

Messrs.

Date:

## APPROVAL SHEET

Product Name : GREEN TYPE HIGH CAPACITANCE CAPACITORS

Part No. : FS series

Description : Size 0402~2225, X7R/X5R/Y5V, 6.3~250Vdc

PREPARED BY	APPROVED BY

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SPECIFICATION FOR  
MA SERIES GREEN TYPE HIGH CAPACITANCE CAPACITORS

Part No.	Description
FS31X105K500EPG	Size 1206 , X7R, 1uF , ±10%, 50V
FS31X105K101EPG	Size 1206 , X7R, 1uF , ±10%, 100V
FS32X105K101EFG	Size 1210 , X7R, 1uF , ±10%, 100V

<u>DRAWN BY</u>	<u>CHECKED BY</u>	<u>APPROVED BY</u>
Anderson Chang	Alan tsai	HJ Wu

## 1. DESCRIPTION

MLCC consists of a conducting material and electrodes. To manufacture a chip-type SMT and achieve miniaturization, high density and high efficiency, ceramic condensers are used.

PDC high capacitance MLCC offers low ESR and excellent frequency characteristics to be suited for coupling and decoupling applications in circuit. The high dielectric constant material X7R, X5R and Y5V are used for this series product.

## 2. FEATURES

- a. Realize high capacitance in small sizes.
- b. Capacitor with lead-free termination (pure Tin).
- c. RoHS compliant.
- d. HALOGEM compliant.
- e. Surface mount suited for wave and reflow soldering
- f. High reliability and no polarity.
- g. Excellent in high frequency characteristic.

## 3. APPLICATIONS

- a. Digital circuit coupling or decoupling applications.
- b. For high frequency and high-density type power suppliers.
- c. For bypassing.
- d. Ideal for smoothing circuits.
- e. Suitable for DC-DC converter, personal computer and peripherals, telecommunication and general electronic equipment

## 4. HOW TO ORDER

<u>FS</u>	<u>31</u>	<u>X</u>	<u>105</u>	<u>K</u>	<u>101</u>	<u>E</u>	<u>P</u>	<u>G</u>
PDC Family	Size	Dielectric	Capacitance	Tolerance	Rated voltage	Packaging	Thickness	Control Code
Table1.	Table2	Table3	Table4	Table5	Table6	Table7	Table8	Table9

Reference document with No.11 reference table detail.

## 5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	Thickness Spec	Remark	M <sub>B</sub> min (mm)	
			T(mm) code			
0402 (1005)	1.00±0.05	0.50±0.05	See No.11 Reference Table	#	0.25 +0.05/-0.10	
	1.00 <sup>+0.20</sup> / <sub>-0.05</sub>	0.50 <sup>+0.20</sup> / <sub>-0.05</sub>				
0603 (1608)	1.60±0.10	0.80±0.10				0.40±0.15
	1.60±0.15/-0.10	0.80±0.15				
0805 (2012)	2.00±0.20	1.25±0.20		#		0.50±0.20
	2.00±0.20	1.25±0.20				
1206 (3216)	3.20±0.20	1.60±0.20		#		0.60±0.20
	3.20 <sup>+0.30</sup> / <sub>-0.10</sub>	1.60 <sup>+0.30</sup> / <sub>-0.10</sub>				
1210 (3225)	3.20±0.30	2.50±0.20		#		0.75±0.25
	3.20±0.40	2.50±0.30				
1812 (4532)	4.50±0.40	3.20±0.30		#		0.75±0.35
1825 (4563)	4.60±0.30	6.30±0.40				0.75±0.35
2220 (5750)	5.70±0.40	5.00±0.40				0.85±0.35
2225 (5763)	5.70±0.40	6.30±0.40				0.85±0.35

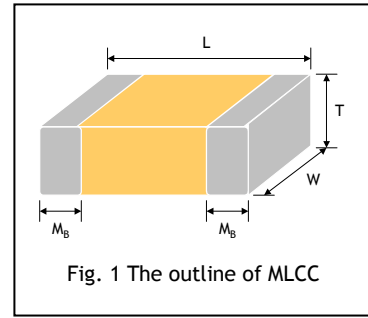


Fig. 1 The outline of MLCC

# Reflow soldering only is recommended.

## 6. GENERAL ELECTRICAL DATA

Dielectric	X7R	X5R	Y5V
Size	0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225		
Capacitance range*	1μF to 10μF	1μF to 100μF	1μF to 100μF
Capacitance tolerance**	K (±10%), M (±20%)		Z (-20/+80%)
Rated voltage (WVDC)	6.3V, 10V, 16V, 25V, 50V, 100V, 250V, 500V, 630V		
Tan δ*	Note 1		
Insulation resistance at Ur	RxC ≥ 500 ΩxF		
Operating temperature	-55 to +125°C	-55 to +85°C	-25 to +85°C
Capacitance characteristic	±15%		+30/-80%
Termination	Ni/Sn (lead-free termination)		

\* Measured at 1.0±0.2Vrms, 1.0kHz±10% for C≤10μF; 0.5±0.2Vrms, 120Hz±20% for C>10μF, 30-70% related humidity, 25°C ambient temperature for X7R, X5R and at 20°C for Y5V.

