276 (7.00)
C322	0.200 (5.08)	0.260 (6.60)	0.125 (3.18)	0.200 (5.08)	0.200 (5.08)	0.020 (.51)	0.276 (7.00)
C323	0.200 (5.08)	0.320 (8.13)	0.125 (3.18)	0.200 (5.08)	0.200 (5.08)	0.020 (.51)	0.276 (7.00)
C330	0.300 (7.62)	0.360 (9.14)	0.150 (3.81)	0.250 (6.35)	0.200 (5.08)	0.020 (.51)	0.276 (7.00)
C333	0.300 (7.62)	0.390 (9.91)	0.150 (3.81)	0.250 (6.35)	0.200 (5.08)	0.020 (.51)	0.276 (7.00)
C340	0.400 (10.16)	0.460 (11.68)	0.150 (3.81)	0.270 (6.86)	0.200 (5.08)	0.020 (.51)	0.276 (7.00)
C350	0.500 (12.70)	0.560 (14.22)	0.200 (5.08)	0.270 (6.86)	0.400 (10.16)	0.025 (.64)	0.276 (7.00)

## **DIMENSIONS INCHES (MILLIMETERS)**

Note: 1 inch = 25.4mm.

Note (1): Measured at seating plane.

Note (2): Thickness = 0.16" (4.064mm) for C320 from 4.7 - 10.0µF.



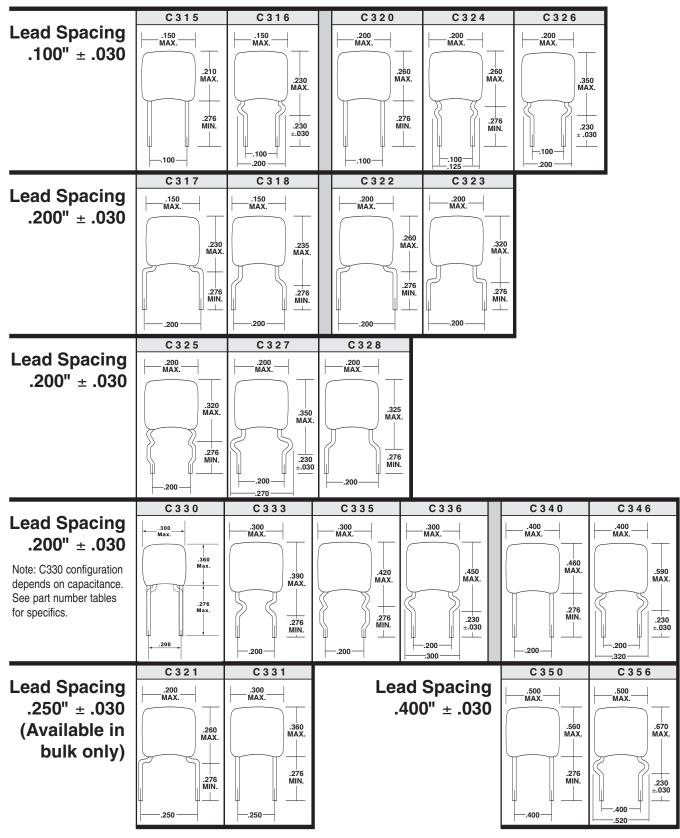
## For packaging information, see pages 47 and 48.

Gold Max



## **OPTIONAL CONFIGURATIONS BY LEAD SPACING**

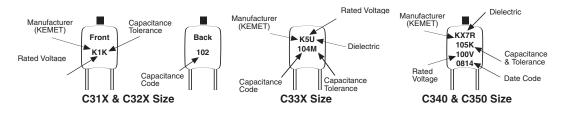
The preferred lead wire configurations are shown on page 15. However, additional configurations are available. All available options, including those on page 15, are shown below grouped by lead spacing.



Note: Non-standard lead lengths are available in bulk only.

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## **CAPACITOR MARKINGS**



### RATINGS & PART NUMBER REFERENCE: ULTRA-STABLE TEMPERATURE CHARACTERISTICS - COG/NP0

	Style			C	31	Х					С	32)	(						С	33	x						C	34)	K					C	;35)	(		٦
<b>C</b> = =	Cap	Cap			WVD	С					١	NVDC							V	VVDO	)						1	NVDC	;					Ń	VVDC			
Сар	Code	Tol	50	100	200	50	00	1k	50	100	200	500	1k	1.5k	2k	50	100	200	500	1k	1.5k	2k	2.5k	3k	50	100	200	500	1k	2k	3k	50	100	200	500	1k	2k	3k
1.0pF	109	D																												_								
1.1	119	D																																				
1.2	129	D																																				
1.3	139	D																																				
1.5	159	D																																				
1.6	169	D																																				
1.8	189	D																																				
2.0	209	D																																				
2.2	229	D																																				
2.4	249	D																																				
2.7	279	D																																				
3.0	309	D																																				
3.3	339	D						_																														
3.6	369	D						_																													_	
3.9	399	D																																				
4.3	439	D	_			-	_	_																							_	_					$\rightarrow$	
4.7	479	D	_			-	_	_																							_	_					$\rightarrow$	
5.1	519	D	_			_	_	_																					_								-	
5.6	569	D				_	_	_	_																												_	
6.2	629	D	_			_	_	_																					_								-	
6.8	689	D				-	_	_	_																_				-		-	_			<u> </u>	$ \rightarrow $	$\rightarrow$	
7.5	759	D	_			-		_	_																					-	-	_			<u> </u>	$ \rightarrow $	$\rightarrow$	
8.2	829			_		-	-	_	_																				-	-	-			<u> </u>	<u> </u>	$\vdash$	-	
9.1 10	919 100	D J,K		_		-	-	_	_																-				-	-	-	_			<u> </u>	$\vdash$	-	
10	110	J,K J,K	_	_		-	-	-	_						_									-						-	-	_				$\vdash$	$\rightarrow$	
11	120	J,K J,K		_		-	-	_	_						_										-				-	-	-	_			<u> </u>	$\vdash$	-	
12	120	J,K J,K		_		-	-	-	_						_										-				-	-	-					$\vdash$	-	
15	150	J,K J,K		_		-	-	-	_						-														-	-	-	_				$\vdash$	-	_
16	160	J,K J,K		_		-	-	-	_						-														-		-	_					-	_
18	180	J,K		_		-	-		_						_										-				-		-		-				-	
20	200	J,K		_		-	-		_						_										-				-		-		-				-	
22	220	J,K		_		-	-		_						-											_					-	_			<u> </u>		-	_
24	240	G,J,K														-																-			<u> </u>		$\rightarrow$	—
27	270	G,J,K														-											_								<u> </u>		-+	_
30	300	G,J,K														-											_								<u> </u>		-+	_
33	330	G,J,K																																	<u> </u>		$\rightarrow$	
36	360	G,J,K														-											_								<u> </u>		-+	_
39	390	G,J,K																																			$\rightarrow$	
43	430	G,J,K																																	<u> </u>		$\rightarrow$	
47	470	G,J,K																																				
51	510	G,J,K																																				
56	560	F,G,J																																				
62	620	F,G,J																																				
68	680	F,G,J																																				
75	750	F,G,J																																				
82	820	F,G,J																																				
91		F,G,J																																				



