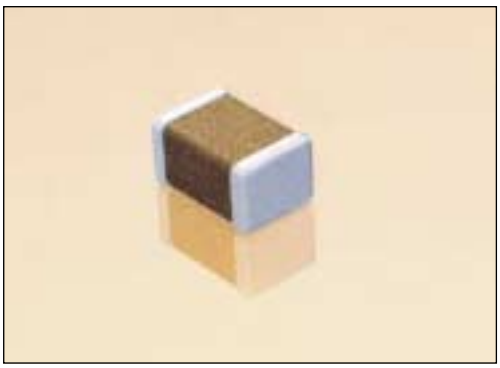
X5R Dielectric

General Purpose Dielectric for MLCCs



GENERAL DESCRIPTION

- General Purpose Dielectric for Ceramic Capacitors
- EIA Class II Dielectric
- Temperature variation of capacitance is within ±15% from -55°C to +85°C
- Well suited for decoupling and filtering applications
- Available in High Capacitance values (up to 100µF)

HOW TO ORDER

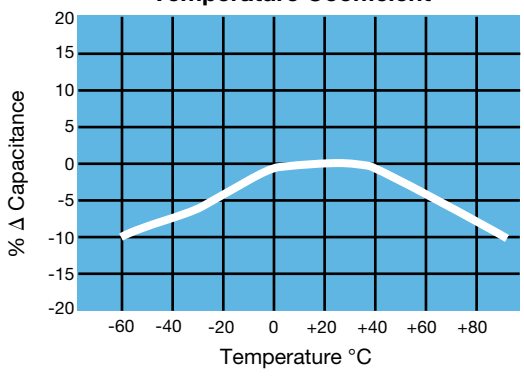
2220	6	D	107	M	A	T	2	A
Size LxW	**Voltage** 6 = 6.3V Z = 10V Y = 16V 3 = 25V 5 = 50V	**Dielectric** D = X5R	**Capacitance Code** 2 Sig Digits + Number of Zeros	**Capacitance Tolerance** J = ±5% K = ±10% M = ±20%	**Failure Rate** A = N/A	**Termination Code** T = Ni/Sn	**Packaging Code** 2 = 7" Reel 4 = 13" Reel	**Special Code** A = Std.

PERFORMANCE CHARACTERISTICS

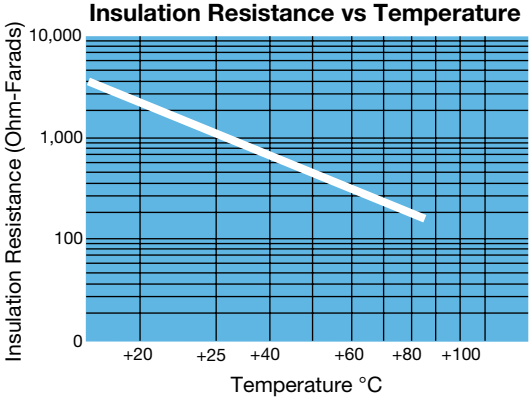
Capacitance Range	up to 100 µF	
Tolerances	Preferred ±10%, ±20% (others ±5%)	
Operating Temperature Range	-55°C to +85°C	
Temperature Coefficient	+15% (0VDC)	
Voltage Ratings	6.3, 10, 16, 25 VDC	
Dissipation Factor	3.5% max. (For 16/25V), 5.0% max. (For 6.3/10V)	
Insulation Resistance (+25°C, RVDC)	100,000 MΩ min. or 500 MΩ - µF, whichever is less	
Dielectric Strength	No problems observed after 2.5 x RVDC for 5 seconds at 50mA max. current	
Test Voltage	C≤10µF : 1.0 ±0.1 Vrms	C>10µF : 0.5 ±0.1 Vrms
Test Frequency	C≤10µF : 1kHz	C>10µF : 120Hz