\*\* Preconditioning for Class II MLCC: Perform a heat treatment at 150±10°C for 1 hour, then leave in ambient condition for 24±2 hours before measurement.

Note 1 : Follow 8.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

## 7. CAPACITANCE RANGE

### 7-1 X7R Dielectric

Dimension		0603					0805					1206					1210					1812									
Cap(μF)	code	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	35V	50V	6.3V	10V	16V	25V	50V	100V	6.3V	10V	16V	25V	50V	100V	10V	16V	25V	50V	100V	200V	250V
1.0	105	B/X	B	B	B	B		C	C	C	C	I		J	J	J	P	P		C	C	C	P/C	G/F	C	C	C	F	F	G	G
1.5	155							I	I	I			J	J	J	P							G	G				F	F		
2.2	225		X					I	I	I	I		I	J	J	J	P	P				F	E	G	G			G	G		
3.3	335													P	P	P						F	E					G	G		
4.7	475							I	I	I	I			P	P	P	P				F	F	F	G							
6.8	685																														
10.0	106							I	I	I				P	P	P	P				F	F	F	G							
22.0	226													P	P						G	G	G								
47.0	476																		G	G											

Dimension		1825				2220				2225					
Cap(μF)	code	50V	100V	200V	250V	50V	100V	200V	250V	50V	100V	200V	250V	500V	630V
1.0	105	F	F	F	F	F	F	F	F	F	F	F	F	G	G
1.5	155	F	F	G	G	F	F	G	G	F	F	G	G		
2.2	225	F	F	G	G	F	F	G	G	F	F	G	G		
3.3	335	F	F			F	F			F	F				
4.7	475	F	G			F	G			F	G				
6.8	685	G	H			G	H			G	H				
10.0	106	H	H			H	H			H	H				

### 7-2 X5R Dielectric

Dimension		0402				0603				0805					1206					1210										
Cap(μF)	code	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V
1.0	105	N	N	N	N	X	X	X	X	X		C	C	C	I					P									C	P
1.2	125																											P	F	
1.5	155					X						I	I	I	I		J	J					F	F	F	F				
1.8	185																											G	G	
2.2	225	N	N	K		X	X	X	X		I	I	I	I		J	J	P				F	F	G	G					
2.7	275																											G		
3.3	335					X	X				I	I	I	I		P	P	P												
3.9	395																													
4.7	475	K	K			X	X	X			I	I	I	I	I	P	P	P	P	P			F	F	F					
5.6	565																													
6.8	685															P	P													
8.2	825																													
10.0	106	K				X	X				I	I	I	I	P	P	P	P			F	F	F	F	G					
22.0	226					X					I	I			P	P	P				G	G	G	G						
47.0	476														P	P					G	G	G							
100.0	107														P						G	G								

## 7. CAPACITANCE RANGE(con.)

### 7-3 Y5V Dielectric

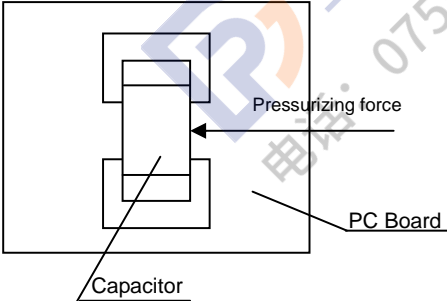
Dimension		0402		0603			0805					1206					1210					1812							
Cap(μF)	code	6.3V	10V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	35V	50V	6.3V	10V	16V	25V	35V	50V	10V	16V	25V	50V	100V
1.0	105	N	N		S	X	X		B	B	C	C		M	M	M		M		M	M	M		M	C	C	C	C	C
1.2	125																												
1.5	155				S				C	C				M	M	M				M	M	M			C	C	C	C	
1.8	185																												
2.2	225			S	S	X			C	C	I			M	M	M		J		M	M	M		E	C	C	C	C	
2.7	275																												
3.3	335								C	C				J	J	J				M	M	M			C	C	C	C	
3.9	395																												
4.7	475			X	X				C	C	I			J	J	J	J	P		M	M	C		E	C	C	C	C	
5.6	565																												
6.8	685								I					J	J					M	M	C			C	C	C	C	
8.2	825																												
10.0	106							I	I	I				J	J	P				C	C	C	F		C	C	C	F	
22.0	226							I	I					P							F	F							
47.0	476												P							F	F					G			
100.0	107																			G									