**"STANDARD & HIGH VOLTAGE GOLD MAX"** 

### RATINGS & PART NUMBER REFERENCE: ULTRA-STABLE TEMPERATURE CHARACTERISTICS -COG/NPO CONT.

	Style			C	31	Х		Τ			C	32)	(						С	33	x				1		С	34)	x					С	35X	(		٦
_	Сар	Cap			WVD	с					W	VDC	;							NVD							٧	VVDC	;					٧	VVDC			
Сар	Code	Tol	50	100	200	500	1k	50	10	00	200	500	1k	1.5k	2k	50	100	200	500	1k	1.5k	2k	2.5k	3k	50	100	200	500	1k	2k	3k	50	100	200	500	1k	2k	3k
100	101	F,G,J																																				
110 120	111 121	F,G,J F,G,J					-		-	_	_					_		-																<u> </u>		_		
120	121	F,G,J F,G,J	-			-	t-		+	+	-		-	-	-		-	-						_					-									—
150	151	F,G,J																																				
160	161	F,G,J																																				
180 200	181 201	F,G,J F,G,J					-		+	+	_			-	-	-	-							_					-					<u> </u>		_		
200	201	F,G,J					┼─		+	+	-			-									-	-					-				-	-				—
240	241	F,G,J																																				
270	271	F,G,J				-	+-	_	-	_				_																		_						_
300 330	301 331	F,G,J F,G,J				-	┿		+	+	-			-	-	-	-								$\vdash$				-							_		_
360	361	F,G,J					+		+					-									_															_
390	391	F,G,J																																				
430 470	431 471	F,G,J F,G,J	_			-	+	-	-	+	_			-	_		_								$\vdash$				-				<u> </u>	<u> </u>		_		
510	511	F,G,J					┼─		+	+	-			-		-	-						-	-					-				-	-				_
560	561	F,G,J																																				
620	621	F,G,J				-	+-	_	-	_				_																		_						_
680 750	681 751	F,G,J F,G,J				-	┿		+	+	-			-	-		-												-							_	-	_
820	821	F,G,J					+		+	+							-												-					<u> </u>				
910	911	F,G,J																																				
1000	102	F,G,J F,G,J			_	-	+-		-	_				-																				<u> </u>		_		
1100 1200	112 122	F,G,J F,G,J	-			-	┾╴		+	+	-		-	-		-	-							-					-							-	-	-
1300	132	F,G,J																																				
1500	152	F,G,J																																				
1600 1800	162 182	F,G,J F,G,J				-	┢		+	+	_			-	-		-							-					-		-	_	<u> </u>	<u> </u>		_		
2000	202	F,G,J				-	⊢		+	+				-		_	-							-			-		-		-		-			_		
2200	222	F,G,J																																				
2400	242	F,G,J					_																															
2700 3000	272 302	F,G,J F,G,J					┿		+	+	-		-		-		-												-	-	-	-				_		
3300	332	F,G,J					┢		+	+				<u> </u>			-												-					<u> </u>				_
3600	362	F,G,J																																				
3900 4300	392 432	F,G,J F,G,J	_		<u> </u>	-	┢		+-	+	_		-		<u> </u>	_					<u> </u>						<u> </u>	-	-	-	-		<u> </u>	<u> </u>		_	_	
4300	432	F,G,J				-	┢		+	+				-		-													-			-	-	<u> </u>				_
5100	512	F,G,J																																				
5600	562	F,G,J					+																		$\square$													
6200 6800	622 682	F,G,J F,G,J	$\vdash$			-	+							-	-									-	$\vdash$					-	-	$\vdash$	-				$\rightarrow$	—
7500	752	F,G,J					+		+					<u> </u>																								_
8200	822	F,G,J																																				
9100 .010uF	912 103	F,G,J F,G,J			<u> </u>		+	-	-		_			<u> </u>	-			-											-	-	-	_	<u> </u>	<u> </u>		_		
.015	123	F,G,J				-	┢		E.	T				-		-													-			-	-	<u> </u>				_
.015	153	F,G,J																																				
.018	183	F,G,J					1		-	$-\Gamma$	_								<u> </u>																		_	
.022	223 273	F,G,J F,G,J				-	+	+	+-	+	$\rightarrow$			-				-						-			-	-	-	-							$\rightarrow$	—
.027	333	F,G,J						t																														_
.039	393	F,G,J																																				
.047	473 563	F,G,J F,G,J				-	+-	+	-	+	$\rightarrow$		-	-	-	-	-							-					-	-	-					_	$\rightarrow$	_
.056	683	F,G,J F,G,J				-	+	+	+	+	$\rightarrow$			-	-	-	-	-	-					-				-	-	-							$\rightarrow$	—
.082	823	F,G,J																																				
.10	104	F,G,J							F	T																												
.12	124	F,G,J												1		I																					_	

