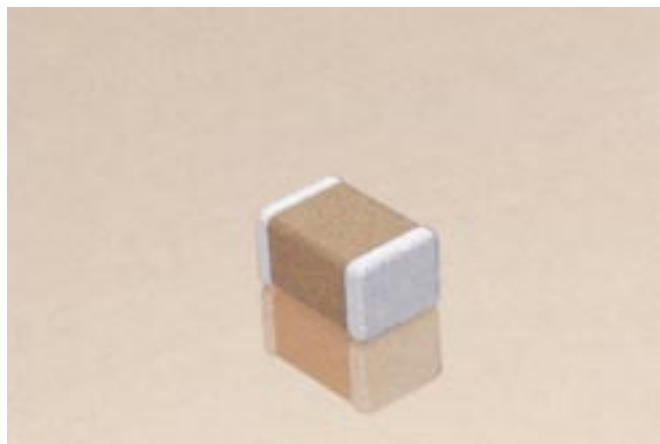


X7R Dielectric

General Specifications



X7R formulations are called "temperature stable" ceramics and fall into EIA Class II materials. X7R is the most popular of these intermediate dielectric constant materials. Its temperature variation of capacitance is within $\pm 15\%$ from -55°C to $+125^{\circ}\text{C}$. This capacitance change is non-linear.

Capacitance for X7R varies under the influence of electrical operating conditions such as voltage and frequency.

X7R dielectric chip usage covers the broad spectrum of industrial applications where known changes in capacitance due to applied voltages are acceptable.

PART NUMBER (see page 3 for complete part number explanation)

0805

Size
(L" x W")

5

Voltage
10V = Z
16V = Y
25V = 3
50V = 5
100V = 1

C

Dielectric
X7R = C

103

Capacitance Code

M

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

A

Failure Rate
A = Not Applicable

T

Terminations
T = Plated Ni and Solder

2

Packaging
2 = 7" Reel
4 = 13" Reel

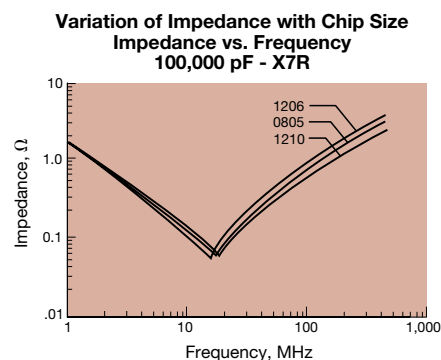
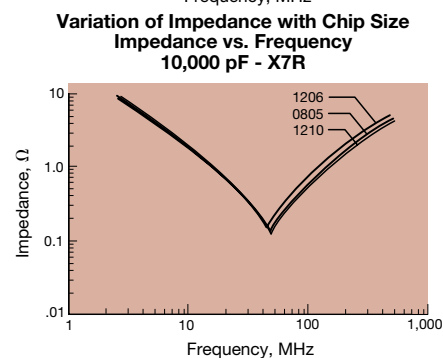
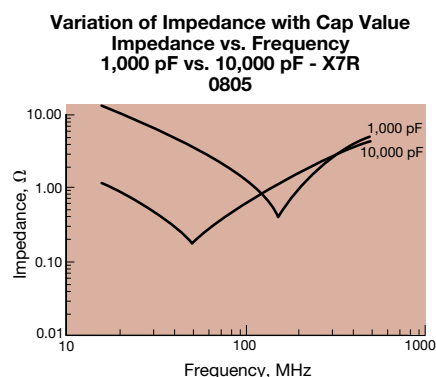
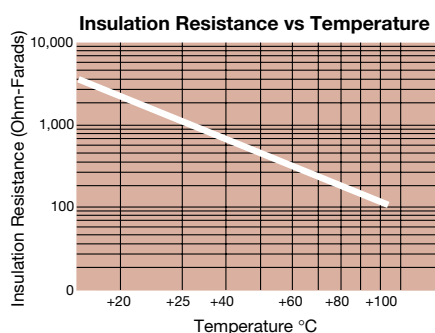
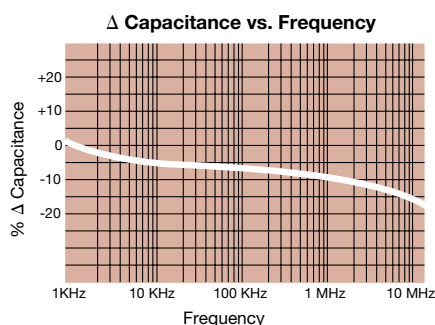
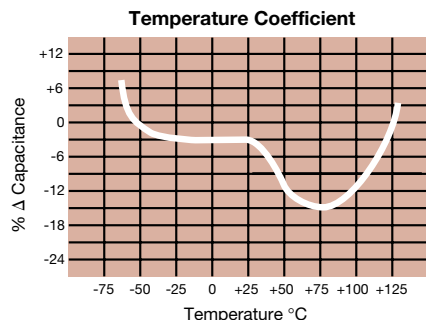
A