### 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements						
1.	Visual and Mechanical	---	* No remarkable defect. * Dimensions to conform to individual specification sheet.						
2.	Capacitance	Class II: X7R, X5R, Y5V Cap≤10μF, 1.0±0.2Vrms, 1kHz±10% **	Shall not exceed the limits given in the detailed spec.						
3.	Q/ D.F. (Dissipation Factor)	Cap>10μF, 0.5±0.2Vrms, 120Hz±20%	X7R, X5R:						
		** Test condition: 0.5±0.2Vrms · 1kHz±10% X7R: 0603 ≥ 225(10V), 0805=106(6.3V&10V) 0402 ≥ 224 (6.3V), X5R: 01R5 ≥ 103, 0201 ≥ 224 (6.3V), 0402 ≥ 335 (4.0V), 0402(6.3V, Thickness=0.5mm) ≥ 225, 0402(6.3V, Thickness=0.3mm) ≥ 105, 0402(6.3V, Thickness=0.2mm) ≥ 224, 0402(10V, Thickness=0.5mm) ≥ 225, 0402(10V, Thickness=0.3mm) ≥ 105, 0603 ≥ 106 (4.0V), 0603(6.3V/10V, Thickness=0.45mm) ≥ 475, 0603(6.3V/10V, Thickness=0.8mm) ≥ 106, 0805(6.3V, Thickness=0.45mm)=106,	Rated vol.   X7R D.F. ≤   X5R D.F. ≤   Exception of D.F. ≤						
		≥50V	2.5%	3%	3.5%   0201(50V); 0603 ≥ 0.047μF; 0805 ≥ 0.1μF; 1206 ≥ 0.47μF 0402 ≥ 0.01μF(X7R); 1210 ≥ 4.7μF				
					5%   0805 ≥ 1μF; 1210 ≥ 4.7μF				
					10%   0603(Thickness=0.8mm) ≥ 0.22μF; 0805(Thickness ≥ 0.85mm) ≥ 0.1μF; 1206 ≥ 1μF; 1210(Thickness ≥ 1.9mm) ≥ 4.7μF 0402(Thickness=0.5mm) ≥ 0.1μF				
		35V	3.5%	3.5%	5%   0402 ≥ 0.1μF; 0603 ≥ 1μF; 1210 ≥ 10μF 10%   0805 ≥ 2.2μF; 1210 ≥ 4.7μF				
		25V	3.5%	3.5%	5%   0201 ≥ 0.01μF; 0805 ≥ 1μF; 1210 ≥ 10μF 0402 ≥ 0.01μF; 0603 ≥ 1μF; 1206 ≥ 4.7μF 10%   0402 ≥ 0.10μF; 0603 ≥ 0.47μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF ; 1210 ≥ 10μF				
		16V	3.5%	3.5%	5%   0201 ≥ 0.01μF; 0402 ≥ 0.033μF; 0603 ≥ 1μF; 0805 ≥ 0.68μF; 1206 ≥ 2.2μF; 1210 ≥ 4.7μF 10%   0402 ≥ 0.22μF; 0603 ≥ 0.68μF; 0805 ≥ 2.2μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF				
		10V	5%	5%	10%   0402 ≥ 0.1μF; 0603 ≥ 0.33μF; 0805 ≥ 2.2μF; 1206 ≥ 2.2μF; 1210 ≥ 22μF 15%   0201 ≥ 0.1μF; 0402 ≥ 1μF				
		6.3V	10%	10%	15%   0201 ≥ 0.1μF; 0402 ≥ 1μF; 0603 ≥ 10μF; 0805 ≥ 4.7μF; 1206 ≥ 47μF ; 1210 ≥ 100μF 20%   0402 ≥ 2.2μF				
4V	15%	15%	---						
			Y5V:						
			Rated vol.   D.F. ≤   Exception of D.F. ≤						
			≥ 50V   5%   7%   0603 ≥ 0.1μF; 0805 ≥ 0.22μF; 1206 ≥ 2.2μF						
			35V   7%   9%   1206 ≥ 10μF						
			25V   5%   7%   0402 ≥ 0.047μF; 0603 ≥ 0.1μF; 0805 ≥ 0.33μF; 1206 ≥ 1μF; 1210 ≥ 4.7μF						
			9%   0402 ≥ 0.068μF; 0603 ≥ 0.47μF; 1206 ≥ 4.7μF; 1210 ≥ 22μF						
			16V (C<1.0μF)   7%   9%   0402 ≥ 0.068μF; 0603 ≥ 0.68μF						
			12.5%   0402 ≥ 0.22μF						
			16V (C ≥ 1.0μF)   9%   16%   0603 ≥ 1μF; 0805 ≥ 3.3μF; 1206 ≥ 10μF; 1210 ≥ 22μF; 1812 ≥ 47μF						
			10V   12.5%   20%   0402 ≥ 0.47μF; 0603 ≥ 1μF; 0805 ≥ 10μF; 1206 ≥ 22μF; 1210 ≥ 22μF;						
			6.3V   20%   ---   ---						
4.	Dielectric Strength	<table border="1"> <thead> <tr> <th>Rated vol.(V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤ 100V</td> <td>2.5 times of U<sub>R</sub></td> </tr> <tr> <td>&gt; 100V</td> <td>2.0 times of U<sub>R</sub></td> </tr> </tbody> </table> <p>Duration: 1 to 5 sec. * Charge and discharge current less than 50mA.</p>	Rated vol.(V)	Condition	≤ 100V	2.5 times of U <sub>R</sub>	> 100V	2.0 times of U <sub>R</sub>	* No evidence of damage or flash over during test.
Rated vol.(V)	Condition								
≤ 100V	2.5 times of U <sub>R</sub>								
> 100V	2.0 times of U <sub>R</sub>								

## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Con.)