TYPICAL ELECTRICAL CHARACTERISTICS

Temperature Coefficient



Insulation Resistance vs Temperature



X5R Dielectric

Capacitance Range

PREFERRED SIZES ARE SHADED

SIZE		0201		0402				0603				0805				1206				1210				1812				2220			
Soldering		Reflow Only		Reflow Only				Reflow Only				Reflow/Wave				Reflow/Wave				Reflow/Wave				Reflow Only				Reflow Only			
Packaging		All Paper		All Paper				All Paper				Paper/Embossed				Paper/Embossed				Paper/Embossed				All Embossed				All Embossed			
(L) Length	MM	0.60 ± 0.03		1.00 ± 0.10				1.60 ± 0.15				2.01 ± 0.20				3.20 ± 0.20				3.20 ± 0.20				4.50 ± 0.30				5.70 ± 0.40			
	(in.)	(0.024 ± 0.001)		(0.040 ± 0.004)				(0.063 ± 0.006)				(0.079 ± 0.008)				(0.126 ± 0.008)				(0.126 ± 0.008)				(0.177 ± 0.012)				(0.225 ± 0.016)			
(W) Width	MM	0.30 ± 0.03		0.50 ± 0.10				0.81 ± 0.15				1.25 ± 0.20				1.60 ± 0.20				2.50 ± 0.20				3.20 ± 0.20				5.00 ± 0.40			
	(in.)	(0.011 ± 0.001)		(0.020 ± 0.004)				(0.032 ± 0.006)				(0.049 ± 0.008)				(0.063 ± 0.008)				(0.098 ± 0.008)				(0.126 ± 0.008)				(0.197 ± 0.016)			
(T) Max. Thickness	MM	0.30 ± 0.03		0.60				0.90				1.30				1.50				1.70				1.70				2.30			
	(in.)	(0.011 ± 0.001)		(0.024)				(0.035)				(0.051)				(0.059)				(0.010)				(0.067)				(0.090)			
(t) Terminal	MM	0.15 ± 0.05		0.25 ± 0.15				0.35 ± 0.15				0.50 ± 0.25				0.50 ± 0.25				0.50 ± 0.25				0.61 ± 0.36				0.64 ± 0.39			
	(in.)	(0.006 ± 0.002)		(0.010 ± 0.006)				(0.014 ± 0.006)				(0.020 ± 0.010)				(0.020 ± 0.010)				(0.020 ± 0.010)				(0.024 ± 0.014)				(0.025 ± 0.015)			
	WVDC	10	16	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25	6.3	10	16	25
Cap (pF)	1000	■																													
	1200	■																													
	1500	■																													
	1800	■																													
	2200	■																													
	2700	■																													
	3300	■																													
	3900	■																													
	4700	■																													
	5600	■																													
	6800	■																													
	8200	■																													
Cap (µF)	0.010	■																													
	0.012																														
	0.015																														
	0.018																														
	0.022																														
	0.027					■																									
	0.033					■																									
	0.039					■																									
	0.047					■																									
	0.056					■					■																				
	0.068					■					■																				
	0.082					■					■																				
	0.10									■	■																				
	0.12									■	■																				
	0.15									■	■																				
	0.18			■					■	■																					
	0.22			■					■	■																					
	0.27			■					■	■																					
	0.33							■	■						■																
	0.47							■	■						■																
	0.56							■	■						■																
	0.68							■	■					■	■																
	0.82							■						■	■																
	1.0							■	■					■	■																
	1.2												■	■																	
	1.5												■	■																	
	1.8												■	■																	
	2.2							■				■	■			■	■	■													
	3.3											■	■			■	■						■								
	4.7											■	■										■								
	10											■				■				■		■					■				
	22																			■		■			■						
	47																								■						
	100																														

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
4V = 4
6.3V = 6
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
C0G (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 µF = 105

For values below 10 pF, use "R" in place of decimal point, e.g., 9.1 pfd = 9R1.

J

Capacitance Tolerance
B = ±.10 pF*
C = ±.25 pF*
D = ±.50 pF*
F = ±1% (≥ 25 pF)
G = ±2% (≥ 13 pF)
J = ±5%
K = ±10%
M = ±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")

*B,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.

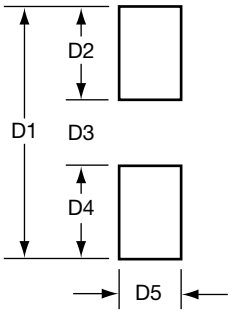
Note: Unmarked product is standard. Marked product is available on special request, please contact AVX.
Standard packaging is shown in the individual tables.
Non-standard packaging is available on special request, please contact AVX.

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.