Special Code
A = Std. Product

PERFORMANCE CHARACTERISTICS

Capacitance Range	100 pF to 2.2 μF (1.0 ± 0.2 Vrms, 1kHz)
Capacitance Tolerances	Preferred $\pm 10\%$, $\pm 20\%$ others available: $\pm 5\%$, $+80 -20\%$
Operating Temperature Range	-55°C to $+125^{\circ}\text{C}$
Temperature Characteristic	$\pm 15\%$ (0 VDC)
Voltage Ratings	10, 16, 25, 50, 100 VDC ($+125^{\circ}\text{C}$)
Dissipation Factor	For 50 volts and 100 volts: 2.5% max. For 25 volts: 3.0% max. For 16 volts: 3.5% max. For 10 volts: 5% max.
Insulation Resistance ($+25^{\circ}\text{C}$, RVDC)	100,000 megohms min. or $1000 \text{ M}\Omega - \mu\text{F}$ min., whichever is less
Insulation Resistance ($+125^{\circ}\text{C}$, RVDC)	10,000 megohms min. or $100 \text{ M}\Omega - \mu\text{F}$ min., whichever is less
Dielectric Strength	250% of rated voltage for 5 seconds at 50 mamp max. current
Test Voltage	1.0 ± 0.2 Vrms
Test Frequency	1 KHz

Typical Characteristic Curves**



SUMMARY OF CAPACITANCE RANGES VS. CHIP SIZE

Style	10V	16V	25V	50V	100V
0402*	—	100pF - 47nF	100pF - 6.8nF	100pF - 3.9nF	—
0504	—	—	—	100pF - .01 μ F	100pF - 3.3nF
0603*	100pF - 0.22 μ F	100pF - 0.1 μ F	100pF - 47nF	100pF - 15nF	100pF - 4.7nF
0805*	100pF - 2.2 μ F	100pF - 0.47 μ F	100pF - 0.22 μ F	100pF - 0.1 μ F	100pF - 22nF
1206*	1.5 μ F - 4.7 μ F	1nF - 1 μ F	1nF - 1.0 μ F	1nF - 0.22 μ F	1nF - 0.1 μ F
1210*	→	1nF - 1.8 μ F	1nF - 1 μ F	1nF - 0.22 μ F	1nF - 0.1 μ F
1505	→	→	→	1nF - 0.1 μ F	1nF - 27nF
1808	→	→	10nF - 0.33 μ F	10nF - 0.33 μ F	10nF - 0.1 μ F
1812*	→	→	→	10nF - 1 μ F	10nF - 0.47 μ F
1825*	→	→	→	10nF - 1 μ F	10nF - 0.47 μ F
2220	→	→	→	10nF - 1.5 μ F	10nF - 1.2 μ F
2225	→	→	→	10nF - 2.2 μ F	10nF - 1.5 μ F