No.	Item	Test Condition	Requirements														
5.	Insulation Resistance	To apply rated voltage for max. 120 sec.	≥10GΩ or RxC≥500Ω-F whichever is smaller.														
			<table border="1"> <thead> <tr> <th>Rated voltage</th> <th>Insulation Resistance</th> </tr> </thead> <tbody> <tr> <td>50V:0603≥0.47uF; 0805≥1uF; 1206≥1uF ; 1210≥4.7uF</td> <td rowspan="5">10GΩ or RxC≥100 Ω-F whichever is smaller.</td> </tr> <tr> <td>35V:1210≥10uF</td> </tr> <tr> <td>25V:1210≥10uF; 0402≥0.01uF; 0603≥1uF; 0805≥0.47uF; 1206≥4.7uF; 1210≥10uF</td> </tr> <tr> <td>16V:0402≥0.22uF; 0603≥1uF; 0805≥1uF; 1206≥10uF; 1210≥22uF</td> </tr> <tr> <td>10V:0402≥0.1uF; 0603≥0.47uF;0805≥2.2uF; 1206≥6.8uF; 1210≥10uF</td> </tr> <tr> <td>6.3V; 4V</td> <td></td> </tr> </tbody> </table> <p>Class II (X5R, X7R, Y5V)</p>	Rated voltage	Insulation Resistance	50V:0603≥0.47uF; 0805≥1uF; 1206≥1uF ; 1210≥4.7uF	10GΩ or RxC≥100 Ω-F whichever is smaller.	35V:1210≥10uF	25V:1210≥10uF; 0402≥0.01uF; 0603≥1uF; 0805≥0.47uF; 1206≥4.7uF; 1210≥10uF	16V:0402≥0.22uF; 0603≥1uF; 0805≥1uF; 1206≥10uF; 1210≥22uF	10V:0402≥0.1uF; 0603≥0.47uF;0805≥2.2uF; 1206≥6.8uF; 1210≥10uF	6.3V; 4V					
Rated voltage	Insulation Resistance																
50V:0603≥0.47uF; 0805≥1uF; 1206≥1uF ; 1210≥4.7uF	10GΩ or RxC≥100 Ω-F whichever is smaller.																
35V:1210≥10uF																	
25V:1210≥10uF; 0402≥0.01uF; 0603≥1uF; 0805≥0.47uF; 1206≥4.7uF; 1210≥10uF																	
16V:0402≥0.22uF; 0603≥1uF; 0805≥1uF; 1206≥10uF; 1210≥22uF																	
10V:0402≥0.1uF; 0603≥0.47uF;0805≥2.2uF; 1206≥6.8uF; 1210≥10uF																	
6.3V; 4V																	
6.	Temperature Coefficient	With no electrical load.															
		<table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp</th> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>X7R</td> <td>-55~125°C at 25°C</td> <td>X7R</td> <td>Within ±15%</td> </tr> <tr> <td>X5R</td> <td>-55~85°C at 25°C</td> <td>X5R</td> <td>Within ±15%</td> </tr> <tr> <td>Y5V</td> <td>-25~85°C at 20°C</td> <td>Y5V</td> <td>Within +30%/-80%</td> </tr> </tbody> </table>	T.C.	Operating Temp	T.C.	Capacitance Change	X7R	-55~125°C at 25°C	X7R	Within ±15%	X5R	-55~85°C at 25°C	X5R	Within ±15%	Y5V	-25~85°C at 20°C	Y5V
T.C.	Operating Temp	T.C.	Capacitance Change														
X7R	-55~125°C at 25°C	X7R	Within ±15%														
X5R	-55~85°C at 25°C	X5R	Within ±15%														
Y5V	-25~85°C at 20°C	Y5V	Within +30%/-80%														
7.	Adhesive Strength of Termination	<p>Capacitors mounted on a substrate. A force of 5N(≤0603) or 10N(&gt; 0603) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 second.</p> 	* No remarkable damage or removal of the terminations.														
8.	Solderability	<p>* Solder temperature: 235±5°C for (0402~1210)            * Solder temperature: 245±5°C for (1808~2225)            * Dipping time: 2±0.5 sec.</p>	75% min. coverage of all metalized area.														
9.	Resistance to flexure of substrate	<p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm and then the pressure shall be maintained for 5±1 sec.            * Measurement to be made after keeping at room temp. for 24±2 hrs.</p>	<p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap Change</th> </tr> </thead> <tbody> <tr> <td>Class II(X7R)</td> <td>within ±12.5%</td> </tr> <tr> <td>Class II(Y5V)</td> <td>within ±30%</td> </tr> </tbody> </table> <p>(This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</p>	Dielectric	Cap Change	Class II(X7R)	within ±12.5%	Class II(Y5V)	within ±30%								
			Dielectric	Cap Change													
Class II(X7R)	within ±12.5%																
Class II(Y5V)	within ±30%																
10.	Resistance to Soldering Heat	<p>* Solder temperature: 260±5°C            * Dipping time: 10±1 sec            * Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.            * Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48±4 hrs at room temp.            * Measurement to be made after keeping at room temp. for 48±4 hrs.</p>	<p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>Q/D.F</th> </tr> </thead> <tbody> <tr> <td>Class II(X7R)</td> <td>≥ 1GΩ</td> <td>within ±7.5%</td> <td rowspan="2">≤ 1.0 × Initial requirement</td> </tr> <tr> <td>Class II(Y5V)</td> <td>≥ 1GΩ</td> <td>within ±20%</td> </tr> </tbody> </table> <p>* 25% max. Leaching on each edge.</p>	Dielectric	I.R	Cap Change	Q/D.F	Class II(X7R)	≥ 1GΩ	within ±7.5%	≤ 1.0 × Initial requirement	Class II(Y5V)	≥ 1GΩ	within ±20%			
Dielectric	I.R	Cap Change	Q/D.F														
Class II(X7R)	≥ 1GΩ	within ±7.5%	≤ 1.0 × Initial requirement														
Class II(Y5V)	≥ 1GΩ	within ±20%															



## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Con.)

No.	Item	Test Condition	Requirements																										
11.	Temperature Cycle	* Conduct the five cycles according to the temperatures and time.	* No remarkable damage.																										
		<table border="1"> <thead> <tr> <th>Step</th> <th>Temp. (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Min. operating temp. +0/-3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>2~3</td> </tr> <tr> <td>3</td> <td>Max. operating temp. +3/-0</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table>	Step	Temp. (°C)	Time (min.)	1	Min. operating temp. +0/-3	30±3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30±3	4	Room temp.	2~3	<table border="1"> <thead> <tr> <th>Dielectric</th> <th>I.R</th> <th>Cap Change</th> <th>D.F</th> </tr> </thead> <tbody> <tr> <td>Class II(X7R)</td> <td>0.25</td> <td>within ±15%</td> <td rowspan="2">≤ 1.0(D.F.) × Initial requirement</td> </tr> <tr> <td>Class II(Y5V)</td> <td>× initial Requirements.</td> <td>within ±20%</td> </tr> </tbody> </table>	Dielectric	I.R	Cap Change	D.F	Class II(X7R)	0.25	within ±15%	≤ 1.0(D.F.) × Initial requirement	Class II(Y5V)	× initial Requirements.	within ±20%
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* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48±4 hrs at room temp.																													
* Measurement to be made after keeping at room temp. for 48±4 hrs.																													
12.	Humidity (Damp Heat) Steady State	* Test temp.: 40±2°C	* No remarkable damage.																										
		* Humidity: 90~95% RH	* Cap change:																										
		* Test time: 500+24/-0hrs.	X7R, X5R: ≥10V, within ±15%; 6.3V, within ±25%																										
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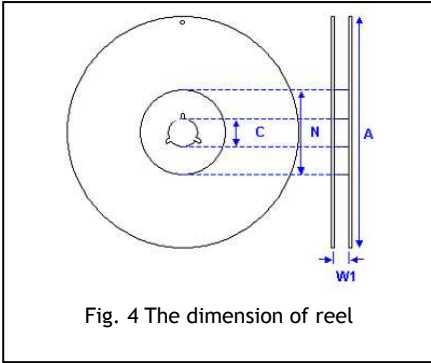
### 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Con.)

No.	Item	Test Condition	Requirements																																																			
13.	High Temperature Load (Endurance)	* Test temp.: X7R: 125±3°C X5R, Y5V: 85±3°C	* No remarkable damage.																																																			
		To apply voltage:	* Cap change: X7R, X5R: ≥10V, within ±15%; 6.3V, within ±25% Y5V: ≥10V, within ±30%; 6.3V, within +30/-40%																																																			
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## 9. PACKAGING STYLE AND QUANTITY

