Introduction

Multilayer Surface Mount Ceramic Capacitors are constructed by screen printing alternative layers of internal metallic electrodes onto ceramic dielectric materials and firing into a concrete monolithic body, then completed by application of metal end terminations which are fired to assure permanent bonding with the individual internal electrodes.

Multilayer ceramic capacitors have various features such as large capacitance values in small sizes and excellent high frequency characteristics.

Moreover, chip capacitors can be used on surface mount assembly equipment. Our fully integrated manufacturing and total quality control systems ensure unprecedented high standards of quality and reliability.

Chip Capacitor Selection

Selection of the most suitable capacitor for any application is based on the following:

Dielectric Type

The choice of dielectric is largely determined by the temperature stability required.

COG (NPO)

Capacitance change with temperature is 0-30ppm/°C which is less than -0.3%°C from -55°C to +125°C. Typical capacitance change with life is less than -0.1% for NPOs, one-fifth that shown by most other dielectrics. NPO formulations show no aging characteristics.

X7R/X5R

Its temperature variation of capacitance is within $\pm 15\%$ from -55°C to +125°C (-55°C to +85°C for X5R). The capacitance change is non-linear.

Z5U

Despite their capacitance instability, Z5U formulations are very popular because of their small size, temperature range low ESL, low ESR and excellent frequency response. These features are particularly important for decoupling application where only a minimum capacitance value is required.

Y5V

Y5V formulations are for general purpose use in a limited temperature range. They have a wide temperature characteristic of +22% - 82% capacitance change over the operating temperature range of -30°C to +85°C. Y5Vs high dielectric constant allows the manufacture of very high capacitance values (up to 22MF) in small physical sizes.

Capacitance Value & Tolerance

Determined by circuit requirements. Note that chip prices decrease with lower capacitance value and looser tolerance.

Voltage

Determined by circuit requirements. Units are designed to exceed the withstanding voltage specification, i.e., the user need not incorporate an additional safety margin.

Capacitor Size

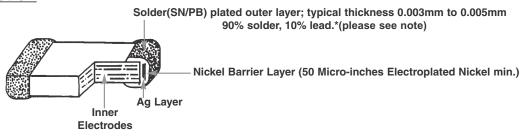
Select the smallest unit permitted by the circuit constraints that provides the required capacitance and voltage rating. All Cal-Chip capacitors conform to EIA specifications.

Capacitor Termination

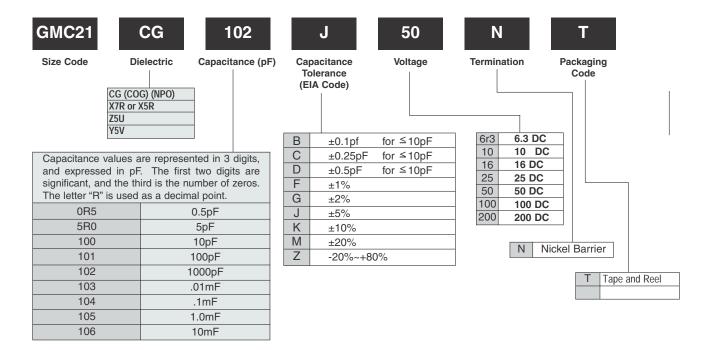
Termination choice is largely determined by the chip attachment method. Silver-palladium is adequate for most applications involving soldering or solder reflow.

Nickel barrier is standard and recommended for units exposed to repeated solder cycles, to minimize leaching of the termination.

Construction



Example



^{*}Note for Lead Free: Cal-Chip is beginning to phase in Lead-Free products. Upon checking availability with the factory, please specify "TLF" at the end of the part number, so the sales team knows you require lead-free product. When you receive the parts you will notice "LF" at the end of the Lot Code indicating the parts are lead-free.

0201

DIME	NSION (M	1M)		GM	C02			
	L							
V	N				0.03			
T(N	IAX)				0.03			
	W				± 0.05			
	ectric	NPO/COG	X5		<u>+ 0.03</u>	X7R		Y5V/Z5U
	Voltage		6.3	10	6.3	10	16	6.3
		25	0.3	10	0.3	10	10	0.3
0.5pF 1.0	Range 0R5 1R0							
1.2	1R2							
1.5 1.8	1R5 1R8							
2.2	2R2 2R7							
3.3	3R3 3R9							
4.7 5.6	4R7 5R6							
6.8	6R8							
8.2 10	8R2 100							
12 15	120 150							
18 22	180 220							
27	270 330 390							
33 39	390							
47 56	470 560							
68 82	680 820	-						
100 120	101 121							
150 180	151							
220 270	181 221 271							
330	331							
390 470	391 471							
560 680	561 681							
820 1.0nF	821 102							
1.2	122 152							
1.5 1.8	182						_	
2.2	222 272							
3.3	332 392							
4.7 5.6	472 562							
6.8 8.2	682 822							
10	103							
12 15	123 153							
18 22	183 223							
27 33	273 333							
39 47	393 473							
56	563 683							
68 82	823							
100 120	104 124							
150 180	154 184							
220 270	224 274							
330 390	334 394							
470	474							
560 680	564 684							
820 1.0uF	824 105							
2.2	225							