* Standard Sizes

** For additional information on performance changes with operating conditions consult AVX's software SpiCap.

SIZE		0402*			0504*		0603*					0805					1206					1505		
Standard Reel Packaging		All Paper			All Embossed		All Paper					Paper/Embossed					Paper/Embossed					All Embossed		
(L) Length	MM (in.)	1.00 ± .10 (.040 ± .004)			1.27 ± .25 (.050 ± .010)		1.60 ± .15 (.063 ± .006)					2.01 ± .20 (.079 ± .008)					3.20 ± .20 (.126 ± .008)					3.81 ± .25 (.150 ± .010)		
(W) Width	MM (in.)	.50 ± .10 (.020 ± .004)			1.02 ± .25 (.040 ± .010)		.81 ± .15 (.032 ± .006)					1.25 ± .20 (.049 ± .008)					1.60 ± .20 (.063 ± .008)					1.27 ± .25 (.050 ± .010)		
(T) Max. Thickness	MM (in.)	.60 (.024)			1.02 (.040)		.90 (.035)					1.30 (.051)					1.50 (.059)					1.27 (.050)		
(t) Terminal	MM (in.)	.25 ± .15 (.010 ± .006)			.38 ± .13 (.015 ± .005)		.35 ± .15 (.014 ± .006)					.50 ± .25 (.020 ± .010)					.50 ± .25 (.020 ± .010)					.50 ± .25 (.020 ± .010)		
WVDC		16	25	50	50	100	10	16	25	50	100	10	16	25	50	100	10	16	25	50	100	50	100	
Cap. (pF)	100 120 150																							
	180 220 270																							
	330 390 470																							
	560 680 820																							
	1000 1200 1500																							
	1800 2200 2700																							
	3300 3900 4700																							
	5600 6800 8200																							
Cap. (μF)	.010 .012 .015																							
	.018 .022 .027																							
	.033 .039 .047																							
	.056 .068 .082																							
	.10 .12 .15																							
	.18 .22 .27																							
	.33 .47 .56																							
	.68 .82 1.0																							
	1.2 1.5 1.8																							
	2.2 4.7																							

 = Paper Tape
 = Embossed Tape



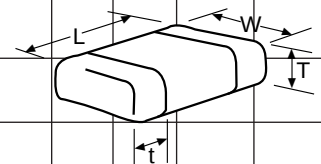
X7R Dielectric

Capacitance Range



PREFERRED SIZES ARE SHADED

SIZE		1210				1808*				1812*				1825*				2220*				2225*			
Standard Reel Packaging		Paper/Embossed				All Embossed				All Embossed				All Embossed				All Embossed				All Embossed			
(L) Length	MM (in.)	3.20 ± .20 (.126 ± .008)				4.57 ± .25 (.180 ± .010)				4.50 ± .30 (.177 ± .012)				4.50 ± .30 (.177 ± .012)				5.7 ± 0.4 (.225 ± .016)				5.72 ± .25 (.225 ± .010)			
(W) Width	MM (in.)	2.50 ± .20 (.098 ± .008)				2.03 ± .25 (.080 ± .010)				3.20 ± .20 (.126 ± .008)				6.40 ± .40 (.252 ± .016)				5.0 ± 0.4 (.197 ± .016)				6.35 ± .25 (.250 ± .010)			
(T) Max. Thickness	MM (in.)	1.70 (.067)				1.52 (.060)				1.70 (.067)				1.70 (.067)				2.30 (.090)				1.70 (.067)			
(t) Terminal	MM (in.)	.50 ± .25 (.020 ± .010)				.64 ± .39 (.025 ± .015)				.61 ± .36 (.024 ± .014)				.61 ± .36 (.024 ± .014)				.64 ± .39 (.025 ± .015)				.64 ± .39 (.025 ± .015)			
WVDC		16	25	50	100	25	50	100		50	100			50	100			50	100	200		50	100		
Cap (pF)	1000																								
	1200																								
	1500																								
	1800																								
	2200																								
	2700																								
	3300																								
	3900																								
	4700																								
	5600																								
	6800																								
	8200																								
Cap. (μF)	.010																								
	.012																								
	.015																								
	.018																								
	.022																								
	.027																								
	.033																								
	.039																								
	.047																								
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	.47																								
	.56																								
	.68																								
	.82																								
	1.0																								
	1.2																								
	1.5																								
	1.8																								
	2.2																								



*Reflow soldering only.

NOTES: For higher voltage chips, see pages 20 and 21.

= Paper Tape
 = Embossed Tape

How to Order

Part Number Explanation

EXAMPLE: 08055A101JAT2A

0805 Size (L" x W") 0402 0504 0603 0805 1005 0907 1206 1210 1505 1805 1808 1812 1825 2225 3640	5 Voltage 10V = Z 16V = Y 25V = 3 50V = 5 100V = 1 200V = 2 250V = V 500V = 7 600V = C 1000V = A 1500V = S 2000V = G 2500V = W 3000V = H 4000V = J 5000V = K	A Dielectric COG (NP0) = A X7R = C X5R = D Z5U = E Y5V = G	101 Capacitance Code (2 significant digits + no. of zeros) Examples: 10 pF = 100 100 pF = 101 1,000 pF = 102 22,000 pF = 223 220,000 pF = 224 1 μ F = 105 For values below 10 pF, use "R" in place of decimal point, e.g., 9.1 pfd = 9R1.	J Capacitance Tolerance C = ± 0.25 pF* D = ± 0.50 pF* F = $\pm 1\%$ (≥ 25 pF) G = $\pm 2\%$ (≥ 13 pF) J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 20\%$ Z = +80%, -20% P = +100%, -0%	A Failure Rate A = Not Applicable	T Terminations Standard: T = Ni and Tin Plated Others: 7 = Plated Ni Gold Plated 1 = Pd/Ag	2 Packaging** Recommended: 2 = 7" Reel 4 = 13" Reel Others: 7 = Bulk Cassette 9 = Bulk	A Special** Code A = Standard Product Non-Standard P = Embossed unmarked M = Embossed marked E = Standard packaging marked Low Profile Chips Only Max. Thickness T = .66mm (.026") S = .56mm (.022") R = .46mm (.018")
---	---	--	---	---	---	---	--	---