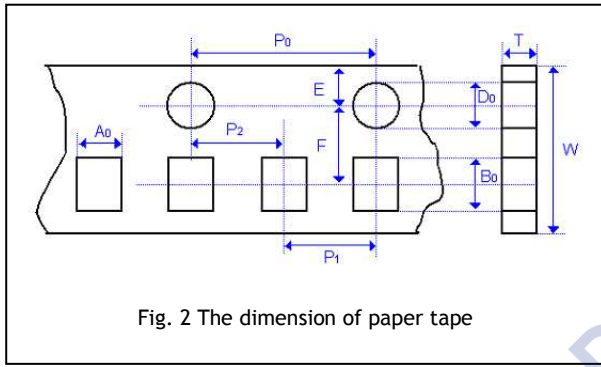
Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
0402 (1005)	0.50±0.05	10k	50k	-	-
0603 (1608)	0.80±0.07	4k	15k	-	-
	0.80+0.15/-0.10	4k	15k	-	-
0805 (2012)	0.80±0.10	4k	15k	-	-
	1.25±0.10	-	-	3k	10k
	1..25±0.20	-	-	3k	10k
1206 (3216)	0.95±0.10	-	-	3k	10k
	1.15±0.15	-	-	3K	10K
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	1.60+0.30/-0.10	-	-	2k	-
1210 (3225)	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	2k	-
	2.50±0.30	-	-	1k	-
1812 (4532)	1.25±0.10	-	-	1k	-
	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
1825 (4563)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
2220 (5750)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-
2225 (5763)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
	2.80±0.30	-	-	0.5k	-

Unit: pieces

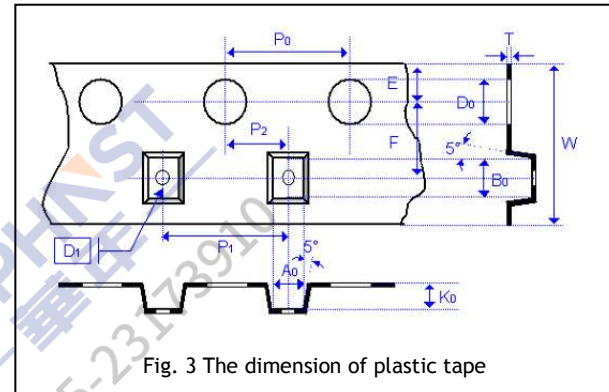


Size	0402, 0603, 0805, 1206, 1210			1812, 1825, 2220, 2225
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W <sub>1</sub>	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	330.0±1.0	178.0±0.10
N	60.0±1.0/-0	100.0±1.0	100±1.0	80.0±1.0

**9-1 CARDBOARD TAPE DIMENSIONS**



**9-2 EMBOSSED TAPE DIMENSIONS**



Size	0402	0603		0805	1206			1210		
Chip Thickness	0.50±0.05	0.80±0.07	0.80+0.15/-0.10	0.80±0.10	1.25±0.10 1.25±0.20	0.80±0.10	0.95±0.10 1.25±0.10	1.60±0.20 1.60+0.3/-0.1	0.95±0.10 1.25±0.10 1.60±0.20	2.50±0.30
A <sub>0</sub>	0.62±0.05	1.00+0.05/-0.10	1.02+0.05/-0.10	1.50±0.10	<1.65	2.00±0.10	<2.00	<2.00	<3.05	<3.10
B <sub>0</sub>	1.12±0.05	1.80±0.10	1.80±0.10	2.30±0.10	<2.40	3.50±0.10	<3.60	<3.70	<3.80	<4.00
T	0.60±0.05	0.95±0.05	0.97±0.05	0.95±0.05	0.23±0.05	0.95±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05
K <sub>0</sub>	-	-	-	-	<2.50	-	<2.50	<2.50	<2.50	<3.50
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P <sub>0</sub>	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.100	4.00±0.10
10xP <sub>0</sub>	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.0±0.10
P <sub>1</sub>	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P <sub>2</sub>	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D <sub>0</sub>	1.55±0.05	1.55±0.05	1.55±0.05	1.55±0.05	1.50±0.10/-0	1.55±0.05	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0
D <sub>1</sub>	-	-	-	-	1.00±0.10	-	1.00±0.10	1.00±0.10	1.00±0.10	1.00±0.10
E	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.05	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
F	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05

Size	1812		1825		2220		2225	
Chip Thickness	1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30	1.60±0.20 2.00±0.20	2.50±0.30	2.00±0.20	2.50±0.30 2.80±0.20	2.00±0.20	2.50±0.30
A <sub>0</sub>	<3.90	<3.90	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B <sub>0</sub>	<5.30	<5.30	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.25±0.05	0.25±0.05	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10
K <sub>0</sub>	<2.50	<3.00	<2.50	<3.10	<2.50	<3.10	<2.50	<3.10
W	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20
P <sub>0</sub>	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP <sub>0</sub>	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.00±0.20
P <sub>1</sub>	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P <sub>2</sub>	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D <sub>0</sub>	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0	1.50+0.10/-0
D <sub>1</sub>	1.50±0.10	1.50+/-0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10
E	1.75±0.10	1.75+/-0.1	1.75±0.1	1.75±0.10	1.75±0.1	1.75±0.10	1.75±0.10	1.75±0.10
F	5.50±0.05	5.50+/-0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05

## 10.APPLICATION NOTES

### STORAGE

To prevent the damage of solderability of terminations, the following storage conditions are recommended:

Indoors under 5 ~ 40°C and 20% ~ 70% RH.