0402 & 0603

GMC04	GMC10
CHICOT	Civic 10

_		_															_						_		_						
Type	()	<u> </u>							402															060							
Length (L1	l) mm inches								±0.0													_		6±0							
		<u> </u>							±0.0													0	.06								
Width (W)	mm								±0.0															8±0							
	inches	<u> </u>					0		±0.0													0	.03								
Thickness									±0.															8±0							
	inches						0	.02	±0.0	04												0	.03	1±0	0.0	80					
Terminatio	n Band				Min							М	ax							M	in							Max			
(L2+L3)	mm				0.1							0.	35							0	.1							0.4			
	inches				0.00	4						0.0	014							0.0	04						C	.01	5		
Band Gap	(L4)mm).3															0.6							
(Min)	inches							0.	012														0	.01	15						
Diele	ectric	C	ЭG		X5R				X7R				Y5	V & .	Z5U			COC	}		X5R			X.	7R			Υ	5V &	Z5U	
Rated Vo	oltage d.c.	25	50	6.3	10	16	6.3	10	16	25	50	6.3	1		25		25	50	100	6.3	10	16 6.	3 10	0 1	16	25 50 ₁₀₀	6.	3 1	0 16	25	50
Cap Range	Code		1	1									1	1	1				1		· -	-				100) [_	1	
0.5pF 1.0 1.2	0R5 1R0 1R2																														
1.0	1R0 1R2	ш	Н														П		ш												
1.5	1R5																														
1.8 2.2	1R8 2R2	ш																	ш												
2.7	2R7	ш																	ш												
2.7 3.3 3.9	2R7 3R3 3R9																														
4.7	4R7																														
5.6 6.8	5R6 6R8																														
8.2	8R2 100 120																	I													
10 12	120																														
15	150 180		Н																ш												
18 22	220			1																											
27 33 39	270 330	4																	ш												
39	390	ш	ш															ш	ш												
47 56	470 560	ш	Н																ш												
68	680																														
82 100	820 101	4						-											ш					d	_						
100 120	121	ш	ш				ш	Т		1								ш	ш					ш							
150 180	151 181	ш	н					•											ш					П		_					
220	221																														
270 330 390	271 331			1																			Ш	Ш							
390	331 391		•					L																Ш							
470 560	471 561																							Ш							
560 680	681																							Ш							
820 1.0nF	821 102 122																							Ш							
1.2 1.5	122 152																	-						Ш							
1.5 1.8 2.2	182 222											_	-	-	-	_												ـ ا		1-	
2.2	222																							Ш							
2.7 3.3 3.9	272 332			1																				ш							
3.9 4.7	392 472			1																				Ш							
5.6	562							L				П	П	П	П									Ш							
6.8 8.2	682 822											П												Ш							
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12 15	123 153																							Ш							
18	183							I				П	П	П	ш									Ш			П				1
22 27	223 273																														
33 39	333 393																							Ш							
47	473																							Ш							
56 68	563 683																							Ш					ш		
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100 150	104 154																														
220	224																							ш							
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390	394							П				П	П							_				Ш						1	
470 560	474 564												Н											Ш							
680	684												Γ											Ш							
820 1.0uF	824 105																							Ш							
2.2	225				_		_	_				•								I			_	Τ'	-						
2.7 3.3	275 335																														
3.9	395																														
4.7 5.6	475 565																														
6.8	685																			I											
8.2 10	825 106																														
15	156																														
22 33	226 336																														
47	476																							Т							

COG/	NPO												
		GM	C21	GM	C31	GM	C32	GMC	40	GMC43	GMC45	GMC55	GMC57
Ту	/pe	30	305	12	206	1:	210	180	18	1812	1825	2220	2225
Length	mm		±0.3		±0.3		2±0.3	4.57±0		4.5±0.35	4.5±0.35	5.7±0.4	5.7±0.4
Width	Inches		±0.012 5±0.2		±0.012 ±0.2		5±0.012 5±0.3	0.18±0 2.03±0		0.18±0.014 3.2±0.3	0.18±0.014 6.3±0.4	0.225±0.016 5.0±0.4	0.225±0.016 6.3±0.4
vvidti	Inches		±0.008		±0.008		±0.012	0.08±0		0.125±0.012	0.25±0.016	0.197±0.016	0.25±0.016
Thickne	ess mm		.3		.6		1.8	2.0		1.8	1.8	1.8	1.8
Terminat	Inches tion Band	Min	051 Max	Min	063 Max	Min	0.07 Max	0.08 Min	Max	0.07 Min Max	0.07 Min Max	0.07 Min Max	0.07 Min Max
	mm	0.25	0.75	0.25	0.75	0.25	0.75	0.25	0.75	0.25 0.75	0.25 0.75	0.25 0.75	0.25 0.75
Band G	Inches Sap mm	0.01	0.03	0.01	.4	0.01	0.03 1.4	0.01	0.03	0.01 0.03 2.2	0.01 0.03 2.2	0.01 0.03 2.9	0.01 0.03 2.9
	İnches	0.	019	0.0	055	0.	.055	0.07	'8	0.087	0.087	0.114	0.114
Rated Vo	Oltage d.c.	16	25 50	25	50	16	25 50/63	50/6	3	50/63	50/63	50/63	50/63
0.5pF	0R5			_									
1.0 1.2	1R0 1R2												
1.5 1.8	1R5 1R8												
2.2 2.7	2R2 2R7												
3.3 3.9	3R3 3R9												
4.7 5.6	4R7 5R6												
6.8 8.0	6R8 8R0												
10 12	100 120												
15 18	150 180												
22	220												
27 33	270 330												
39 47	390 470												
56 68	560 680												
82 100	820 101												
120 150	121 151												
180 220	181 221												
270 330	271 331						ш						
390 470	391 471	_				ш							
560	561						ш						
680 820	681 821	_				_							
1.0nF 1.2	102 122												
1.5 1.8	152 182												
2.2 2.7	222 272												
3.3 3.9	332 392												
4.7 5.6	472 562												
6.8 8.2	682 822												
10 12	103 123												
15 18	153 183				_								
22 27	223 273												
33 39	333 393												
47	473												
56 68	563 683												
82 100	823 104												
120 150	124 154												•
180 220	184 224												
270 330	274 334												
390 470	394 474												
560 680	564 684												
820 1.0uF	824 105												
2.2	225												
3.3 4.7	335 475												
6.8 10	685 106												
22 33	226 336												
47 100	476 107												
	L			l						L			

Multilayer Ceramic Chip Capacitors COG/NPO (cont.)