* C&D tolerances for ≤ 10 pF values.

** Standard Tape and Reel material depends upon chip size and thickness.
See individual part tables for tape material type for each capacitance value.

Note: Unmarked product is standard. Marked product is available on special request, please contact AVX.
Standard packaging is shown in the individual tables.

Non-standard packaging is available on special request, please contact AVX.

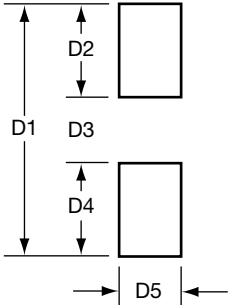
MLC Chip Capacitors

Component Pad Design

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

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

REFLOW SOLDERING

 Dimensions in millimeters (inches)	Case Size	D1	D2	D3	D4	D5
	0402	1.70 (0.07)	0.60 (0.02)	0.50 (0.02)	0.60 (0.02)	0.50 (0.02)
	0603	2.30 (0.09)	0.80 (0.03)	0.70 (0.03)	0.80 (0.03)	0.75 (0.03)
	0805	3.00 (0.12)	1.00 (0.04)	1.00 (0.04)	1.00 (0.04)	1.25 (0.05)
	1206	4.00 (0.16)	1.00 (0.04)	2.00 (0.09)	1.00 (0.04)	1.60 (0.06)
	1210	4.00 (0.16)	1.00 (0.04)	2.00 (0.09)	1.00 (0.04)	2.50 (0.10)
	1808	5.60 (0.22)	1.00 (0.04)	3.60 (0.14)	1.00 (0.04)	2.00 (0.08)
	1812	5.60 (0.22)	1.00 (0.04))	3.60 (0.14)	1.00 (0.04)	3.00 (0.12)
	1825	5.60 (0.22)	1.00 (0.04)	3.60 (0.14)	1.00 (0.04)	6.35 (0.25)
	2220	6.60 (0.26)	1.00 (0.04)	4.60 (0.18)	1.00 (0.04)	5.00 (0.20)
	2225	6.60 (0.26)	1.00 (0.04)	4.60 (0.18)	1.00 (0.04)	6.35 (0.25)

Surface Mounting Guide



MLC Chip Capacitors

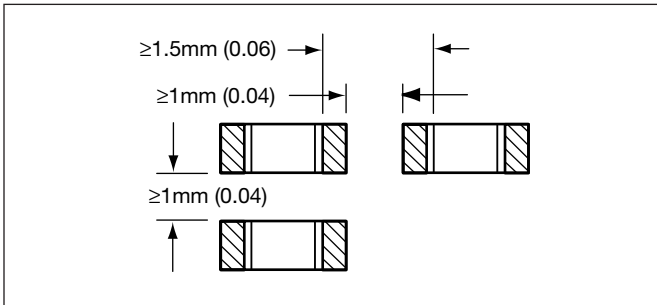
WAVE SOLDERING

	Case Size	D1	D2	D3	D4	D5
	0603	3.10 (0.12)	1.20 (0.05)	0.70 (0.03)	1.20 (0.05)	0.75 (0.03)
	0805	4.00 (0.15)	1.50 (0.06)	1.00 (0.04)	1.50 (0.06)	1.25 (0.05)
	1206	5.00 (0.19)	1.50 (0.06)	2.00 (0.09)	1.50 (0.06)	1.60 (0.06)
	1210	5.00 (0.19)	1.50 (0.06)	2.00 (0.09)	1.50 (0.06)	2.50 (0.10)

Dimensions in millimeters (inches)

Component Spacing

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



Preheat & Soldering

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

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

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

Cleaning

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

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

Surface Mounting Guide



MLC Chip Capacitors

APPLICATION NOTES

Storage

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

Solderability

Terminations to be well soldered after immersion in a 60/40 tin/lead solder bath at 235 ±5°C for 2±1 seconds.