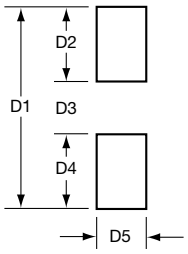
REFLOW SOLDERING



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)

WAVE SOLDERING

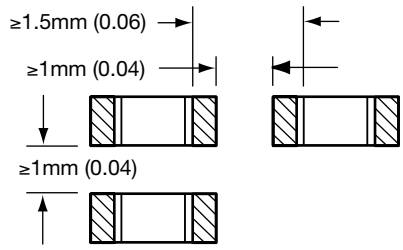


Case Size	D1	D2	D3	D4	D5
0603	3.10 (0.12)	1.20 (0.05)	0.70 (0.03)	1.20 (0.05)	0.75 (0.03)
0805	4.00 (0.15)	1.50 (0.06)	1.00 (0.04)	1.50 (0.06)	1.25 (0.05)
1206	5.00 (0.19)	1.50 (0.06)	2.00 (0.09)	1.50 (0.06)	1.60 (0.06)
1210	5.00 (0.19)	1.50 (0.06)	2.00 (0.09)	1.50 (0.06)	2.50 (0.10)

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.

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.

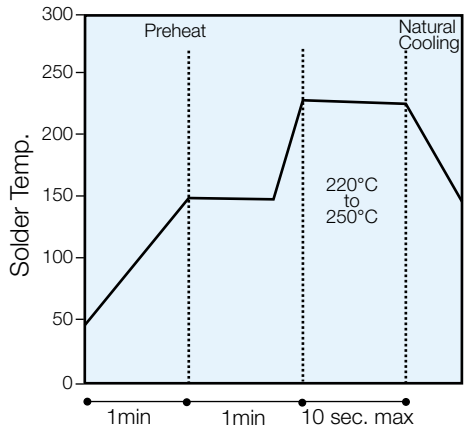
Solderability
Terminations to be well soldered after immersion in a 60/40 tin/lead solder bath at 235 ±5°C for 2±1 seconds.

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

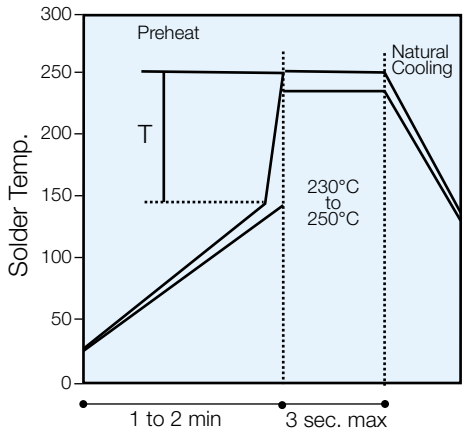
Recommended Soldering Profiles

Reflow



(Minimize soldering time)