COG/	NPO												_				_
		GMC	221	GM	C31	GM	C32	GM	C40	GM	C43	GM	C45	GM	C55	GM	C57
	ре		05		206		10		808		12		25		20		25
Length	mm hes	-	±0.3 :0.012		±0.3 ±0.012	-	±0.3 ±0.012		±0.25 ±0.01		0.35 0.014		0.35 0.014		±0.4 ±0.016		±0.4 ±0.016
Width	mm	1.25	±0.2	1.6	±0.2	2.5	±0.3	2.03:	±0.25	3.2	±0.3	6.3	±0.4	5.0	±0.4	6.3	±0.4
	hes ess mm		.3		±0.008		0.012		±0.01 03		±0.012 .8		.0.016 .8		±0.016 .8	0.25±	0.016 .8
Incl	hes	0.0	051	0.	063	0.	07	0.	08	0.	07	0.	07	0.	07	0.	07
	tion Band im	Min 0.25	Max 0.75 Min 0.25	Max 0.75	Min 0.25	Max 0.75	Min 0.25	Max 0.75									
Incl	hes	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03
	ap mm hes		.5)19		.4 055		.4)55		.0 078		.2)87		.2)87		.9 114		.9 14
Rated Vo	ltage d.c.	100	200	100	200	100		100	200	100	200	100	200	100	200	100	200
Cap. Range 0.5pF	Code 0R5		T =			1	1	1				1					
1.0	1R0 1R2																
1.5	1R5 1R8																
2.2 2.7	2R2 2R7																
3.3	3R3 3R9																
4.7 5.6	4R7 5R6																
6.8 8.2	6R8 8R2																
10 12	100													ı			1
15 18	150 180																
22 27	220 270																
33 39	330 390																
47 56	470 560																
68 82	680 820																
100 120	101 121																
150 180	151 181											_	_				
220 270	221 271																
330 390	331 391																
470 560	471 561																
680 820	681 821		•														
1.0nF 1.2	102 122																
1.5 1.8	152 182	_															
2.2	222 272																
3.3 3.9	332 392																
4.7 5.6	472 562																
6.8 8.2	682 822						-		_								
10 12	103 123																
15 18	153 183							_									
22 27	223 273																
33 39	333 393														•		
47 56	473 563																
68 82	683 823																
100 120	104 124																
150 180	154 184																
220 270	224 274																
330 390	334 394																
470 560	474 564																
680 820	684 824																
1.0uF 2.2	105 225																
3.3 4.7	335 475																
6.8	685																
10 22	106 226																
33 47	336 476																
68 100	686 107																

X7R																				
		G	MC2	1	GN	IC31	G	MC32	2	GMC	40	GN	MC43	GMC4	45	G	MC55	G	MC57	
Туре			0805		1	206		1210		18	08		1812	182	5	2	2220	T	2225	П
Length	mm		2.0±0.3			2±0.3		3.2±0.3		4.57±			5±0.35	4.5±0			.7±0.4		5.7±0.4	
Width	Inches mm		08±0.0			5±0.012 6±0.2		25±0.0° 2.5±0.3	12	0.18± 2.03±			8±0.014 .2±0.3	0.18±0 6.3±0			25±0.016 .0±0.4	_	25±0.01 6.3±0.4	6
	Inches		05±0.0			0±0.2 3±0.008		0±0.01	2	2.03± 0.08±		-	.2±0.3 25±0.012	0.25±0			.u±u.4 97±0.016		5.3±0.4 25±0.016	6
Thickness			1.5			1.8		2.8		3.			3.0	3.2			3.5		3.5	
Terminati	Inches	Mir	0.059	lax	Min	0.071 Max	Mir	<u>0.110</u> n I м	ах	0.1 Min	18 Max	Min	0.118 Max	0.12 Min	6 Max	Mir	0.138 n Max	_	0.138 n Ma:	
Terriiriau	mm	0.2		.75	0.25	0.75	0.2		75	0.25	0.75	0.25		0.25	0.75	0.2				
	Inches	0.0		.03	0.01		0.0		03	0.01	0.03	0.01		0.01	0.03	0.0		0.0		3
Band Gar	p mm Inches		0.5 0.019		(1.4 .055		1.4 0.055		2. 0.0			2.2 0.087	2.2 0.08		١.,	2.9 0.114		2.9 0.114	
Rated Vo	ltage d.c.	6.3	10 16	25		0 16 2			25	10 1		10	16 25	10 16		10	16 25			25
Cap. Range 0.5pF	Code 0R5	<u> </u>		1									1	1 1	1					
1.0	1R0																			
1.2 1.5	1R2 1R5																			
1.8 2.2	1R8 2R2																			
2.7 3.3	2R7 3R3																			
3.9	3R9																			
4.7 5.6	4R7 5R6																			
6.8 8.2	6R8 8R2																			
10	100																			
12 15	120 150																			
18 22	180 220																			
27 33	270 330																			
39	390																			
47 56	470 560																			
68 82	680 820																			
100 120	101 121			l .																
150	151		ш	ш																
180 220	181 221		ш	ш																
270 330	271 331		ш	н																
390 470	391 471		ш	ш			1_		_	_	_									
560	561	ш	ш	ш			ш		ш		ш				ш					
680 820	681 821		ш	ш					ш			_								
1.0nF 1.2	102 122		ш	Н																
1.5 1.8	152 182		ш	Ш																
2.2	222																			
2.7 3.3	272 332		•	ш																
3.9 4.7	392 472			н									_							L
5.6 6.8	562 682		ш																	L
8.2	822		ш	П					П											
10 12	103 123																			
15 18	153 183																			
22 27	223 273																			
33	333 393														-					
39 47	473																			
56 68	563 683																			
82 100	823 104																			
120	124			П																
150 180	154 184			П																
220 270	224 274																			
330 390	334 394																			
470	474																			
560 680	564 684																			
820 1.0uF	824 105																			
2.2	225 335								П	• •										Г
3.3 4.7	475																			
6.8 10	685 106																			
22 33	226 336	-				-			-				- -					1		
47	476																			
68 100	686 107																			

Multilayer Ceramic Chip Capacitors
X7R (cont)