### **RATINGS & PART NUMBER REFERENCE: STABLE TEMPERATURE CHARACTERISTICS - X7R**

	Style				(	C31)								32)										33X				
	Сар	Сар		_		WVD								NVDC										VDC				
Сар	Code	Tol	25	50	100	200	250	500	1k	25	50	100	200	250	500	1k	1.5k	2k	25	50	100	200	250	500	1k	1.5k	2k	2.5k 3
10pF 12	100 120	K,M,P,Z K,M,P,Z								_							-		_									_
15	150	K,M,P,Z	_			<u> </u>											-					<u> </u>						_
18	180	K,M,P,Z																										
22	220	K,M,P,Z																										
27	270 330	K,M,P,Z				<u> </u>													_			<u> </u>						_
33 39	330	K,M,P,Z K,M,P,Z	_			<u> </u>				_							-		_			<u> </u>			-			
47	470	K,M,P,Z								_							-											
56	560	K,M,P,Z																										
68	680	K,M,P,Z																										
82 100	820 101	K,M,P,Z K,M,P,Z					_			_		_		_			-											_
120	101	K,M,P,Z	_			<u> </u>			-								-		_			<u> </u>			-			
150	151	K,M,P,Z							_										_						_			
180	181	K,M,P,Z																										
220	221	K,M,P,Z																										
270	271	K,M,P,Z				<u> </u>																<u> </u>						_
330 390	331 391	K,M,P,Z K,M,P,Z																	-			<u> </u>						
470	471	K,M,P,Z																	-									
560	561	K,M,P,Z																										
680	681	K,M,P,Z																										
820	821	K,M,P,Z																										_
1000 1200	102 122	K,M,P,Z K,M,P,Z					_		-					_	_				-									
1500	152	K,M,P,Z	_														-		_									
1800	182	K,M,P,Z																							_			
2200	222	K,M,P,Z																										
2700	272	K,M,P,Z																										
3300 3900	332 392	K,M,P,Z K,M,P,Z				<u> </u>											_					<u> </u>						_
4700	472	K,M,P,Z K,M,P,Z	_																		_		_					
5600	562	K,M,P,Z																							-			
6800	682	K,M,P,Z																										
8200	822	K,M,P,Z																										
.010uF	103	K,M,P,Z	_																									_
.012 .015	123 153	K,M,P,Z K,M,P,Z														-	-			_								
.013	183	K,M,P,Z								_															-			
.022	223	K,M,P,Z																										
.027	273	K,M,P,Z																										
.033	333	K,M,P,Z																										
.039	393 473	K,M,P,Z K,M,P,Z														-	-			_								
.047	563	K,M,P,Z					-		-						_	-		-							-			-
.068	683	K,M,P,Z																										
.082	823	K,M,P,Z																										
.10	104	K,M,P,Z				<u> </u>	<u> </u>								<u> </u>												$\square$	
.12 .15	124 154	K,M,P,Z K,M,P,Z							-			_		_		-					_		_		-			
.15	184	K,M,P,Z							-							-						2	2		-			
.22	224	K,M,P,Z																				2	2					
.27	274	K,M,P,Z																				2	2					
.33	334	K,M,P,Z				<u> </u>										<u> </u>	-				-	2	2	<u> </u>	-			
.39 .47	394 474	K,M,P,Z K,M,P,Z				<u> </u>			-			_				-	-				2	2	2	<u> </u>	-	$\vdash$		
.56	564	K,M,P,Z				<u> </u>			-												2	2	2		-			
.68	684	K,M,P,Z																			2	2	2					
.82	824	K,M,P,Z																			2	2	2					
1.0	105	K,M,P,Z				<u> </u>								<u> </u>	<u> </u>		-		~	-	2	2	2	<u> </u>				
1.2 1.5	125 155	K,M,P,Z K,M,P,Z														-			2	2	2	2	2		-	$\vdash$		
1.5	155	K,M,P,Z K,M,P,Z				<u> </u>	<u> </u>		-			<u> </u>		<u> </u>	<u> </u>	-			2	2	<u> </u>	<u> </u>	<u> </u>	<u> </u>	-		$\square$	
2.2	225	K,M,P,Z																	2	2								
2.7	275	K,M,P,Z																										
3.3	335	K,M,P,Z					<u> </u>							<u> </u>	<u> </u>								<u> </u>				$\square$	
3.9	395	K,M,P,Z K,M,P,Z			<u> </u>	<u> </u>	<u> </u>		-	4	4		<u> </u>									<u> </u>		<u> </u>	-			-+
4.7 5.6	475 565	K,M,P,Z K,M,P,Z				<u> </u>				1	1					-	-		-			<u> </u>		<u> </u>				
6.8	685	K,M,P,Z				<u> </u>				1						<u> </u>			-			<u> </u>		<u> </u>				
10.0	106	K,M,P,Z								1																		

(1) Thickness max = 0.160" (4.064mm)

(2) Requires straight leads (all other C33X's require bent leads)

## For packaging information, see pages 47 and 48.

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### **RATINGS & PART NUMBER REFERENCE: STABLE TEMPERATURE CHARACTERISTICS - X7R**

	Style	;					(	C34)	X								(	C35)	(			
	Сар	Сар						WVDC	:									WVDC				
Сар	Code	Tol	25	50	100	200	250	500	1k	1.5k	2k	2.5k	3k	25	50	100	200	250	500	1k	2k	3k
10pF	100	K,M,P,Z																				
12	120	K,M,P,Z																				<u> </u>
15 18	150 180	K,M,P,Z K,M,P,Z																				<u> </u>
22	220	K,M,P,Z																				
27	270	K,M,P,Z																				
33 39	330 390	K,M,P,Z																				<u> </u>
39 47	390 470	K,M,P,Z K,M,P,Z																				
56	560	K,M,P,Z																				
68	680	K,M,P,Z																				
82 100	820 101	K,M,P,Z K,M,P,Z																				<u> </u>
120	121	K,M,P,Z																				<u> </u>
150	151	K,M,P,Z																				
180	181	K,M,P,Z																				
220 270	221 271	K,M,P,Z K,M,P,Z																				<u> </u>
330	331	K,M,P,Z									<u> </u>								<u> </u>			
390	391	K,M,P,Z																				
470	471	K,M,P,Z										$\square$										<u> </u>
560 680	561 681	K,M,P,Z K,M,P,Z										$\vdash$										<u> </u>
820	821	K,M,P,Z																				
1000	102	K,M,P,Z																				
1200	122	K,M,P,Z																				<u> </u>
1500 1800	152 182	K,M,P,Z K,M,P,Z										_										
2200	222	K,M,P,Z																				
2700	272	K,M,P,Z																				
3300 3900	332 392	K,M,P,Z K,M,P,Z																				<u> </u>
4700	472	K,IVI, P,Z K,M,P,Z																				
5600	562	K,M,P,Z																				
6800	682	K,M,P,Z																				
8200 .010uF	822 103	K,M,P,Z K,M,P,Z																				<u> </u>
.012	123	K,M,P,Z										_										
.015	153	K,M,P,Z																				
.018	183	K,M,P,Z																				
.022	223 273	K,M,P,Z K,M,P,Z																				
.033	333	K,M,P,Z								_												
.039	393	K,M,P,Z																				
.047	473	K,M,P,Z K,M,P,Z																				
.056	563 683	K,IVI,P,Z K,M,P,Z																				
.082	823	K,M,P,Z																				
.10	104	K,M,P,Z																				
.12 .15	124 154	K,M,P,Z K,M,P,Z							_			$\mid$								_		<u> </u>
.13	184	K,M,P,Z										$\vdash$										<u> </u>
.22	224	K,M,P,Z																				
.27	274	K,M,P,Z										$\mid$										<u> </u>
.33 .39	334 394	K,M,P,Z K,M,P,Z										$\vdash$										<u> </u>
.47	474	K,M,P,Z																				
.56	564	K,M,P,Z																				
.68 .82	684 824	K,M,P,Z										$\vdash$										<u> </u>
.82	824	K,M,P,Z K,M,P,Z										$\vdash$										<u> </u>
1.2	125	K,M,P,Z																				
1.5	155	K,M,P,Z																				
1.8 2.2	185 225	K,M,P,Z K,M,P,Z										$\mid$			_	_						<u> </u>
2.2	225	K,M,P,Z K,M,P,Z										$\vdash$										-
3.3	335	K,M,P,Z																				
3.9	395	K,M,P,Z													_							
4.7 5.6	475 565	K,M,P,Z K,M,P,Z										$\vdash$			_							<u> </u>
6.8	685	K,IVI, P,Z K,M,P,Z										$\vdash$				<u> </u>						<u> </u>
10	106	K,M,P,Z																				

(2) Requires straight leads (all other C33X's require bent leads)

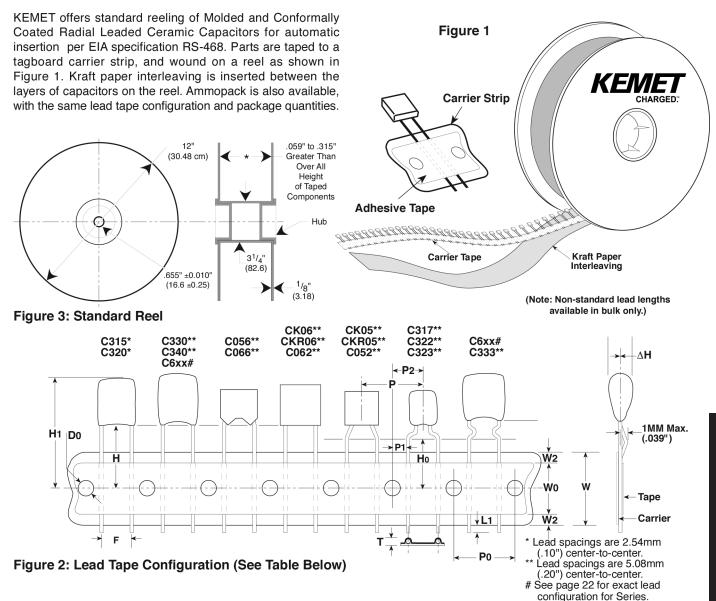
## RATINGS & PART NUMBER REFERENCE GENERAL PURPOSE TEMPERATURE CHARACTERISTIC — Z5U