Wave



(Preheat chips before soldering)
T/maximum 150°C

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

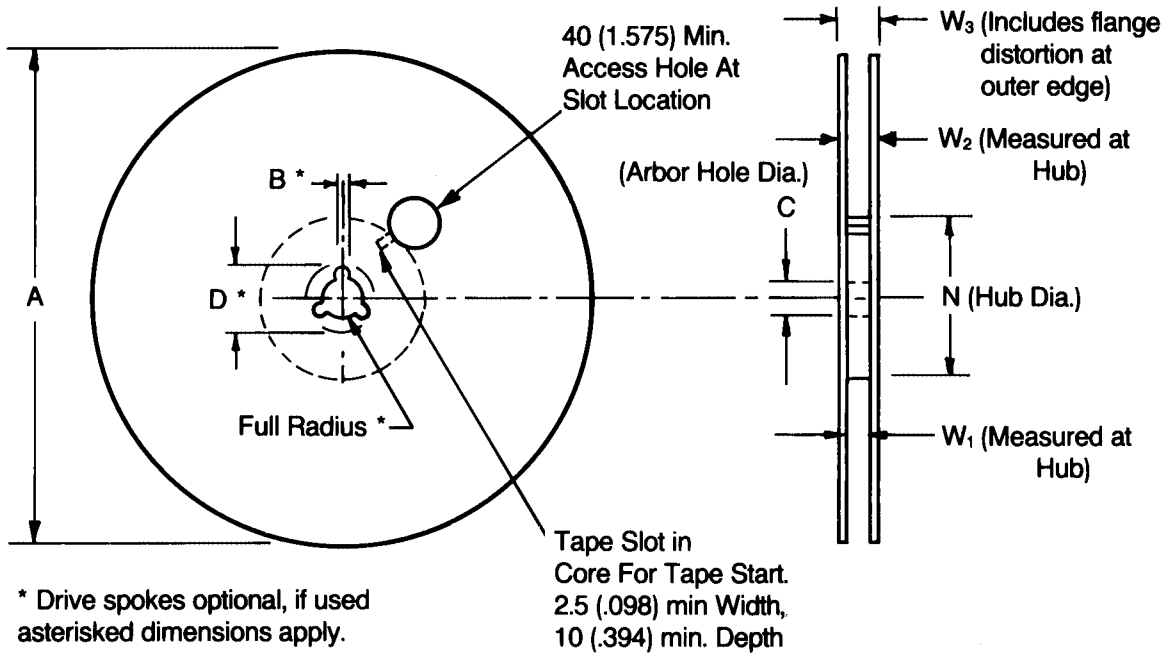
TAPE & REEL QUANTITIES

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

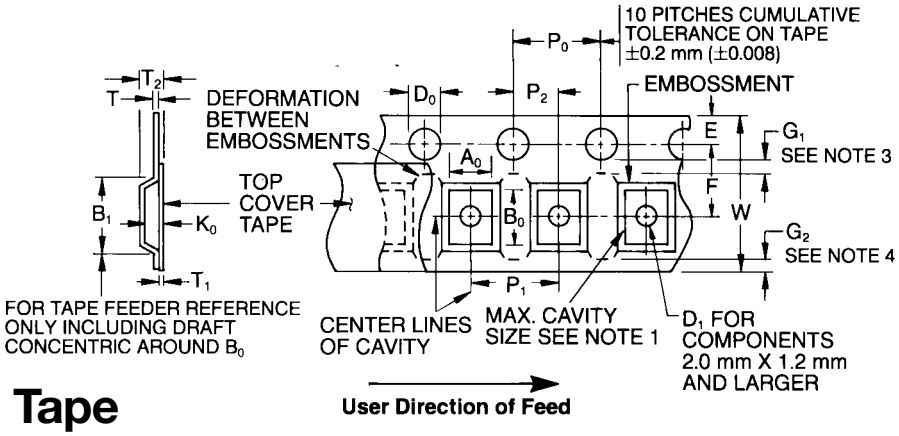


Tape Size(1)	A Max.	B* Min.	C	D* Min.	N Min.	W_1	W_2 Max.	W_3
8mm	330 (12.992)	1.5 (.059)	13.0±0.20 (.512±.008)	20.2 (.795)	50 (1.969)	$8.4^{+1.0}_{-0.0}$ ($.331^{+.060}_{-0.0}$)	14.4 (.567)	7.9 Min. (.311) 10.9 Max. (.429)
12mm						$12.4^{+2.0}_{-0.0}$ ($.488^{+.076}_{-0.0}$)	18.4 (.724)	11.9 Min. (.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

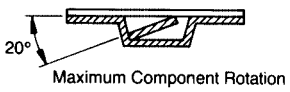
Tape Size	D_0	E	P_0	P_2	T Max.	T_1	G_1	G_2
8mm and 12mm	$8.4^{+0.10}_{-0.0}$ ($.059^{+.004}_{-0.0}$)	1.75 ± 0.10 (.069 ± .004)	4.0 ± 0.10 (.157 ± .004)	2.0 ± 0.05 (.079 ± .002)	0.600 (.024)	0.10 (.004) Max.	0.75 (.030) Min. See Note 3	0.75 (.030) Min. See Note 4

VARIABLE DIMENSIONS

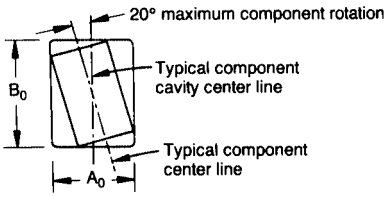
Tape Size	B_1 Max. See Note 6	D_1 Min. See Note 5	F	P_1	R Min. See Note 2	T_2	W	A_0 B_0 K_0
8mm	4.55 (.179)	1.0 (.039)	3.5 ± 0.05 (.138 ± .002)	4.0 ± 0.10 (.157 ± .004)	25 (.984)	2.5 Max (.098)	$8.0^{+0.3}_{-0.1}$ ($.315^{+.012}_{-.004}$)	See Note 1
12mm	8.2 (.323)	1.5 (.059)	5.5 ± 0.05 (.217 ± .002)	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)	$8.0^{+0.3}_{-0.1}$ ($.315^{+.012}_{-.004}$)	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:

1. A_0, B_0, and K_0 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 (A_0, B_0, and K_0) 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).
2. 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).
3. G_1 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.
4. G_2 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.
5. 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.
6. B_1 dimension is a reference dimension for tape feeder clearance only.