A/K (COIIL)	GMC21	GMC31	GMC32	GMC40	GMC43	GMC45	GMC55	GMC57
Туре		0805	1206	1210	1808	1812	1825	2220	2225
Length	mm	2.0±0.3	3.2±0.3	3.2±0.3	4.57±0.25	4.5±0.35	4.5±0.35	5.7±0.4	5.7±0.4
Width	Inches mm	0.08±0.012 1.25±0.2	0.125±0.012 1.6±0.2	0.125±0.012 2.5±0.3	0.18±0.01 2.03±0.25	0.18±0.014 3.2±0.3	0.18±0.014 6.3±0.4	0.225±0.016 5.0±0.4	0.225±0.016 6.3±0.4
	mm Inches	1.25±0.2 0.05±0.008	0.063±0.008	2.5±0.3 0.10±0.012	2.03±0.25 0.08±0.01	3.2±0.3 0.125±0.012	6.3±0.4 0.25±0.016	5.0±0.4 0.197±0.016	6.3±0.4 0.25±0.016
Thickness		1.5	1.8	2.8	3.0	3.0	3.0	3.5	3.5
Termination	Inches on Band	0.051 Min Max	0.063 Min Max	0.07 Min Max	0.08 Min Max	0.07 Min Max	0.07 Min Max	0.07 Min Max	0.07 Min Max
	mm	0.25 0.75	0.25 0.75	0.25 0.75	0.25 0.75	0.25 0.75	0.25 0.75	0.25 0.75	0.25 0.75
Band Gar	Inches mm	0.01 0.03	0.01 0.03	0.01 0.03 1.4	0.01 0.03 2.0	0.01 0.03 2.2	0.01 0.03 2.2	0.01 0.03 2.9	0.01 0.03 2.9
	Inches	0.019	0.055	0.055	0.078	0.087	0.087	0.114	0.114
Rated Vol Cap. Range	Itage d.c.	50 100 200	50 100 200	50 100 200	50 100 200	50 100 200	50 100 200	50 100 200	50 100 200
0.5pF	0R5								
1.0 1.2	1R0 1R2								
1.5 1.8	1R5 1R8								
2.2	2R2 2R7								
3.3	3R3								
3.9 4.7	3R9 4R7								
5.6 6.8	5R6 6R8								
8.2	8R2								
10 12	100 120								
15 18	150 180								
22 27	220 270								
33	330								
39 47	390 470								
56 68	560 680								
82 100	820 101								
120	121								
150 180	151 181								
220 270	221 271								
330 390	331 391								
470 560	471 561								
680	681								
820 1.0nF	821 102								
1.2 1.5	122 152								
1.8	182 222								
2.7	272								
3.3 3.9	332 392								
4.7 5.6	472 562								
6.8 8.2	682 822								
10 12	103 123								
15	153								
18 22	183 223								
27 33	273 333								
39 47	393 473								
56	563								
68 82	683 823								
100 120	104 124								
150 180	154 184								
220	224			▎▊▏▊▎▘			▎▊▏▊▏▊		
270 330	274 334								
390 470	394 474								
560 680	564 684								
820	824								
1.0uF 2.2	105 225								
3.3 4.7	335 475								
6.8	685								
10 22	106 226								

YOK																			
		GN	IC21	(GMC	31	GMC3	2	GM	C40	GN	VIC4	3	GM	C45	GM	C55	GM	C57
Туре		n	805		1206	3	1210)	18	08		1812)	18	25	22	220	22	225
Length	mm		0±0.3		3.2±0.		3.2±0.			±0.25		5±0.3		4.5±			±0.4		±0.4
	Inches		±0.012	2 0.	125±0.		0.125±0.			±0.01		8±0.0		0.18±			±0.016		±0.016
Width	mm Inches		25±0.2		1.6±0.		2.5±0.			±0.25		.2±0.:		6.3± 0.25±			±0.4		±0.4
Thickness			±0.008 1.5	0.	063±0. 1.8	008	0.10±0.0 2.8	112		±0.01 .0	0.12	25±0.0 3.0	012	0.25±			±0.016		±0.016 5.5
	Inches	0	.059		0.070)	0.110		0.1	18		0.118	3	0.1		0.	138	0.	138
Terminati		Min	Ma			Max		Max	Min	Max	Mir		Max	Min	Max	Min	Max	Min	Max
	mm Inches	0.25 0.01	0.7).75).03		0.75 0.03	0.25 0.01	0.75 0.03	0.25).75).03	0.25 0.01	0.75 0.03	0.25	0.75 0.03	0.25	0.75 0.03
Band Gap	o mm		0.5		1.4		1.4		2.	.0		2.2		2.	2	2	2.9	2	1.9
	Inches		.019	0.0	0.055		0.055			78		0.087		0.0			114		114
Rated Vo Cap. Range		6.3	10 1	6.3	10 16	25	6.3 10/16	25	N.	/A	6.3	10	16	N/	A	I N	I/A	I N	I/A
0.5pF	0R5																		
1.0 1.2	1R0 1R2																		
1.5 1.8	1R5 1R8																		
2.2	2R2																		
2.7 3.3	2R7 3R3																		
3.9	3R9																		
4.7 5.6	4R7 5R6																		
6.8 8.2	6R8 8R2																		
10	100																		
12 15	120 150																		
18 22	180 220																		
27 33	270 330																		
39	390																		
47 56	470 560																		
68 82	680 820																		
100	101																		
120 150	121 151																		
180 220	181 221																		
270	271																		
330 390	331 391																		
470 560	471 561																		
680	681																		
820 1.0nF	821 102																		
1.2 1.5	122 152																		
1.8 2.2	182 222																		
2.7	272																		
3.3 3.9	332 392																		
4.7 5.6	472 562																		
6.8	682																		
8.2 10	822 103																		
12 15	123 153																		
18	183																		
22 27	223 273																		
33 39	333 393																		
47	473																		
56 68	563 683																		
82 100	823 104																		
120	124																		
150 180	154 184																		
220 270	224 274																		
330	334																		
390 470	394 474																		
560 680	564 684																		
820	824																		
1.0uF 2.2	105 225				. .	-													
3.3 4.7	335 475																		
6.8	685																		
10 22	106 226																		
33 47	336 476												-						
100	107																		