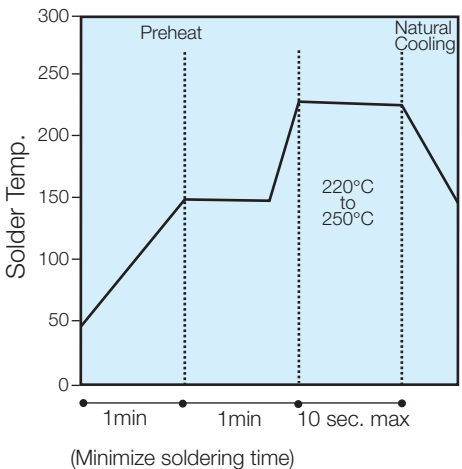
Leaching

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

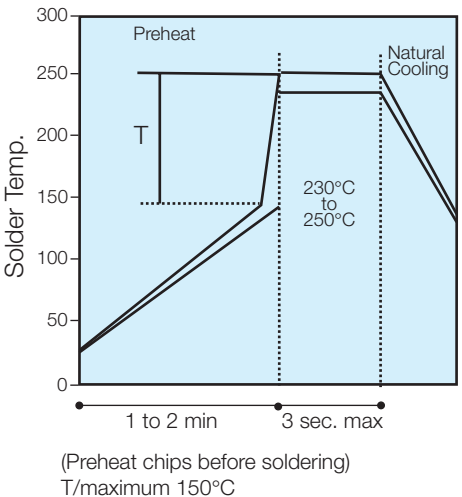
Termination Type	Solder Tin/Lead/Silver	Solder Temp. °C	Immersion Time Seconds
Nickel Barrier	60/40/0	260±5	30±1

Recommended Soldering Profiles

Reflow



Wave



General

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

Handling

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

Preheat

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

Soldering

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

Cooling

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

Cleaning

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



Packaging of Chip Components



Automatic Insertion Packaging

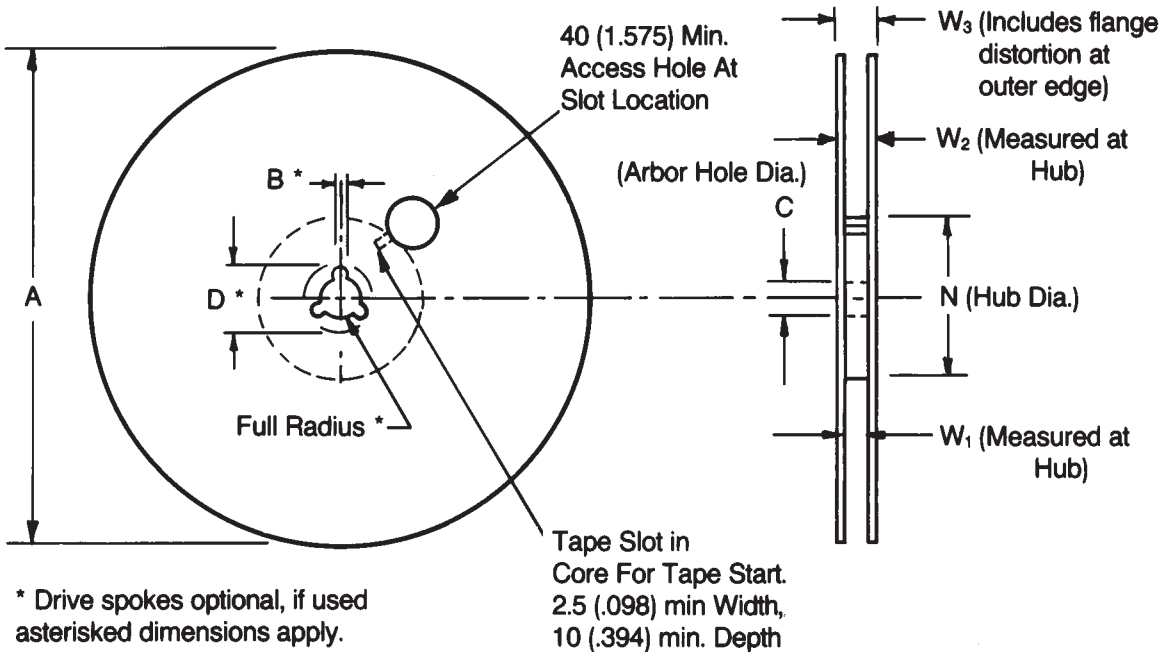
TAPE & REEL QUANTITIES

All tape and reel specifications are in compliance with RS481.