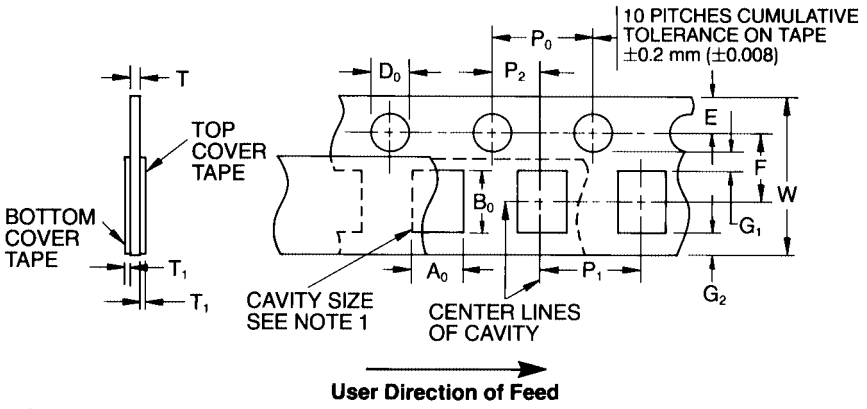
Side or Front Sectional View
Sketch "C"



Top View
Sketch "D"

Paper Carrier Configuration

8 & 12mm Tape Only



8 & 12mm Paper Tape Metric Dimensions Will Govern

CONSTANT DIMENSIONS

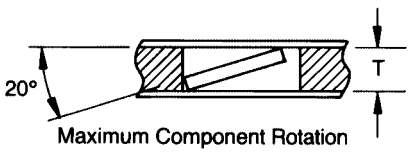
Tape Size	D_0	E	P_0	P_2	T_1	G_1	G_2	R MIN.
8mm and 12mm	$1.5^{+0.1}_{-0.0}$ ($.059^{+.004}_{-.000}$)	1.75 ± 0.10 (.069 ± .004)	4.0 ± 0.10 (.157 ± .004)	2.0 ± 0.05 (.079 ± .002)	0.10 (.004) Max.	0.75 (.030) Min.	0.75 (.030) Min.	25 (.984) See Note 2

VARIABLE DIMENSIONS

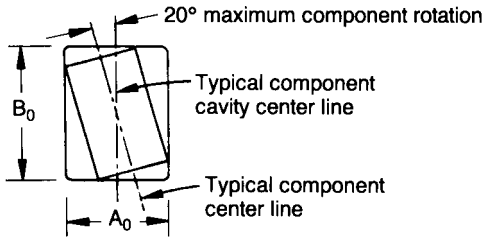
Tape Size	P_1	F	W	A_0 B_0	T
8mm	4.0 ± 0.10 (.157 ± .004)	3.5 ± 0.05 (.138 ± .002)	$8.0^{+0.3}_{-0.1}$ ($.315^{+.012}_{-.004}$)	See Note 1	See Note 3
12mm	4.0 ± .010 (.157 ± .004)	5.5 ± 0.05 (.217 ± .002)	12.0 ± 0.3 (.472 ± .012)		
8mm 1/2 Pitch	2.0 ± 0.10 (.079 ± .004)	3.5 ± 0.05 (.138 ± .002)	$8.0^{+0.3}_{-0.1}$ ($.315^{+.012}_{-.004}$)		
12mm Double Pitch	8.0 ± 0.10 (.315 ± .004)	5.5 ± 0.05 (.217 ± .002)	12.0 ± 0.3 (.472 ± .012)		

NOTES:

1. A_0, B_0, 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 (A_0, B_0, 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.