150/2	-30	c	3M	C2	1	c	M	C3 [,]	1	G	M	232	2	(3M	C4	0	c	M	C43	3	G	MC	245	;	G	М	C5!	5	c	M	C57	7
Туре				305				206				10				308				12				25		Ī		220			22		
Length	mm Inches	^	2.0	±0.3		^	3.2	±0.3		^	3.2	±0.3			4.57	±0.2			4.5±	0.35			4.5±	0.35			5.7	±0.4		^	5.7±	<u></u> 0.4	
Width	mm			0.01 ±0.2		U.		±0.0 ±0.2		0.	125: 2.5:	±0.0 ±0.3		_		±0.0 ±0.2		U	.18±	±0.0			6.3±	0.01 ±0.4	4	0.		±0.0 ±0.4		0.	225± 6.3±		10
Thickness	Inches	0		0.00 .5	8	0.		±0.00	80	0	±10.	0.0°	12			±0.0	1	0.	125:	±0.0 .0	12	0.		0.01 .2	6	0.		±0.0	16	0	.25±		6
	Inches		0.0	059			0.	07				110				118			0.1	118			0.1	26			0.	138			0.1	38	
Termination	on Band mm	0.2	in 25		ax 75	M 0.:		Ma 0.7			lin 25		lax .75		1in .25		ах 75		lin 25		ах 75	M 0.:	in 25	0.	ах 75		lin 25		ах 75		lin 25	M: 0.	
	Inches		01	0.	03		01	0.0			01	0	.03		.01	0.	03		01	0.	03		01	0.			01	0.	03		01	0.0	
Band Gap	mm Inches).5)19				.4)55				.4)55				2.0 078				.2)87			0.0					9 114			2. 0.1		
Rated Vol		6.3	10	16	25	6.3	10	16	25	6.3	10	16	25/35	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. Range 0.5pF	Code 0R5																																
1.0	1R0 1R2																																
1.5 1.8	1R5 1R8																																
2.2	2R2 2R7																																
3.3	3R3 3R9																																
4.7 5.6	4R7 5R6																																
6.8 8.2	6R8 8R2																																
10 12	100 120																																
15 18	150 180																																
22 27	220 270																																
33 39	330 390																																
47 56	470 560																																
68 82	680 820																																
100 120	101 121																																
150 180	151 181																																
220 270	221 271																																
330 390	331 391																																
470 560	471 561																																
680 820	681 821																																
1.0nF	102																																
1.2	122 152																																
1.8	182 222																																
2.7 3.3	272 332																																
3.9 4.7	392 472																																
5.6 6.8	562 682																																
8.2 10	822 103																																
12 15	123 153				I									ı	ı																		
18 22	183 223																																
27 33	273 333														ı																		
39 47	393 473													ı	ı	ı			-														
56 68	563 683						ı			ı	I	I		I	ı	ı	I	ı															
82 100	823 104						I					I		I	I	I	I	ı	I							I	ı			ı			ı
120 150	124 154		I				I		I	I	I	I	ı	I	ı	ı	I	I	I	I		_		_	_	ı	I		I	ı		I	I
180 220	184 224		ı				ı			ı	I	I		ı	ı	I	ı		I	ı			I		ı	ı	ı		ı	ı			1
270 330	274 334				П		I		ı	I	I	I	ı	I	ı	I	I	I	I		I		I	I	I	I	ı	I	I	ı			I
390 470	394 474		ı				I		I	ı	ı	I	I	I	ı	I	ı	I	I	ı	I		I		I	ı	I	I	ı	ı		I	I
560 680	564 684				П		ı		ı			I	ı	ı	ı	1	ı		ı	١	ı				ı	ı	ı		ı	۱			1
820 1.0uF	824 105		I		П		I		I	ı	ı	I	ı	I	1	1	1	I	I	ı	I		I	ı	ı	ı	I	I	ı	ı		I	ı
2.2	225						1			1	I			•	1	1	ı	I	1	1	1				1	1	ı		1	1		ı	1
3.3 4.7	335 475		ı				ı			ı	ı	ı	ı					I	ı	ı	ı		I		1			•		ı			ı
6.8	685 106						ı	_		ı	ı	ı	ı					ı	ı	ı	-		I	ı	•								
22 33	226 336									ı	ı	ı						I	ı			_											
47 68	476 686																	ı															
100	107																																
			_	_		_	_	_		_	_	_		_	_		_	_							_	_	_	_	_	_			_

Multilayer Ceramic Chip Capacitors
Y5V/Z5U (cont)

150/2	.30 (C		<i>)</i> ИС2	21	GN	C31	GM	C32	G	MC	40	GI	MC4	13	GI	/IC4	5	GN	/IC5	55	GN	/IC5	7
Туре		(0805	;	1:	206	12	10		1808	3		1812	2		1825	5	:	2220)		2225	5
Length	mm Inches	2.	0±0.	3	3.2	2±0.3	3.2	±0.3 ±0.012		57±0	.25	4.	.5±0.3	35	4.	5±0.3 8±0.0	35	5	.7±0	.4	5	5.7±0. 25±0.	4
Width	mm		8±0.0 25±0			5±0.012 5±0.2	2.5	±0.3		18±0 03±0			8±0.0 3.2±0.			.3±0.			.0±0	.016		25±0. 3.3±0.	
I	Inches	0.0	5±0.0	800		8±0.008		0.012	0.	08±0	.01	0.12	25±0.	012	0.2	5±0.0	016	0.19	97±0	.016	0.2	25±0.0)16
Thickness I	s mm Inches	(1.5 0.059			1.8 .07		.8 I 10		3.0	3		3.0 0.118	3		3.2 0.126	3		3.5 0.138	3		3.5 0.138	;
Termination	on Band	Min		Max	Min	Max	Min	Max	Mi		Max	Mir		Max	Mir		Max	Mir	ı I	Max	Mir		Лах
	mm Inches	0.25 0.01).75).03	0.25 0.01	0.75 0.03	0.25 0.01	0.75 0.03	0.2		0.75 0.03	0.2		0.75 0.03	0.2		0.75 0.03	0.2		0.75 0.03	0.2).75).03
Band Gap			0.5			1.4 055		.4)55		2.0	,		2.2	,		2.2	,		2.9	1		2.9	
Rated Vol	Inches Itage d.c.		0.019 100			00 200		00 200	50	100	200		0.087 100			0.087 100	200		0.11 <u>4</u> 100	200		0.114 100	
Cap. Range	Code 0R5									1	1	1									1		
0.5pF 1.0 1.2	1R0 1R2																						
1.5	1R5																						
1.8 2.2	1R8 2R2																						
2.7 3.3	2R7 3R3																						
3.9 4.7	3R9 4R7																						
5.6 6.8	5R6 6R8																						
8.2 10	8R2 100																						
12	120																						
15 18	150 180																						
22 27	220 270																						
33 39	330 390																						
47 56	470 560																						
68 82	680 820																						
100	101																						
120 150	121 151																						
180 220	181 221																						
270 330	271 331																						
390 470	391 471																						
560 680	561 681																						
820	821																						
1.0nF 1.2	102 122																						
1.5 1.8	152 182																						
2.2 2.7	222 272																						
3.3 3.9	332 392																						
4.7 5.6	472 562																						
6.8 8.2	682 822																						
10	103																						
12 15	123 153																						
18 22	183 223														_	_							
27 33	273 333														1	П							
39 47	393 473												_										
56 68	563 683							Ш															
82 100	823 104															1				ı			
120	124							Ш												ı			
150 180	154 184																						
220 270	224 274																						
330 390	334 394																						
470 560	474 564																						
680 820	684 824																						
1.0uF	105															_							
2.2 3.3	225 335																			_			-
4.7 6.8	475 685																						
10	106 226																						
33 47	336 476																						
68	686																						
100	107																						

COG Dielectric

Ultra stable class I dielectric: linear temperature coefficient, low loss, negligible change of electrical properties with time, voltage and frequency.