Cap         Cc           1000pF         1           1200         1           1500         1           1800         1           2200         2           2700         2           3300         3           3900         3           4700         4           5600         5           6800         6           8200         8           .010µF         1           .012         1           .012         1           .012         2           .033         3           .039         3           .047         4           .056         5           .068         66           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2	ap bode         Cal Toi           02         M,P,           22         M,P,           52         M,P,           52         M,P,           82         M,P,           92         M,P,           93         M,P,           93         M,P,           93         M,P,           93         M,P,           93         M,P,           93         M,P,	50 2	100           100           2 <th>C 200</th> <th>50</th> <th>C</th> <th></th> <th></th> <th>C 200</th> <th></th> <th></th> <th></th> <th>50</th> <th>200</th>	C 200	50	C			C 200				50	200
Cap         Cc           1000pF         1           1200         1           1500         1           1800         1           2200         2           2700         2           3300         3           3900         3           4700         4           5600         5           6800         6           8200         8           .010µF         1           .012         1           .012         1           .012         2           .033         3           .039         3           .047         4           .056         5           .068         66           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2	ode         To           02         M,P,           22         M,P,           52         M,P,           52         M,P,           82         M,P,           92         M,P,           93         M,P,           93         M,P,	50 2			50	200	50		200	50		200	50	200
1200         1           1500         1           1500         1           1800         1           2200         2           2700         2           3300         3           3900         3           4700         4           56800         6           8200         8           .010µF         1           .015         1           .018         1           .027         2           .033         3           .047         4           .056         5           .0682         8           .10         1           .12         1           .15         1           .16         1           .12         1           .15         1           .18         1           .22         2	22         M,P,           52         M,P,           82         M,P,           82         M,P,           92         M,P,           93         M,P,           93         M,P,	Z 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2												
1500         1           1800         1           2200         2           2700         2           3300         3           3900         3           4700         4           5600         5           6800         6           8200         8           .010uF         1           .012         1           .012         1           .013         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2	52         M,P,           82         M,P,           72         M,P,           732         M,P,           992         M,P,           772         M,P,           862         M,P,           872         M,P,           882         M,P,           882         M,P,           882         M,P,           823         M,P,           83         M,P,           84         M,P,           85         M,P,           86         M,P,           87         M,P,           8	Z												
1800         1           2200         2           2700         2           3300         3           3900         3           4700         4           5600         5           6800         6           8200         8           .010uF         1           .012         1           .015         1           .012         2           .033         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2	82         M,P,           22         M,P,           72         M,P,           32         M,P,           92         M,P,           77         M,P,           88         M,P,           72         M,P,           72         M,P,           73         M,P,	Z												
2200         2           2700         2           3300         3           3900         3           4700         4           5600         5           6800         6           8200         8           .010uF         1           .012         1           .015         1           .018         1           .022         2           .023         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	22         M,P,           72         M,P,           332         M,P,           992         M,P,           992         M,P,           62         M,P,           62         M,P,           72         M,P,           73         M,P,	Z												
2700         2           3300         3           3900         3           4700         4           5600         5           6800         6           8200         8           .010uF         1           .012         1           .015         1           .018         1           .022         2           .033         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .12         1           .13         .14           .22         .22           .237         2	72         M,P,           32         M,P,           92         M,P,           92         M,P,           62         M,P,           82         M,P,           93         M,P,           93         M,P,           93         M,P,	Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z												
3300         3           3900         3           4700         4           5600         5           6800         6           8200         8           .010uF         1           .012         1           .015         1           .018         1           .022         2           .023         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	32         M,P,           92         M,P,           92         M,P,           62         M,P,           82         M,P,           82         M,P,           93         M,P,           93         M,P,           93         M,P,           93         M,P,           93         M,P,	Z 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2											· · · · · · · · · · · · · · · · · · ·	
3900         3           4700         4           5600         5           6800         6           8200         8           .010uF         1           .012         1           .015         1           .018         1           .022         2           .027         2           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	92         M,P,           72         M,P,           62         M,P,           82         M,P,           93         M,P,	Z 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2											· · · · · · · · · · · · · · · · · · ·	
4700         4           5600         5           6800         6           8200         8           .010uF         1           .012         1           .015         1           .018         1           .022         2           .027         2           .033         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	72         M,P,           662         M,P,           882         M,P,           903         M,P,           933         M,P,           933         M,P,           933         M,P,           933         M,P,           933         M,P,           933         M,P,	Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z												
5600         5           6800         6           8200         8           .010uF         1           .012         1           .015         1           .018         1           .022         2           .033         3           .047         2           .033         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	62         M,P,           82         M,P,           93         M,P,	Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z												
6800         6           8200         8           .010uF         1           .012         1           .015         1           .018         1           .022         2           .033         3           .047         2           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	82         M,P,           92         M,P,           03         M,P,           23         M,P,           53         M,P,           83         M,P,           93         M,P,           93         M,P,           93         M,P,           93         M,P,	Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z												
8200         8           .010uF         1           .012         1           .015         1           .018         1           .022         2           .023         3           .039         3           .047         4           .056         55           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	22         M,P,           03         M,P,           23         M,P,           53         M,P,           83         M,P,           123         M,P,           133         M,P,           133         M,P,           193         M,P,	Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z												
.010uF         1           .012         1           .015         1           .018         1           .022         2           .023         3           .039         3           .047         4           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	03         M,P,           23         M,P,           53         M,P,           83         M,P,           123         M,P,           133         M,P,           193         M,P,	Z Z Z Z Z Z Z												
.012         1           .015         1           .018         1           .022         2           .027         2           .033         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .15         1           .18         1           .22         2           .27         2	23         M,P,           53         M,P,           83         M,P,           23         M,P,           73         M,P,           93         M,P,	Z Z Z Z Z												
.015         1           .018         1           .022         2           .027         2           .033         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .15         1           .18         1           .22         2           .27         2	53         M,P,           83         M,P,           23         M,P,           73         M,P,           93         M,P,	Z Z Z Z Z												
.018         1           .022         2           .027         2           .033         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	83         M,P,           123         M,P,           173         M,P,           133         M,P,           193         M,P,	Z Z Z Z												
.022         2           .027         2           .033         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	23 M,P, 73 M,P, 33 M,P, 93 M,P,	Z Z Z												
.027         2           .033         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	73 M,P, 33 M,P, 93 M,P,	Z Z												
.033         3           .039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	33 M,P, 93 M,P,	z												
.039         3           .047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	93 M,P,													
.047         4           .056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2		7												
.056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	73 M,P,	4												
.056         5           .068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2		Z												
.068         6           .082         8           .10         1           .12         1           .15         1           .18         1           .22         2           .27         2	i63 M,P,													
.10         1           .12         1           .15         1           .18         1           .22         2           .27         2	83 M,P,													
.10         1           .12         1           .15         1           .18         1           .22         2           .27         2	23 M,P,	z												
.12     1       .15     1       .18     1       .22     2       .27     2	04 M,P,													
.15         1           .18         1           .22         2           .27         2	24 M,P,													
.18 1 .22 2 .27 2	54 M,P,					 								
.22 2 .27 2	84 M,P,								1					
.27 2	24 M,P,					 			1					
	.74 M,P,								1					
.33 3	34 M,P,								1					
	94 M,P,							1	1					
	74 M,P,							1	1					
	64 M,P,							1						
	84 M,P,							1						
	24 M,P,							1						
	05 M,P,							1						
	25 M,P,						1							
	55 M,P,						1							
	85 M,P,						1							
	25 M,P,						1							-
	25 M,P,													
	35 M,P,													
	95 M,P,					 								
	75 M,P,								<u> </u>					
	65 M,P,								<u> </u>		-			-
6.8 6		Z	-											