	8mm	12mm	
Paper or Embossed Carrier	0805, 1005, 1206, 1210		
Embossed Only	0504, 0907	1505, 1805, 1808	1812, 1825, 2220, 2225
Paper Only	0402, 0603		
Qty. per Reel/7" Reel	2,000 or 4,000 ⁽¹⁾	3,000	1,000
Qty. per Reel/13" Reel	10,000	10,000	4,000

⁽¹⁾ Dependent on chip thickness. Low profile chips shown on page 27 are 5,000 per reel for 7" reel. 0402 size chips are 10,000 per 7" reels and are not available on 13" reels. For 3640 size chip contact factory for quantity per reel.

REEL DIMENSIONS



Tape Size ⁽¹⁾	A Max.	B* Min.	C	D* Min.	N Min.	W ₁	W ₂ Max.	W ₃
8mm	330 (12.992)	1.5 (.059)	13.0±0.20 (.512±.008)	20.2 (.795)	50 (1.969)	8.4 ^{+1.0} _{-0.0} (.331 ^{+0.60} _{-0.0})	14.4 (.567)	7.9 Min. (.311) 10.9 Max. (.429)
12mm						12.4 ^{+2.0} _{-0.0} (.488 ^{+0.76} _{-0.0})	18.4 (.724)	11.9 Min. (.469) 15.4 Max. (.607)

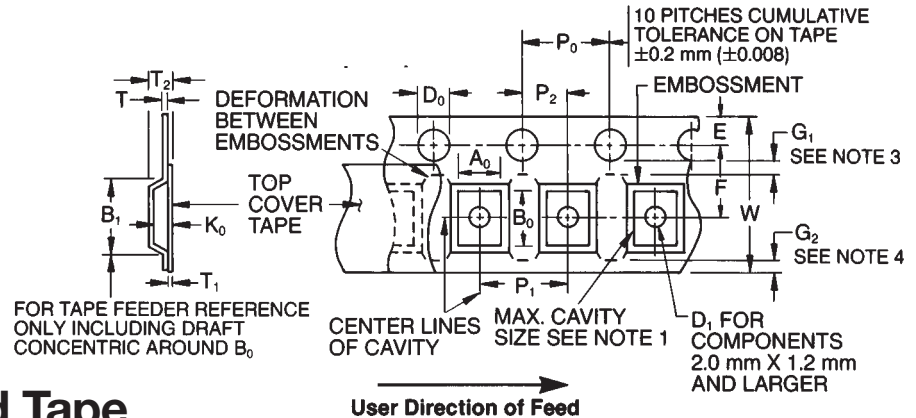
Metric dimensions will govern.
English measurements rounded and for reference only.

⁽¹⁾ For tape sizes 16mm and 24mm (used with chip size 3640) consult EIA RS-481 latest revision.

Embossed Carrier Configuration



8 & 12mm Tape Only



8 & 12mm Embossed Tape Metric Dimensions Will Govern

CONSTANT DIMENSIONS

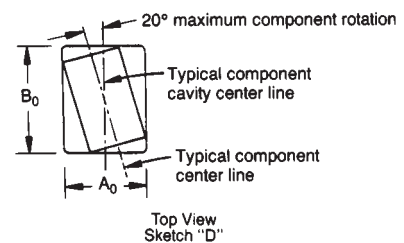
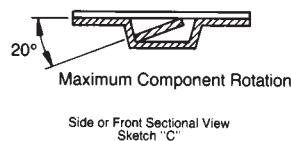
Tape Size	D ₀	E	P ₀	P ₂	T Max.	T ₁	G ₁	G ₂
8mm and 12mm	8.4 ^{+0.10} _{-0.0} (.059 ^{+0.004} _{-0.0})	1.75 ± 0.10 (.069 ± .004)	4.0 ± 0.10 (.157 ± .004)	2.0 ± 0.05 (.079 ± .002)	0.600 (.024)	0.10 (.004) Max.	0.75 (.030) Min. See Note 3	0.75 (.030) Min. See Note 4