Operating Temperature Range	Temperature Coefficient	Temperature Voltage Coefficient (∆cMax @ VDCW)	Dissipation Factor	Insulation Resistance	Dielectric withstanding Voltage	Aging Rate	Test Parameters
-55°C to +125°C	0±30ppm°C	0±30ppm/°C	0.1% Max, 0.02% Typical	$ \begin{tabular}{ll} \bullet 25^{\circ}C, VDCW: \\ > 100G\Omega F \ or \\ 1000\Omega F, \\ whichever is less \\ \bullet 125^{\circ}C, VDCW: \\ > 10G\Omega F \ or \\ 100\Omega F \\ whichever is less \\ \end{tabular} $	3 X VDCW	0% per decade hour	• C≤1000pF f=1MHz V=1.0Vrms ±0.2Vrms T=25°C • C>1000pF f=1KHz V=1.0Vrms ±0.2Vrms T=25°C

X7R Dielectric

Stable class II dielectric (EIA X7R)

Operating Temperature Range	Temperature Coefficient	Temperature Voltage Coefficient (∆cMax @ VDCW)	Dissipation Factor	Insulation Resistance	Dielectric withstanding Voltage	Aging Rate	Test Parameters
-55°C to +125°C	±15%	X7R Not Applicable	2.5% Max, 1.8% Typical	$ \begin{tabular}{ll} \bullet 25^{\circ}C, VDCW:: \\ > 100G\Omega For \\ 1000\Omega F, \\ whichever is less \\ \bullet 125^{\circ}C, VDCW: \\ > 10G\Omega F \ or \\ 100\Omega F \\ whichever is less \\ \end{tabular} $	2.5 X VDCW	<2% per decade hour	1KHz, 1.0Vrms ±0.2Vrms 25°C values > or = to 10uF 1.0Vrms 120Hz

Unit:mm

Unit:mm

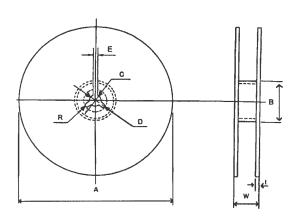
Multilayer Ceramic Chip Capacitors - Z5U (Y5V) Dielectric

High capacitance per unit volume: general purpose product

Operating Temperature Range	Temperature Coefficient	Dissipation Factor	Insulation Resistance	Dielectric withstanding Voltage	Aging Rate	Test Parameters
-30°C to +85°C	+22% -82%	3.0% Max, 2.0% Typical	10GΩ or $100ΩF$ whichever is less, $25°C$, VDCW	2.5 X VDCW	3.0% per decade hour	1KHz, 1Vrms 25℃ values > or = to 10uF 1.0Vrms 120Hz

Packaging (Taping)

(Reel Type-Size)



Standard	Reel
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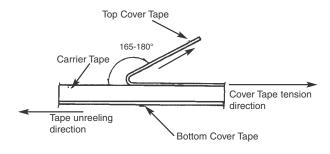
А	В	С	D	Е	W	t	R
ø178	ø50	ø13.0	ø21.0	2.0	14.9	0.8	1.0
±2.0	min.	±0.5	±0.8	±0.5	±1.5	±0.2	

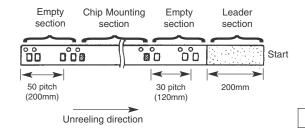
10000 units per reel OPTIONAL

А	В	С	D	Е	W	t	R
ø250	ø50	ø13.0	ø21.0	2.0	10.0	0.8	1.0
±2.0	min.	±0.5	±0.8	±0.5	±1.5	±0.2	

Carrier Tape (Standard)

- To peel off the cover tape by the method shown in the right figure apply a peel-off force of 20 gf 60 gf (card board); 35 gf 75 gf (plastic tape).
- The cover tape should not touch the top or bottom of the chip.
- If the cover tape has been peeled off it may be difficult to remove the chip due to punch-hole clearance, dirt, and debris. Make sure therefore that no paper waste will adhere to and block the absorption nozzle.
- If the cover tape has been peeled off from the top, stick it back on with a suitable adhesive.
- Follow the illustration for the start and end of the winding operation.





• Cardboard carrier tape for 0402, 0603 type and 0805/1206 type

Unit: mm

Type A	B W	F E	P ₁	Po Do	t1 t2							Mounting Hole	Quantity per Reel
0402	0.7±0.2	1.3±0.2				2.0±0.05							10000
0603	1.1±0.2	1.9±0.2										Angular	4000
0805	1.65±0.2	2.4±0.2	8.0±0.3	3.5±0.05	1.75±0.1	4.0±0.1	2.0±0.05	4.0±0.1	ø1.5 ^{+0.1}	1.1 max	1.4 max	Punch Hole	4000 to 5000*
1206	2.0±0.2								-0				4000 to 5000*

*Dependent on chip thickness

• Embossed plastic carrier tape for 0805/1206 type and 1210 type

Unit: mm

Туре	Α	В	W	F	E	P ₁	P ₂	P ₀	D ₀	t1	t2	Mounting Hole	Quantity per Reel
0805	1.45±0.2	2.3±0.2										Angular	2000 to 5000*
1206	2.0±0.2	3.6±0.2	8.0±0.3	3.5±0.05	1.75±0.1	4.0±0.1	2.0±0.05	4.0±0.1	ø1.5 ^{+0.1}	0.6 max	2.5 max	Embossed	2000 to 5000*
1210	2.9±0.2	3.6±0.2							-0			Hole	2000 to 4000*

*Dependent on chip thickness

• Embossed plastic carrier tape for 1812, 1825, 2220 and 2225 type

Unit: mm

Туре	Α	В	W	F	E	P ₁	P ₂	P ₀	D ₀	t1	t2	Mounting Hole	Quantity per Reel
1812	3.6±0.2	4.9±0.2										Angular	1000
1825	6.8±0.3	4.9±0.2	12.0±0.3	5.5±0.05	1.75±0.1	8.0±0.1	2.0±0.05	4.0±0.1	ø1.5±0.			Embossed	1000
2220	5.5±0.3	6.2±0.3							1	0.6 max.	6.5 max.	Hole	1000
2225	6.8±0.3	6.2±0.3										1000	1000

*Dependent on chip thickness

Tape and Reel Packing Quantities

Chip Size	178 mm (7") Reel	330 mm (13") Reel			
0402	10,000	N/A			
0603	4,000	16,000			
0805	4,000	12,000			
1206	4,000	15,000			
1210	2,000 , 4,000	8,000			
1812	1,000	4,000			
1825	1,000	4,000			
2220	1,000	4,000			
2225	1,000	4,000			

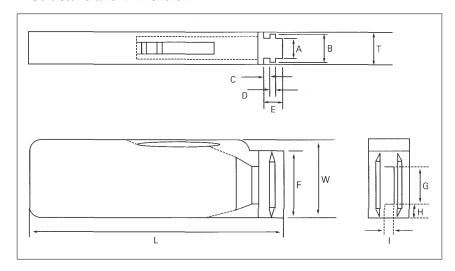
The tape and reel packing quantities apply to voltages up to 200V rating only.