1 Requires straight leads (all other C33x's require bent leads)

## **CERAMIC LEADED** PACKAGING INFORMATION

## Ceramic Radial Lead Tape and Reel Packaging





Dimension	Symbol	Nominal mm (inch)		Tolerance mm (inch)		Dimension	Symbol	Nominal mm (inch)		Tolerance mm (inch)	
Sprocket Hole Diameter	Do	4.0 (	.157)	± 0.2 (.008)		Height to Seating Plane (formed leads) (2)	Ho	7301 7303 16.0 (.630) 18.0 (.709)		7301 7303 ±0.5 (.020) Minimum	
Sprocket Hole Pitch	P0	12.7	(.500)	± 0.3 (.012)		Component Alignment	Δh	4.0 (.157)		±0.2 (.008)	
Component Pitch	Р	12.7	(.500)	± 0.3 (	.012)	Lead Protrusion	L1	1.0 (	.039)	Maxin	num
Lead Spacing (1)	F	5.08 (.20)	2.54 (.10)	+0.6 (+.024		Composite Tape Thickness	t	0.7 (	.051)	±0.2 (.	008)
Sprocket Hole Center to Lead Center (1)	P1	3.81 (.150)	5.08 (.200)	± 0.7 (	.028)	Overall Tape and Lead Thickness	Т	1.5 (	.059)	Maxin	num
Sprocket Hole Center to Component Center	P2	6.35	(.250)	± 1.3 (	.051)	Carrier Tape Width	W	18.0	(.709)	+1.0 - (+.039 ·	
Height to Seating Plane (straight leads) (2)	Н	7301 16.0 (.630)	7303 18.0 (.709)	7301 ±0.5 (.020)	7303 Minimum	Hold-Down Tape Width	W0	5.0 (	.197)	Minim	num
Component Height Above Tape Center	H1	32.2	(1.27)	Maxir	num	Hold-Down Tape Location	W2	3.0 (	.118)	Maxin	num

(2)

 Determined by a 4 digit suffix placed at the end of the part number, as follows:

 7301 = Recommended for parts with formed leads.

 7303 = Recommended for parts with straight leads.