Side or Front Sectional View
Sketch "A"



Top View
Sketch "B"

Bar Code Labeling Standard

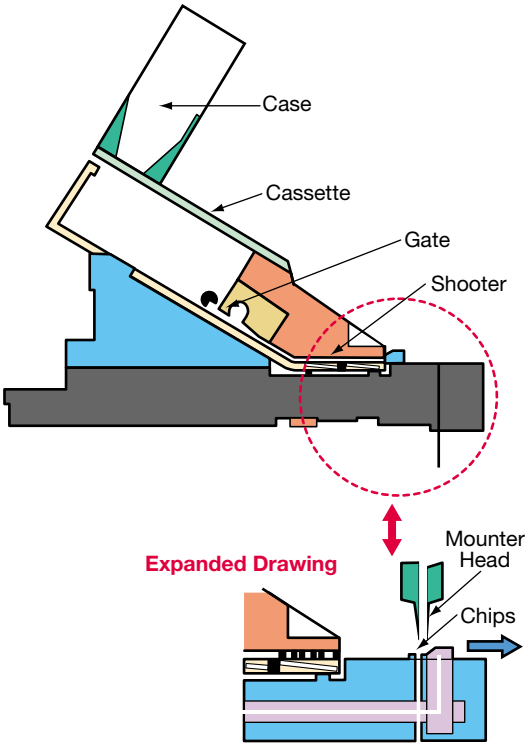
AVX bar code labeling is available and follows latest version of EIA-556-A.

Bulk Case Packaging

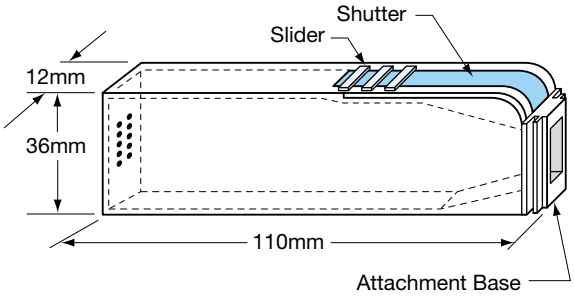
BENEFITS

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

BULK FEEDER



CASE DIMENSIONS



CASE QUANTITIES

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

USA

AVX Myrtle Beach, SC Corporate Offices
Tel: 843-448-9411
FAX: 843-626-5292

AVX Northwest, WA
Tel: 360-669-8746
FAX: 360-699-8751

AVX North Central, IN
Tel: 317-848-7153
FAX: 317-844-9314

AVX Mid/Pacific, MN
Tel: 952-974-9155
FAX: 952-974-9179

AVX Southwest, AZ
Tel: 480-539-1496
FAX: 480-539-1501

AVX South Central, TX
Tel: 972-669-1223
FAX: 972-669-2090

AVX Southeast, NC
Tel: 919-878-6357
FAX: 919-878-6462

AVX Canada
Tel: 905-564-8959
FAX: 905-564-9728

EUROPE

AVX Limited, England European Headquarters
Tel: ++44 (0)1252 770000
FAX: ++44 (0)1252 770001

AVX S.A., France
Tel: ++33 (1) 69.18.46.00
FAX: ++33 (1) 69.28.73.87

AVX GmbH, Germany - AVX
Tel: ++49 (0) 8131 9004-0
FAX: ++49 (0) 8131 9004-44

AVX GmbH, Germany - Elco
Tel: ++49 (0) 2741 2990
FAX: ++49 (0) 2741 299133

AVX srl, Italy
Tel: ++390 (0)2 614571
FAX: ++390 (0)2 614 2576

AVX Czech Republic, s.r.o.
Tel: ++420 (0)467 558340
FAX: ++420 (0)467 558345

ASIA-PACIFIC

AVX/Kyocera, Singapore Asia-Pacific Headquarters
Tel: (65) 258-2833
FAX: (65) 350-4880

AVX/Kyocera, Hong Kong
Tel: (852) 2-363-3303
FAX: (852) 2-765-8185

AVX/Kyocera, Korea
Tel: (82) 2-785-6504
FAX: (82) 2-784-5411

AVX/Kyocera, Taiwan
Tel: (886) 2-2696-4636
FAX: (886) 2-2696-4237

AVX/Kyocera, China
Tel: (86) 21-6249-0314-16
FAX: (86) 21-6249-0313

AVX/Kyocera, Malaysia
Tel: (60) 4-228-1190
FAX: (60) 4-228-1196

Elco, Japan
Tel: 045-943-2906/7
FAX: 045-943-2910

Kyocera, Japan - AVX
Tel: (81) 75-604-3426
FAX: (81) 75-604-3425

Kyocera, Japan - KDP
Tel: (81) 75-604-3424
FAX: (81) 75-604-3425

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