The 0402 and 0603 size chips have similar width and thickness dimensions.

BULK CASE

- Bulk case packaging can reduce the stock space and transportation costs.
- The bulk feeding system can increase the productivity.
- It can eliminate the components loss.

• Structure and Dimension



Symbol	Α	В	Т	С	D	E
Dimension	6.8±0.1	8.8±0.1	12±0.1	1.5 ^{+0.1} ,	2 ⁺⁰ , -0.1	4.7±0.1

Symbol	F	W	G	Н	L	1
Dimension	31.5 ^{+0.2} ,	36 ⁺⁰ . -0.2	19±0.35	7±0.35	110±0.7	5±0.35

• Quantity

Size	04(0402)	10(0603)	21(0805)		
Oize	04(0402)	10(0000)	T≤0.85mm	T≥1.0mm	
Quantity	80,000	15,000	10,000	5,000	

RELIABILITY AND TEST CONDITIONS

Item		Specification	Test Method
Capacitance		Within tolerance shown by part number code	• Class (I) C<1000pF:1MHz±10%, 0.5 to 5Vrms
Dissipation Factor (tanδ or Q)	r	• Class (I) C<30pF:Q≥400+20xC C≥30pF:Q≥1000 • Class (II) X7R:DF≤2.5% Y5V/Z5U:DF≤3.0%	0.5 to 5Vms C≥1000pF:1KHz±10%, 1.0±0.2Vrms • Class (II) 1KHz±10%, 1.0±0.2Vrms values > or = to 10uF 1.0Vrms 120Hz
Insulation Resistance(IR)		NPO–XR7: C≤50,000pF: IR≥100GΩ C>50,000pF: IR≥500MΩ. Per Uf. Y5V/Z5U: IR≥10GΩ	Apply rated voltage for 60 seconds at room temperature and normal humidity. (70% RH max)
Dielectric Withstanding Voltage		There shall be no evidence of damage or flash over during the test	Apply 3 x rated voltage (Class I) or 2.5 x rated voltage (Class II) to both terminations for 5 seconds. Charge and discharge current are less than 50mA.
Termination Adherence		No mechanical damage	Care shall be taken to avoid thermal shock. 500g of steady pull is applied in direction of arrow for 1 minute.
Bend Strength		No mechanical damage	After soldering capacitor on the glass-epoxy PWB, 2 mm of vending shall be applied for 10 seconds as shown by drawing. Load Soldered 90mm
Life Test (High Temperature Loading Test)		Class (I) No more than ±3% or ±0.3pF whichever is less Class (II) X7R:±10% max Y5V/Z5U:±30% max	Applied 2 x rated voltage at maximum operating temperature for 1000 hours. The surge current shall not exceed 50mA after above testing condition, test samples shall be kept in room temperature for 24 hours (Class I) or
	Q or DF	• Class (I) C<10pF:Q>200+10xC 10≤C<30pF:Q≥275+5/2xC C≥30pF:Q≥350 • Class (II) X7R:DF≤5.0% Y5V/Z5U:DF≤7.5%	48 hours (Class II), and then shall be measured.
	IR	1000M Ω or 50 Ω F, min whichever is less	

RELIABILITY AND TEST CONDITIONS

Item		Specification	Test Method	
Moisture Test	ΔC Q or DF	Class (I) No more than ±5% or ±0.5pF whichever is larger Class (II) X7R:±10% Y5V/Z5U:±30% Class (I) C<10pF:Q>200+10xC 10≤C<30pF:Q≥275+5/2xC C≥30pF:Q≥350 Class (II) X7R:DF≤5.0% Y5V/Z5U:DF≤7.5% 1000MΩ or 50ΩF, whichever is less	The capacitors shall be subjected to 40°C, 90-95%RH for 500 hours. After above testing condition, samples shall be kept in room temperature for 24 hours (Class I) or 48 hours (Class II), and then shall be measured.	
Moisture Resistance Test	ΔC	• Class (I) No more than ±7.5% or ±0.75pF whichever is larger • Class (II) X7R:±10% Y5V/Z5U:±30% • Class (I)	Apply rated voltage at 40°C, 90-95%RH for 500 hours. The surge current shall not exceed 50mA. After testing with above condition,	
	Q or DF	C<30pF:Q>100+100/3xC C≥30pF:Q≥200 • Class (II) X7R:DF≤5.0% Y5V/Z5U:DF≤7.5% 500MΩ or 25ΩF, min whichever is less	samples shall be kept in room temperature for 24 hours (Class I) or 48 hours (Class II), and then shall be measured.	
Temperature Cycle	ΔC	• Class (I) No more than ±2.5% or ±0.25pF whichever is larger • Class (II) X7R:±5% Y5V/Z5U:±20%	Perform 5 cycles as follow: 1. Room temperature. Dwell for 15 minutes. 2. Minimum operating temperature, dwell for 30 minutes. 3. Room temperature, dwell for 30 minutes. 4. Maximum operating temperature, dwell for 30 minutes. After above testing condition, samples shall be kept in room temperature for 24 hours (Class I) or 48 hours (Class II), and then shall be measured.	
	Q or DF	To satisfy the specified initial value. To satisfy the specified initial value.		
Solderability		Termination area shall be at least 95% covered with a new solder coating. There shall be no crack and ceramic exposure of terminated surface by melting.	The capacitors are completely immersed during 4±0.5 seconds in the molten solder with a temperature of 230±5°C *Solder: Sn 63.	
Resistance to Solder Heat Test	ΔС	Class (I) No more than ±2.5% or ±0.25pF whichever is larger Class (II) X7R:±5% Y5V/Z5U:±20%	Immerse into molten solder at 270±5°C for 3±0.5 seconds. Preheat before immersion. 1. 80~100°C for 2 minutes. 2. 150~180°C for 2 minutes. 3. 270±5°C for 3±0.5 seconds.	
	Q or DF IR	To satisfy the specified initial value. To satisfy the specified initial value.	The capacitance measurement shall be made after sample keeping at room temperature for 24 hours.	