Tape and Reel Packaging



## CERAMIC LEADED PACKAGING INFORMATION

KEMET Series         Military Style         Military Specification         Standard (1) Bulk Quantity         Ammo Pack Quantity Maximum         Maximum Rel Quantity           C114C-K-G C124C-K-G C124C-K-G C124C-K-G         CK12, CC75         MIL-C-11015/ MIL-PRF-20         200/Box         5000           C202C-K         CK16         200/Box         5000         200/Box         5000           C222C-K         CK16         10/Tray         300         2000         2000           C052C-K-G         CK05, CC05         100/Bag         1500         1500           C144G         CCR75         MIL-PRF-20         200/Box         5000           C144G         CCR76         200/Box         5000         5000           C144G         CCR77         200/Box         5000         200           C052/G6G         CCR07         100/Bag         1700         300           C052/G6G         CCR06         100/Bag         1700           C052/G6G         CCR07         Footnote (2)         N/A           C141T         CKR11         MIL-PRF-39014         200/Box         5000           C192T         CKR14         100/Bag         1700         300           C052/G6G         CR07         250/Box <td< th=""><th colspan="9">CERAMIC PACKAGING</th></td<>	CERAMIC PACKAGING								
C124C-K-G         CK13, CC76         MIL-PRF-20         200/Box         5000           C192C-K-G         CK14, CC77         25/Fbox         3000           C202C-K         CK15         25/Fbox         300           C222C-K         CK16         10/Tray         300           C622C-K-G         CK06, CC05         100/Bag         2000         2000           C622C-K-G         CK06, CC06         100/Bag         1500         1500           C144G         CCR75         MIL-PRF-20         200/Box         5000           C124G         CCR76         200/Box         5000         5000           C124G         CCR77         100/Box         500         500           C222G         CC78-CCR78         25/Fbox         500         500           C222G         CC79-CCR79         10/Tray         300         5000           C62/26G         CR06         100/Bag         1700         5000           C124T         CKR11         MIL-PRF-39014         20/Box         5000           C124T         CKR11         MIL-PRF-39014         20/Box         5000           C222T         CKR16         10/Tray         300         5000           C222T				Bulk	Quantity	Reel	Reel Size		
C124C-K-G         CK13, CC76         MIL-PRF-20         200/Box         5000           C192C-K-G         CK14, CC77         100/Box         3000           C202C-K         CK16         10/Tray         300           C222C-K         CK16         10/Rag         2000         2000           C022C-K-G         CK05, CC05         100/Bag         1500         1500           C0262C-K-G         CK06, CC06         100/Bag         1500         5000           C022C-K         CK06, CC06         100/Bag         1500         5000           C142G         CCR75         MIL-PRF-20         200/Box         5000           C122G         CCR76         25/Box         3000         2026           C203C-GC         CC78-CCR78         25/Box         500         200           C0226G         CC79-CCR79         10/Tray         300         200           C0226G         CC07-CCR07         Footnote (2)         N/A           C124T         CKR11         MIL-PRF-39014         200/Box         5000           C124T         CKR15         25/Box         500         200           C227T         CKR16         100/Bag         1700           C222T <t< td=""><td>C114C-K-G</td><td>CK12, CC75</td><td>MIL-C-11015/</td><td>200/Box</td><td></td><td>5000</td><td>12"</td></t<>	C114C-K-G	CK12, CC75	MIL-C-11015/	200/Box		5000	12"		
C192C-K-G         CK14, CC77         100/Box         3000           C202C-K         CK15         25/Box         500           C222C-K         CK16         10/Tray         300           C052C-K-G         CK05, CC05         100/Bag         2000         2000           C052C-K-G         CK06, CC06         100/Bag         1500         1500           C114G         CCR76         200/Box         5000         5000           C122G         CCR76         200/Box         5000         5000           C222G         CC79-CCR79         100/Bag         100/Bag         5000           C222G         CC79-CCR79         100/Bag         1700         5000           C32/56G         CCR05         100/Bag         1500         5000           C512G         CC07-CCR07         Footnote (2)         N/A           C522G         CC8-CCR08         Footnote (2)         N/A           C114T         CKR14         100/Box         5000           C124T         CKR14         200/Box         5000           C124T         CKR14         100/Bag         1700           C122T         CKR16         100/Bag         1500           C31X         <							12"		
C202C-K         CK15         25/Box         500           C222C-K-G         CK16         10/Tray         300           C052C-K-G         CK05, CC05         100/Bag         2000         2000           C062C-K-G         CK06, CC06         100/Bag         1500         5000           C114G         CCR75         MIL-PRF-20         200/Box         5000           C122G         CCR77         100/Bag         500           C222G         CC78-CCR78         25/Box         500           C222G         CC79-CCR79         10/Tray         300           C052/56G         CCR06         100/Bag         1500           C522G         CC07-CCR07         Footnote (2)         N/A           C522G         CC08-CCR08         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C122T         CKR14         100/Bag         500         500           C122T         CKR16         10/Tray         300         500           C33X         CKR06         100/Bag         1500         500           C33X         CKR06         100/Bag         1500           C33X         C							12"		
C222C-K         CK16         10/Tray         300           C052C-K-G         CK05, CC05         100/Bag         2000         2000           C062C-K-G         CK06, CC06         100/Bag         1500         1500           C114G         CCR75         MIL-PRF-20         200/Box         5000           C124G         CCR76         200/Box         5000           C122G         CC78-CCR78         25/Box         500           C222G         CC79-CCR79         10/Tray         300           C052/66G         CCR05         100/Bag         1700           C052/66G         CCR06         100/Bag         1700           C052/66G         CCR07         Footnote (2)         N/A           C114T         CKR12         20/Box         5000           C124T         CKR12         20/Box         5000           C122T         CKR14         100/Bag         1700           C052/66T         CKR05         100/Bag         1700           C052/66T         CKR05         100/Bag         1500           C31X         S00/Bag         2500         2500           C31X         CKR16         100/Bag         1500           C310 <td>C202C-K</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>12"</td>	C202C-K						12"		
C052C-K-G         CK05, CC05         100/Bag         2000         2000           C062C-K-G         CK06, CC06         100/Bag         1500         1500           C114G         CCR75         MIL-PRF-20         200/Box         5000           C124G         CCR76         200/Box         5000           C192G         CCR77         100/Box         3000           C222G         CC79-CCR79         25/Box         500           C052/56G         CCR05         100/Bag         1700           C052/56G         CCR06         100/Bag         1500           C512G         CC07-CCR07         Footnote (2)         N/A           C512G         CC08-CCR08         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C124T         CKR14         100/Bag         5000         5000           C122T         CKR16         10/Tray         300         5000           C022/56T         CKR06         100/Bag         1500         500           C31X         CKR16         10/Tray         300         500           C32X         CKR66         100/Bag         1500         500 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>12"</td>							12"		
C062C-K-G         CK06, CC06         100/Bag         1500         1500           C114G         CCR75         MIL-PRF-20         200/Box         5000           C124G         CCR76         200/Box         3000           C192G         CCR77         100/Box         3000           C202G         CC78-CCR78         25/Box         500           C052/56G         CCR05         100/Bag         1700           C062/66G         CCR06         100/Bag         1500           C512G         CC07-CCR07         Footnote (2)         N/A           C522G         CC08-CCR08         Footnote (2)         N/A           C144T         CKR11         MIL-PRF-39014         200/Box         5000           C122T         CKR14         100/Bag         1700         3000           C052/67T         CKR05         100/Bag         1700         3000           C222T         CKR16         10/Tray         300         3000           C31X         CKR06         100/Bag         1500         1500           C32X         S00/Bag         2500         2500         2500         2500           C340         -         200/Box         4000         5000 <td></td> <td></td> <td></td> <td>-</td> <td>2000</td> <td></td> <td>12"</td>				-	2000		12"		
C114G         CCR75         MIL-PRF-20         200/Box         5000           C124G         CCR76         200/Box         5000           C129G         CCR77         100/Box         3000           C2026         CC78-CCR78         25/Box         500           C222G         CC79-CCR79         10/Tray         300           C052/56G         CCR05         100/Bag         1700           C062/66G         CCR06         100/Bag         1500           C5126         CC07-CCR07         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C122T         CKR14         200/Box         5000         5000           C122T         CKR15         25/Box         500         200           C31X         S00/Bag         2500         2500           C31X         S00/Bag         2500         2500           C32X         S00/Bag         2500         2500           C33X         250/Bag         1500         1500           C324         S00/Bag         2500         2500           C340         200/Box         2000         2500           C311X <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>12"</td>							12"		
C124G         CCR76         200/Box         5000           C192G         CCR77         100/Box         3000           C202G         CC78-CCR78         25/Box         500           C222G         CC79-CCR79         10/Tray         300           C052/56G         CCR05         100/Bag         1700           C062/66G         CCR06         100/Bag         1500           C512G         CC07-CCR07         Footnote (2)         N/A           C522G         CC08-CCR08         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C122T         CKR14         100/Bag         100         3000           C022T         CKR16         10/Tray         300         300           C052/56T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         1700           C062/66T         CKR06         100/Bag         1500           C31X          500/Bag         2500         2500           C33X          250/Bag         1500         1500           C340          200/Box         4000			MII -PRF-20		1000		12"		