No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.

Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The capacitors should be used within 6 months and checked the solderability before use.

### HANDLING

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

### PREHEAT

In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 4°C per second and the final preheat temperature should be within 100°C of the soldering temperature for small chips such as 0402, 0603, 0805 and 1206, and within 50°C of the soldering temperature for bigger chips such as 1210, 1808, 1825, 1812, 2220 and 2225, etc.

### SOLDERING

Use mildly activated rosin RA and RMA fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

Hand soldering with temperature-controlled iron not exceeding 30 watts and diameter of tip less than 1.2 mm is recommended, tip of iron should not contact the ceramic body directly, and the temperature of iron should be set to not more than 260°C.

For bigger chips such as 1210, 1808, 1812, 2211, 2220 etc. wave soldering and hand soldering are not recommended.

Refer IPC/JEDEC J-STD-020D Method recommended soldering profiles :

Reflow not sooner than 15 minutes and not longer than 4 hrs after removal from the temperature/humidity chamber, subject the sample to 3 cycle of the appropriate reflow conditions as defined as below Table description.

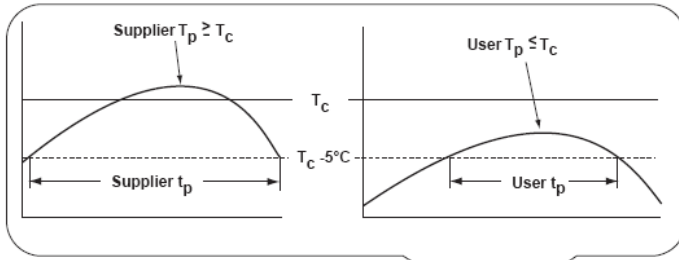
Profile Feature	Pb-Free Assembly
Preheat/Soak	
Temperature Min.(T <sub>smin</sub> )	150°C
Temperature Max.(T <sub>smax</sub> )	200°C
Time(t <sub>s</sub> ) from (T <sub>smin</sub> to T <sub>smax</sub> )	60 to 120 seconds
Ramp-up rate(T <sub>L</sub> to T <sub>p</sub> )	3°C/second max.
Liquidous temperature(T <sub>L</sub> )	217°C
Time(t <sub>L</sub> ) maintained above T <sub>L</sub>	60 to 150 seconds
Peak package body temperature(T <sub>p</sub> )	For user T <sub>p</sub> must not exceed the Classification temp 260°C For suppliers T <sub>p</sub> must equal or exceed the Classification temp 260°C
Time(T <sub>p</sub> )* within 5°C of the specified classification temperature(T <sub>c</sub> )	30* second
Ramp-down rate (T <sub>p</sub> to T <sub>L</sub> )	6°C/second max.
Time 25°C to peak temperature 260°C	8 minutes max.

Lead-free : Soldering temperature = 235 to 260°C, depending on product.

Maximum temperature = Minimum temperature(235°C)+ΔT+ Tolerance for oven process and measurement(5 ~ 7°C)

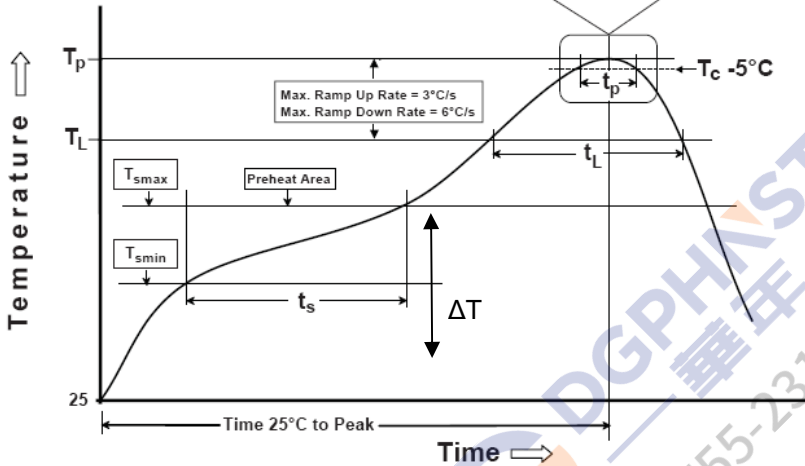
Time at peak temperature = 10sec, Dwell above 217°C = 90sec, Ramping rate = 3°C/sec(heating) and 6°C/sec(heating).

Classification Reflow Profiles



Chip Size	$\Delta T$
0402, 0603, 0805, 1206	100 °C
1210, 1808, 1812, 1825, 2220, 2225	50 °C

Soldering	Solder Temp.( $T_c$ )	Soldering Time ( $t_p$ )
Reflow	235 – 260 °C	< 15 sec.
Wave	230 – 260 °C	< 5 sec.