APPLICATION MANUAL FOR SURFACE MOUNTING

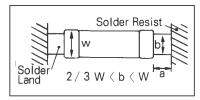
1. Temperature / Humidity Control

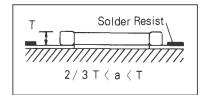
Since dew condensation may occur by the differences in temperature when the products are take out of storage, it is important to maintain a temperature-controlled environment.

2. Design of Solder Land Pattern

When designing printed circuit boards, the shape and size of the solder lands must allow for the proper amount of solder on the capacitor. The amount of solder at the end terminations has a direct effect on the probability that the chip will crack. The greater amount of solder, the larger amount of stress on the chip, and the more likely that it will break. Use the following illustrations as guidelines for proper solder land design.

Recommendation of solder land shape and size.





3. Adhesives

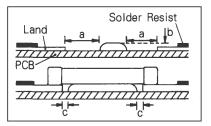
MLCCs generally require the use of an adhesive to adhere the chips to the circuit board prior to wave soldering.

3-1. Requirements for Adhesives

- They must have enough adhesion so that the chips will not fall off or move during the handling of the circuit board.
- They must maintain their adhesive strength when exposed to soldering temperatures.
- They should not spread or run when applied to the circuit board.
- They should have a long pot life.
- They should harden quickly.
- They should not corrode the circuit board or chip material.
- They should be a good insulator.
- They should be non-toxic, and not produce harmful gases, nor be harmful when touched.

3-2. Application Method

It is important to use the proper amount of adhesive. Too little will cause poor adhesion to the circuit board, and too much may strain the conductor pattern, thereby causing defective soldering. The following illustrations show the proper quantity of adhesive.



 Type
 21
 31

 a
 0.2 min
 0.2 min

 b
 70~100μm
 70~100μm

 c
 >0
 >0

3-3. Adhesive Hardening Characteristics

To prevent oxidation of the terminations, the adhesive must harden at 160°C or less, within 2 minutes or less.

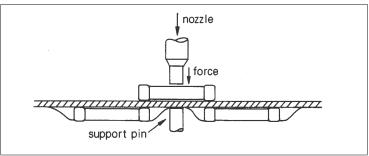
4. Mounting

4-1. Mounting Head Pressure

Excessive pressure will cause chip capacitors to crack. The pressure between nozzle and chip capacitor will be 300g maximum during mounting.

4-2. Bending Stress

Bending of printed circuit board by mounting head when double-sided circuit boards are used, chip capacitors first are mounted and soldered onto one side of the board. When the capacitors are mounted onto the other side, it is important to support the board as shown in the illustration. If the circuit board is not supported, it may bend, causing the already installed capacitors to crack.



5. Flux

Although highly activated flux gives better solderability, substances which increase activity may also degrade the insulation of the chip capacitors. To avoid such degradation, it is recommended that a mildly activated rosin flux (less than 0.2% chlorine) be used.

6. Soldering

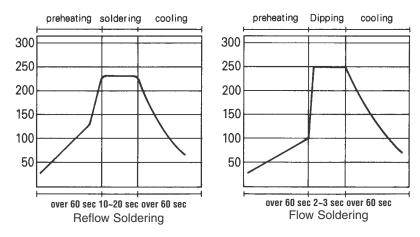
Since a multilayer chip ceramic capacitor comes into direct contact with melted solder during soldering, it is exposed to potentially damaging mechanical stress caused by the sudden temperature change. The capacitor may also be subject to silver migration, and to contamination by the flux. Because of these factors, soldering technique is critical.

6-1. Soldering Methods

Method	Classification			
Reflow Soldering	Mass reflow	• IR/Convection • VPS (Vapor phase)		
	Selective reflow	• Hot air/gas • Laser		
Flow Soldering	Dual Wave			

6-2. Soldering Profile

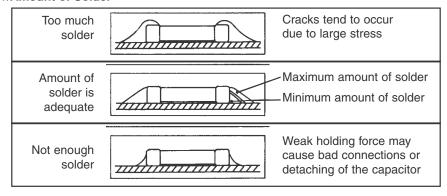
To avoid the crack problem by sudden temperature change, follow the temperature profile in the adjacent graph.



6-3. Manual Soldering

Manual Soldering can pose a great risk of creating thermal cracks in chip capacitors. The hot soldering iron tip comes into direct contact with the end terminations, and operator's carelessness may cause the tip of the soldering iron to come into direct contact with the ceramic body of the capacitor. Therefore the soldering iron must be handled carefully, and close attention must be paid to the selection of the soldering iron tip and to temperature control of the tip.

6-4. Amount of Solder



6-5. Cooling

Natural cooling using air is recommended. If the chips are dipped into solvent for cleaning, the temperature difference (ΔT) must be less than 100°C.

6-6. Cleaning

If rosin flux is used, cleaning usually is unnecessary. When strongly activated flux is used, chlorine in the flux may dissolve into some types of cleaning fluids, thereby affecting the chip capacitors. This means that the cleaning fluid must be carefully selected, and should always be new.

7. Notes for Separating Multiple, Shared PC Boards

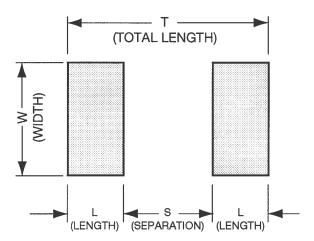
A multi-PC board is separated into many individual circuit boards after soldering has been completed. If the board is bent or distorted at the time of separation, cracks may occur in the chip capacitors. Carefully choose a separation method that minimizes the bending of the circuit board.

APPLICATION INFORMATION ON SOLDER PAD DESIGN FOR SURFACE MOUNT CHIP CAPACITOR

Recommended Pad Dimensions

		Dimension		
Chip Size	L	W	S	Т
0402*	0.021	0.022	0.017	0.059
0603*	0.035	0.030	0.030	0.100
0805	0.040	0.050	0.040	0.120
1206	0.040	0.065	0.080	0.160
1210	0.040	0.100	0.080	0.160
1812*	0.050	0.120	0.130	0.230
1825*	0.050	0.250	0.130	0.230
2220	0.050	0.250	0.130	0.230
2225*	0.050	0.250	0.170	0.270
3640*	0.060	0.400	0.300	0.420

^{*}These sizes are recommended for use with IR and vapor phase soldering only.



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