C192G         CCR77         100/Box         3000           C202G         CC78-CCR78         25/Box         500           C222G         CC79-CCR79         10/Tray         300           C052/56G         CCR05         100/Bag         1700           C052/56G         CCR05         100/Bag         1500           C052/56G         CCR06         100/Bag         1500           C512G         CC07-CCR07         Footnote(2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C122T         CKR14         100/Box         5000         5000           C122T         CKR16         10/Tray         300         5000           C222T         CKR16         10/Tray         300         5000           C31X         CKR05         100/Bag         1700         500/Bag         1500           C31X         CKR06         100/Bag         1500         500         500           C31X         CKR06         100/Bag         1500         1500         500         500         500         500         500         500         500         500         500         500         500         500							12"		
C202G         CC78-CCR78         25/Box         500           C222G         CC79-CCR79         10/Tray         300           C052/56G         CCR05         100/Bag         1700           C062/66G         CCR06         100/Bag         1500           C512G         CC07-CCR07         Footnote (2)         N/A           C522G         CC08-CCR08         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C192T         CKR14         100/Bag         5000         200/Box         5000           C122T         CKR15         25/Box         500         200/Box         500           C222T         CKR16         10/Tray         300         250/Bag         1700           C062/66T         CKR06         100/Bag         1500         2500           C33X          500/Bag         2500         2500           C33X          20/Box         4000         5000           C410          300/Box         4000         5000           C33X          200/Box         2000         2500           C330          200/Box							12"		
C222G         CC79-CCR79         10/Tray         300           C052/56G         CCR05         100/Bag         1700           C062/66G         CCR06         100/Bag         1500           C512G         CC07-CCR07         Footnote (2)         N/A           C522G         CC08-CCR08         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C192T         CKR12         200/Box         5000         5000           C222T         CKR16         10/Tray         300         5000           C052/56T         CKR05         100/Bag         1700           C052/56T         CKR05         100/Bag         1700           C052/56T         CKR06         100/Bag         1500           C31X          500/Bag         2500         2500           C33X          250/Bag         1500         1500           C340          300/Box         4000         5000           C340          300/Box         4000         5000           C340          200/Box         2000         2500           C410							12"		
C052/56G         CCR05         100/Bag         1700           C062/66G         CCR06         100/Bag         1500           C512G         CC07-CCR07         Footnote (2)         N/A           C522G         CCR11         MIL-PRF-39014         200/Box         5000           C124T         CKR11         MIL-PRF-39014         200/Box         5000           C124T         CKR12         200/Box         5000           C192T         CKR14         100/Bag         3000           C222T         CKR16         10/Tray         300           C052/5T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         2500           C31X          500/Bag         2500         2500           C33X          250/Bag         1500         1500           C340          100/Bag         1000         1000           C350          300/Box         4000         5000           C31X           250/Bag         1500           C340           300/Box         4000         5000           C340							12"		
C062/66G         CCR06         100/Bag         1500           C512G         CC07-CCR07         Footnote (2)         N/A           C522G         CC08-CCR08         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C124T         CKR12         200/Box         5000         3000           C192T         CKR14         100/Box         300         300           C202T         CKR15         25/Box         500         300           C32X         CKR06         10/Tray         300         300           C052/56T         CKR06         100/Bag         1500         1500           C31X         CKR06         100/Bag         2500         2500           C33X         C         500/Bag         2500         2500           C340         C         50/Bag         1000         1000           C340         C         S00/Box         4000         5000           C410         C         300/Box         4000         5000           C410         C         200/Box         2000         2500           C410         N/A         Footnote (2)         N/A				-			12"		
C512G         CC07-CCR07         Footnote (2)         N/A           C522G         CC08-CCR08         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C124T         CKR12         200/Box         5000           C192T         CKR14         100/Box         3000           C202T         CKR15         25/Box         500           C222T         CKR16         10/Tray         300           C52/66T         CKR05         100/Bag         1500           C31X         S00/Bag         2500         2500           C32X         S00/Bag         1500         1500           C340         S00/Bag         1000         1000           C340         S00/Bag         1000         1000           C350         S00/Bag         1000         1000           C410         S00/Bag         1000         5000           C410         S00/Box         4000         5000           C410         S00/Box         200/Box         2000         2500           C410         N/A         N/A         Footnote (2)         N/A           C512         N/A         <							12"		
C522G         CC08-CCR08         Footnote (2)         N/A           C114T         CKR11         MIL-PRF-39014         200/Box         5000           C124T         CKR12         200/Box         5000           C192T         CKR14         100/Box         3000           C202T         CKR16         100/Tray         300           C222T         CKR16         10/Tray         300           C052/56T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         2500           C31X         CKR06         500/Bag         2500         2500           C32X         S00/Bag         2500         2500         2500           C340         S00/Bag         1000         1000         1000           C340         S00/Bag         1000         1000         1000           C340         S00         S0/Bag         1000         1000           C410         S00/Bax         4000         5000         500           C410         S0         S00/Box         4000         5000           C430         N/A         N/A         Footnote (2)         N/A           C512         N/A <td></td> <td></td> <td></td> <td>-</td> <td></td> <td></td> <td>N/A</td>				-			N/A		
C114T         CKR11         MIL-PRF-39014         200/Box         5000           C124T         CKR12         200/Box         5000           C192T         CKR14         100/Box         3000           C202T         CKR15         25/Box         500           C222T         CKR16         10/Tray         300           C052/56T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         2500         2500           C31X         500/Bag         2500         2500         2500           C32X         500/Bag         1500         1500         1500           C340         100/Bag         1500         1500         1500           C340         100/Bag         1000         1000         1000           C340         200/Box         4000         5000           C410         300/Box         4000         5000           C412         200/Box         2000         2500           C420         300/Box         4000         5000           C440         200/Box         2000         2500           C440         200/Box         2000         2500							N/A		
C124T         CKR12         200/Box         5000           C192T         CKR14         100/Box         3000           C202T         CKR15         25/Box         500           C222T         CKR16         10/Tray         300           C052/56T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         2500           C31X          500/Bag         2500         2500           C32X          500/Bag         1500         1500           C340          100/Bag         1000         1000           C340          100/Bag         1000         1000           C340          100/Bag         1000         1000           C340          300/Box         4000         5000           C410          300/Box         4000         5000           C412          200/Box         2000         2500           C410          200/Box         2000         2500           C412           200/Box         2000         2500           C410							12"		
C192T         CKR14         100/Box         3000           C202T         CKR15         25/Box         500           C222T         CKR16         10/Tray         300           C052/56T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         2500           C31X          500/Bag         2500         2500           C31X          500/Bag         2500         2500           C33X          250/Bag         1500         1500           C340          250/Bag         1500         1500           C340          300/Box         4000         5000           C410          300/Box         4000         5000           C412          200/Box         4000         5000           C412          200/Box         2000         2500           C410          200/Box         2000         2500           C410          200/Box         2000         2500           C410          200/Box         2000         2500           C410          N/A			WIIL-FKF-39014				12"		
C202T         CKR15         25/Box         500           C222T         CKR16         10/Tray         300           C052/56T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         1500           C31X         CKR06         500/Bag         2500         2500           C32X         S00/Bag         2500         2500         2500           C33X         S00/Bag         1500         1500         1500           C340         S00/Bag         100/Bag         1000         1500           C350         S00/Bag         1000         500         1500           C410         S00/Bag         N/A         500         500           C412         S00/Box         4000         5000           C420         S00/Box         4000         5000           C430         S00/Box         2000         2500           C440         N/A         Footnote (2)         N/A           C512         N/A         N/A         Footnote (2)         N/A           C512         N/A         N/A         Footnote (2)         N/A           C617         S00/Bag         S00         5							12"		
C222T         CKR16         10/Tray         300           C052/56T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         1500           C31X         CKR06         500/Bag         2500         2500           C32X         S00/Bag         2500         2500         2500           C33X         C         S00/Bag         1500         1500           C340         Indo/Bag         1000         1000         1000           C350         Indo/Bag         1000         1000         1000           C340         Indo/Bag         1000         1000         1000           C350         Indo/Bag         1000         1000         1000           C340         Indo/Bag         N/A         500         50/Bag         1000           C410         Indo/Bag         Indo/Bag         1000         5000         5000           C412         Indo/Indo/Indo/Indo/Indo/Indo/Indo/Indo/									