VARIABLE DIMENSIONS

Tape Size	B ₁ Max. See Note 6	D ₁ Min. See Note 5	F	P ₁	R Min. See Note 2	T ₂	W	A ₀ B ₀ K ₀
8mm	4.55 (.179)	1.0 (.039)	3.5 ± 0.05 (.138 ± .002)	4.0 ± 0.10 (.157 ± .004)	25 (.984)	2.5 Max. (.098)	8.0 ^{+0.3} _{-0.1} (.315 ^{+0.012} _{-.004})	See Note 1
12mm	8.2 (.323)	1.5 (.059)	5.5 ± 0.05 (.217 ± .002)	4.0 ± 0.10 (.157 ± .004)	30 (1.181)	6.5 Max. (.256)	12.0 ± .30 (.472 ± .012)	See Note 1
8mm 1/2 Pitch	4.55 (.179)	1.0 (.039)	3.5 ± 0.05 (.138 ± .002)	2.0 ± 0.10 0.79 ± .004	25 (.984)	2.5 Max. (.098)	8.0 ^{+0.3} _{-0.1} (.315 ^{+0.012} _{-.004})	See Note 1
12mm Double Pitch	8.2 (.323)	1.5 (.059)	5.5 ± 0.05 (.217 ± .002)	8.0 ± 0.10 (.315 ± .004)	30 (1.181)	6.5 Max. (.256)	12.0 ± .30 (.472 ± .012)	See Note 1

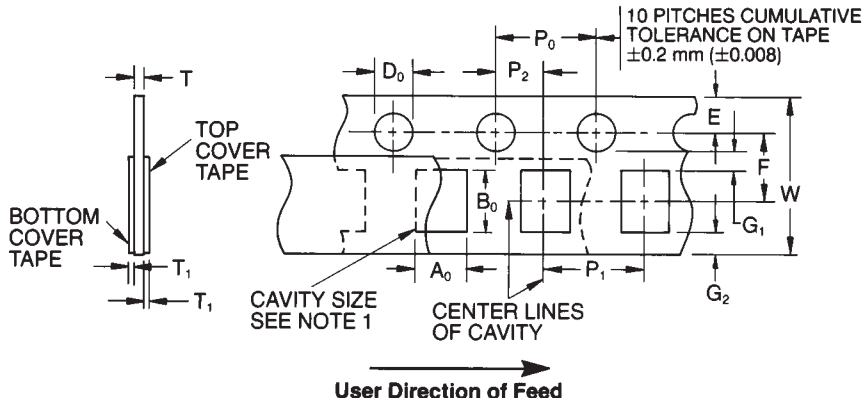
NOTES:

- A₀, B₀, and K₀ are determined by the max. dimensions to the ends of the terminals extending from the component body and/or the body dimensions of the component. The clearance between the end of the terminals or body of the component to the sides and depth of the cavity (A₀, B₀, and K₀) must be within 0.05 mm (.002) min. and 0.50 mm (.020) max. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see sketches C & D).
- Tape with components shall pass around radius "R" without damage. The minimum trailer length (Note 2 Fig. 3) may require additional length to provide R min. for 12 mm embossed tape for reels with hub diameters approaching N min. (Table 4).
- G₁ dimension is the flat area from the edge of the sprocket hole to either the outward deformation of the carrier tape between the embossed cavities or to the edge of the cavity whichever is less.
- G₂ dimension is the flat area from the edge of the carrier tape opposite the sprocket holes to either the outward deformation of the carrier tape between the embossed cavity or to the edge of the cavity whichever is less.
- The embossment hole location shall be measured from the sprocket hole controlling the location of the embossment. Dimensions of embossment location and hole location shall be applied independent of each other.
- B₁ dimension is a reference dimension for tape feeder clearance only.



Paper Carrier Configuration

8 & 12mm Tape Only



8 & 12mm Paper Tape Metric Dimensions Will Govern

CONSTANT DIMENSIONS

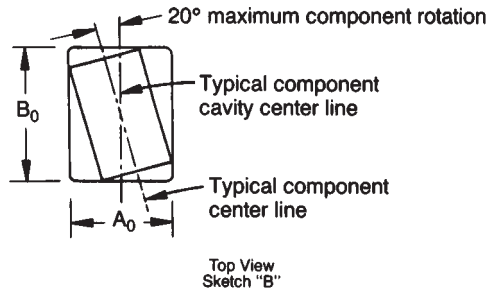
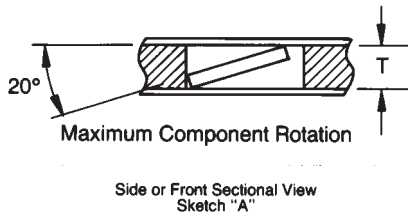
Tape Size	D ₀	E	P ₀	P ₂	T ₁	G ₁	G ₂	R MIN.
8mm and 12mm	1.5 ^{+0.1} _{-0.0} (.059 ^{+0.004} _{-.000})	1.75 ± 0.10 (.069 ± .004)	4.0 ± 0.10 (.157 ± .004)	2.0 ± 0.05 (.079 ± .002)	0.10 (.004) Max.	0.75 (.030) Min.	0.75 (.030) Min.	25 (.984) See Note 2