Note : For example ,  $T_c$  is 260°C and time  $t_p$  is 15sec.  
for user : The peak temperature must not exceed 260°C. The time above 255°C must not exceed 15 seconds.

**COOLING**

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint. A cooling rate not exceeding 4°C per second should be used when forced cooling is necessary.

**CLEANING**

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.

# 11.REFERENCE TABLE

<u>FS</u>	<u>21</u>	<u>X</u>	<u>105</u>	<u>K</u>	<u>500</u>	<u>E</u>	<u>C</u>	<u>G</u>
PDC Family	Size	Dielectric	Capacitance	Tolerance	Rated voltage	Packaging	Thickness	Control Code
Table1.	Table2	Table3	Table4	Table5	Table6	Table7	Table8	Table9

Code	Description	Code	Description
FH	Safety X2 & Y3 series	FN	General Purpose Product
FK	Safety X1 & Y2 series	FP	Anti-bend Series
FL	Low Dissipation Series	FS	Rated voltage $\leq 250Vdc$ Capacitance $\geq 1.0 \mu F$ Series Product
FM	100V $\leq$ Rated Voltage $\leq 630V$ series	FT	Trigger application and rated voltage 350-630Vdc
FV	High voltage application with $\geq 1KVdc$		

General Purpose				FK/FH series	
Code	Description	Code	Description	Code	Description
15	0402(1005)	43	1812 (4532)	06	1206 (3216)
18	0603 (1608)	46	1825 (4563)	08	1808 (4520)
21	0805 (2012)	52	2211 (5728)	12	1812 (4532)
31	1206 (3216)	55	2220 (5750)	21	2211 (5728)
32	1210 (3225)	56	2225 (5763)	20	2220 (5750)
42	1808 (4520)				

Code	Description	Code	Description
N	C0G(NPO)	X	X7R
B	X5R	F	Y5V

Two significant digits followed by no. of zeros. And R is in place of decimal point.					
Code	Description	Code	Description	Code	Description
R47	0.47pF	100	100=10x10 <sup>0</sup> =10pF	104	104=10x10 <sup>4</sup> =100nF
0R5	0.5pF	102	102=10x10 <sup>2</sup> =1000pF	106	106=10x10 <sup>6</sup> =10μF

Code	Description	Code	Description	Code	Description	Code	Description
A	±0.05 pF	F	±1 %	J	±5 %	N	-5% ~ +10%
B	±0.10 pF	G	±2 %	K	±10 %	P	±0.02 pF
C	±0.25 pF	H	±3 %	L	0% ~ +10%	Q	±0.03 pF
D	±0.50 pF	I	-10% ~ 0%	M	±20 %	Z	-20% ~ 80%

Table 6 Rated voltage									
General Purpose						FK/FH series			
Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
6R3	6.3VDC	101	100VDC	102	1000VDC	402	4000VDC	302	2.5KV IMPULSE
100	10VDC	201	200VDC	152	1500VDC	502	5000VDC	502	5KV IMPULSE
160	16VDC	251	250VDC	202	2000VDC	602	6000VDC	602	6KV IMPULSE
250	25VDC	501	500VDC	252	2500VDC				
500	50VDC	631	630VDC	302	3000VDC				

Table 7 Packaging Type			
Code	Description	Code	Description
B	Bulk	T	Tray package
E	Tape and 7" Reel, Embossed Tape	P	Tape and 7" Reel, Paper Tape
K	Tape and 10" Reel, Embossed Tape	Q	Tape and 10" Reel, Paper Tape
L	Tape and 13" Reel, Embossed Tape	G	Tape and 13" Reel, Paper Tape

Table 8 Thickness Description					
Code	Description	Code	Description	Code	Description
A	0.60 ± 0.10 mm	I	1.25 ± 0.20 mm	Q	0.50 + 0.02/-0.05 mm
B	0.8 + 0.15/-0.10 mm	J	1.15 ± 0.15 mm	R	3.10 ± 0.30 mm
C	1.25 ± 0.10 mm	K	0.50 ± 0.20 mm	S	0.80 ± 0.07 mm
D	1.40 ± 0.15 mm	L	0.30 ± 0.03 mm	T	0.85 ± 0.10 mm
E	1.60 ± 0.20 mm	M	0.95 ± 0.10 mm	U	0.50 ± 0.10 mm
F	2.00 ± 0.20 mm	N	0.50 ± 0.05 mm	V	0.20 ± 0.02 mm
G	2.50 ± 0.30 mm	O	3.50 ± 0.20 mm	X	0.80 ± 0.10 mm
H	2.80 ± 0.30 mm	P	1.60 +0.3/-0.10 mm	Z	0.25 ± 0.03 mm

Table 9 Special Control Code			
Code	Description	Code	Description
G	RoHS Compliant		