C052/56T         CKR05         100/Bag         1700           C062/66T         CKR06         100/Bag         1500           C31X         500/Bag         2500         2500           C32X         500/Bag         2500         2500           C33X         6         250/Bag         1500         1500           C340         6         250/Bag         1000         1000           C350         6         6         50/Bag         1000         1000           C350         6         6         50/Bag         1000         1000           C410         6         300/Box         4000         5000           C412         6         200/Box         4000         5000           C420         6         300/Box         4000         5000           C430         6         200/Box         2000         2500           C440         6         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C627         N/A         N/A         Footnote (2)         N/A           C617         6         100/Bag         500         500							12"		
C062/66T         CKR06         100/Bag         1500           C31X         500/Bag         2500         2500           C32X         500/Bag         2500         2500           C33X         250/Bag         1500         1500           C340         100/Bag         1000         1000           C350         100/Bag         1000         1000           C350         0         50/Bag         N/A         500           C410         300/Box         4000         5000         5000           C412         200/Box         4000         5000         5000           C420         300/Box         4000         5000         5000           C430         200/Box         2000         2500         2500           C440         200/Box         2000         2500         2500           C512         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000         500         500           C622/C623         100/Bag         500         500         500         500           C630/C631         600         50/Bag         500         500         50/Bag         500 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>12"</td>							12"		
C31X         500/Bag         2500         2500           C32X         500/Bag         2500         2500           C33X         250/Bag         1500         1500           C340         100/Bag         1000         1000           C350         50/Bag         1000         1000           C350         50/Bag         N/A         500           C410         300/Box         4000         5000           C412         200/Box         4000         5000           C420         200/Box         4000         5000           C420         200/Box         2000         2500           C440         200/Box         2000         2500           C440         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         500         500           C627/C628         100/Bag         500         500           C630/C631         100/Bag         500         500           C640/C641         50/Bag         500         500							12"		
C32X         500/Bag         2500         2500           C33X         250/Bag         1500         1500           C340         100/Bag         1000         1000           C350         50/Bag         N/A         500           C410         300/Box         4000         5000           C412         200/Box         4000         5000           C420         300/Box         4000         5000           C430         200/Box         2000         2500           C440         200/Box         2000         2500           C410         N/A         Footnote (2)         N/A           C512         N/A         N/A         Footnote (2)         N/A           C512         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000         500           C622/C623         100/Bag         500         500           C630/C631         100/Bag         500         500           C637/C638         50/Bag         500         50/Bag         500           C640/C641         50/Bag         500         50/Bag         500		CKRU6		-	0500		12"		
C33X         250/Bag         1500         1500           C340         100/Bag         1000         1000           C350         50/Bag         N/A         500           C410         300/Box         4000         5000           C412         200/Box         4000         5000           C420         300/Box         4000         5000           C430         200/Box         2000         2500           C440         200/Box         2000         2500           C440         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000         500         500           C627/C628         100/Bag         500         500         500           C630/C6311         100/Bag         500         500         500           C637/C638         50/Bag         500         500         50/Bag         500           C640/C641         50/Bag         500         50/Bag         500         500							12"		
C340         I00/Bag         I000         I000           C350         50/Bag         N/A         500           C410         300/Box         4000         5000           C412         200/Box         4000         5000           C420         300/Box         4000         5000           C430         200/Box         4000         5000           C440         200/Box         2000         2500           C440         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         100/Bag         500         500           C622/C623         I00         100/Bag         500         500           C630/C631         I00         100/Bag         500         500           C637/C638         I00         50/Bag         500         50/Bag         500           C640/C641         I00/Eag         50/Bag         500         50/Bag         500				-			12"		
C350         N/A         500           C410         300/Box         4000         5000           C412         200/Box         4000         5000           C420         300/Box         4000         5000           C430         200/Box         4000         5000           C440         200/Box         2000         2500           C440         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000         500           C622/C623         I         I         100/Bag         500           C630/C631         I         100/Bag         500           C637/C638         I         50/Bag         500           C640/C641         I         50/Bag         500           C642/C643         I         50/Bag         500				-			12"		
C410         300/Box         4000         5000           C412         200/Box         4000         5000           C420         300/Box         4000         5000           C430         200/Box         4000         5000           C440         200/Box         2000         2500           C440         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000         5000         500           C622/C623         100/Bag         500         500         500           C630/C631         50/Bag         500         500         500           C640/C641         50/Bag         500         500         500           C642/C643         50/Bag         500         500         500							12"		
C412         200/Box         4000         5000           C420         300/Box         4000         5000           C430         200/Box         2000         2500           C440         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000         500         500           C622/C623         100/Bag         500         500         500           C630/C631         100/Bag         500         500         50/Bag         500           C637/C638         6         50/Bag         500         50/Bag         500           C640/C641         6         50/Bag         500         50/Bag         500				• •			12"		
C420         300/Box         4000         5000           C430         200/Box         2000         2500           C440         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         K         K         250/Bag         1000           C622/C623         K         100/Bag         500         500           C630/C631         K         100/Bag         500         500           C637/C638         K         50/Bag         500         50/Bag         500           C640/C641         K         50/Bag         500         50/Bag         500							12"		
C430         200/Box         2000         2500           C440         200/Box         2000         2500         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617          Z50/Bag         1000           C622/C623         100/Bag         500         500           C630/C631         100/Bag         500         500           C637/C638         500         50/Bag         500           C640/C641         640/C641         50/Bag         500           C642/C643         640/C643         50/Bag         500							12"		
C440         200/Box         2000         2500           C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000         500           C622/C623         100/Bag         500         500           C630/C631         100/Bag         500         500           C637/C638         6         50/Bag         500           C640/C641         50/Bag         500         50/Bag           C642/C643         6         50/Bag         500							12"		
C512         N/A         N/A         Footnote (2)         N/A           C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000         1000           C622/C623         100/Bag         500         500           C637/C628         100/Bag         500         500           C637/C638         50/Bag         500         500           C640/C641         50/Bag         500         500           C642/C643         50/Bag         500         500							12"		
C522         N/A         N/A         Footnote (2)         N/A           C617         250/Bag         1000           C622/C623         100/Bag         500           C627/C628         100/Bag         500           C630/C631         100/Bag         500           C637/C638         50/Bag         500           C640/C641         50/Bag         500           C642/C643         50/Bag         500					2000		12"		
C617         250/Bag         1000           C622/C623         100/Bag         500           C627/C628         100/Bag         500           C630/C631         100/Bag         500           C637/C638         50/Bag         500           C640/C641         50/Bag         500           C642/C643         50/Bag         500							N/A		
C622/C623       100/Bag       500         C627/C628       100/Bag       500         C630/C631       100/Bag       500         C637/C638       50/Bag       500         C640/C641       50/Bag       500         C642/C643       50/Bag       500		N/A	N/A				N/A		
C627/C628         100/Bag         500           C630/C631         100/Bag         500           C637/C638         50/Bag         500           C640/C641         50/Bag         500           C642/C643         50/Bag         500							12"		
C630/C631       100/Bag       500         C637/C638       50/Bag       500         C640/C641       50/Bag       500         C642/C643       50/Bag       500				-			12"		
C637/C638         50/Bag         500           C640/C641         50/Bag         500           C642/C643         50/Bag         500				-			12"		
C640/C641         50/Bag         500           C642/C643         50/Bag         500							12"		
C642/C643 50/Bag 500							12"		
							12"		
	C642/C643 C647/C648			50/Bag		500 500	12"		
C657/C658 50/Bag 500							12" 12"		
C667/C668 50/Bag 500				-			12" 12"		

NOTE: (1) Standard packaging refers to number of pieces per bag, tray or vial.

(2) Quantity varies. For further details, please consult the factory.