VARIABLE DIMENSIONS

Tape Size	P ₁	F	W	A ₀ B ₀	T
8mm	4.0 ± 0.10 (.157 ± .004)	3.5 ± 0.05 (.138 ± .002)	8.0 ^{+0.3} _{-0.1} (.315 ^{+0.012} _{-.004})	See Note 1	See Note 3
12mm	4.0 ± .010 (.157 ± .004)	5.5 ± 0.05 (.217 ± .002)	12.0 ± 0.3 (.472 ± .012)		
8mm 1/2 Pitch	2.0 ± 0.10 (.079 ± .004)	3.5 ± 0.05 (.138 ± .002)	8.0 ^{+0.3} _{-0.1} (.315 ^{+0.012} _{-.004})		
12mm Double Pitch	8.0 ± 0.10 (.315 ± .004)	5.5 ± 0.05 (.217 ± .002)	12.0 ± 0.3 (.472 ± .012)		

NOTES:

1. A₀, B₀, and T are determined by the max. dimensions to the ends of the terminals extending from the component body and/or the body dimensions of the component. The clearance between the ends of the terminals or body of the component to the sides and depth of the cavity (A₀, B₀, and T) must be within 0.05 mm (.002) min. and 0.50 mm (.020) max. The clearance allowed must also prevent rotation of the component within the cavity of not more than 20 degrees (see sketches A & B).
2. Tape with components shall pass around radius "R" without damage.
3. 1.1 mm (.043) Base Tape and 1.6 mm (.063) Max. for Non-Paper Base Compositions.



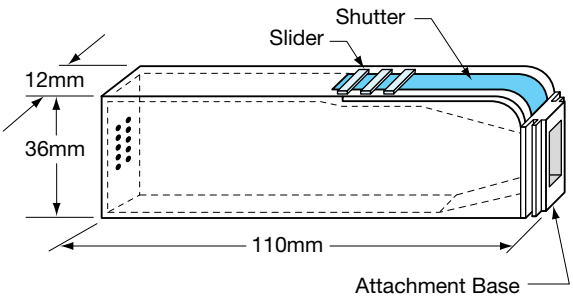
Bar Code Labeling Standard

AVX bar code labeling is available and follows latest version of EIA-556-A.

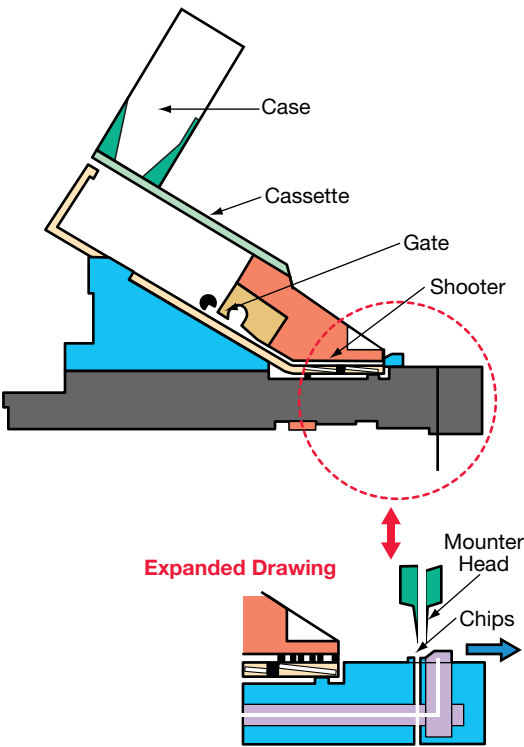
BENEFITS

- Easier handling
- Smaller packaging volume
(1/20 of T/R packaging)
- Easier inventory control
- Flexibility
- Recyclable

CASE DIMENSIONS



BULK FEEDER



CASE QUANTITIES

Part Size	0402	0603	0805
Qty. (pcs / cassette)	80,000	15,000	10,000 (T=0.6mm) 5,000 (T≥0.6mm)