



信昌電子陶瓷股份有限公司  
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Messrs.

Date:

## APPROVAL SHEET

Product Name : GREEN TYPE HIGH CAPACITANCE CAPACITORS

Part No. : FS series

Description : Size  $\leq 2225$ , CAP  $\geq 1\mu F$ ,  $U_R < 1000V$ , X7R/X5R/Y5V/X6S,

PREPARED BY	APPROVED BY

信昌電子陶瓷股份有限公司

PROSPERITY DIELECTRICS CO., LTD.

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SPECIFICATION FOR  
FS SERIES GREEN TYPE HIGH CAPACITANCE CAPACITORS

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Description : Size  $\leq 2225$ , CAP  $\geq 1\mu\text{F}$ ,  $U_R < 1000\text{V}$ , X7R/X5R/Y5V/X6S,

<u>DRAWN BY</u>	<u>CHECKED BY</u>	<u>APPROVED BY</u>
蕭敏珍	蔡永承	巫宏俊

## 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

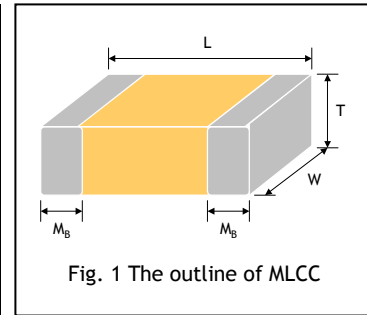
## 4. HOW TO ORDER

<u>FS</u>	<u>32</u>	<u>X</u>	<u>225</u>	<u>K</u>	<u>101</u>	<u>E</u>	<u>G</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	M <sub>B</sub> min (mm)
			T(mm) code	
0201 (0603)	0.60±0.05	0.30±0.05	See No.11 Reference Table	0.15±0.05
0402 (1005)	1.00+0.15/-1.0	0.50+0.15/-1.0		0.25+0.05/-0.10
0603 (1608)	1.60±0.20	0.80±0.15		0.40±0.15
0805 (2012)	2.10±0.20	1.25±0.20		0.50±0.20
1206 (3216)	3.30±0.30	1.60+0.30/-0.10		0.60±0.20
1210 (3225)	3.30±0.40	2.50±0.30		0.75±0.35
1808 (4520)	4.60±0.50	2.00±0.20		0.75±0.35
1812 (4532)	4.60±0.50	3.20±0.30		0.75±0.35
1825 (4563)	4.60±0.50	6.30±0.40		0.75±0.35
2220 (5750)	5.70±0.50	5.00±0.40		0.85±0.35
2225 (5763)	5.70±0.50	6.30±0.40		0.85±0.35



## 6. GENERAL ELECTRICAL DATA

Dielectric	X7R	X5R	Y5V	X6S
Size	0201,0402, 0603, 0805, 1206, 1210, 1812, 1825, 2220, 2225			
Capacitance range*	1μF to 10μF	1μF to 100μF	1μF to 100μF	1μF to 100μF
Capacitance tolerance**	Reference to Table5	Reference to Table5	Reference to Table5	Reference to Table5
Rated voltage (WVDC)	6.3V, 10V, 16V, 25V,35V, 50V, 100V, 250V, 500V, 630V			4V, 6.3V, 10V, 16V, 25V, 50V
Tan δ*	Note 1			
Insulation resistance at U <sub>r</sub>	≥10GΩ or R•C≥100Ω•F whichever is smaller			
Operating temperature	-55 to +125°C	-55 to +85°C	-25 to +85°C	-55 to +105°C
Capacitance characteristic	±15%		+30/-80%	±22%
Termination	Ni/Sn (lead-free termination)			

\* Measured at 1.0±0.2V<sub>rms</sub>, 1.0kHz±10% for C≤10μF; 0.5±0.2V<sub>rms</sub>, 120Hz±20% for C>10μF, 30-70% related humidity, 25°C ambient temperature for X7R, X5R, X6S 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		0402		0603				0805				1206				1210										
Cap(μF)	code	6.3V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	100V	6.3V	10V	16V	25V	35V	50V	100V	
1.0	105	N	B	B	B	B	B		C	C	C	I		J	J	J	P	P		C	C	C		C	F	
1.2	125																								G	G
1.5	155								I	I	I		J	J	J	P					E	E		G	G	
1.8	185																								G	G
2.2	225		B	B	B			I	I	I	I	I	J	J	J	P	P	P			E	E		G	G	
2.7	275																								G	
3.3	335													P	P	P					E	E				
4.7	475							I	I	I	I		P	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	G		
22.0	226												P	P	P					G	G	G				
47.0	476																		G	G						

Dimension		1808		1812						1825				
Cap(μF)	code	50V	100V	10V	16V	25V	50V	100V	200V	250V	50V	100V	200V	250V
1.0	105	F	F	C	C	C	F	F	G	G	F	F	F	F
1.2	125	F					F	F			F	F	G	G
1.5	155						F	F			F	F	G	G
1.8	185						F	F			F	F	G	G
2.2	225						G	G			F	F	G	G
2.7	275						G	G			F	F	H	H
3.3	335						G	G			F	F		
3.9	395										F	F		
4.7	475										F	G		
5.6	565										G	G		
6.8	685										G	G		
8.2	825										G	G		
10.0	106										G	G		

Dimension		2220						2225					
Cap(μF)	code	50V	100V	200V	250V	500V	630V	50V	100V	200V	250V	500V	630V
1.0	105	F	F	F	F	H	H	F	F	F	F	G	G
1.2	125	F	F	G	G			F	F	G	G	H	H
1.5	155	F	F	G	G			F	F	G	G	H	H
1.8	185	F	F	G	G			F	F	G	G		
2.2	225	F	F	G	G			F	F	G	G		
2.7	275	F	F	H	H			F	F	G	G		
3.3	335	F	F					F	F	H	H		
3.9	395	F	F					F	F	H	H		
4.7	475	F	G					F	G				
5.6	565	G	G					F	G				
6.8	685	G	G					G	G				
8.2	825	G	G					G	G				
10.0	106	G	G					G	G				

**7-2 X5R Dielectric**

Dimension		0201		0402				0603					0805					1206					1210								
Cap(μF)	code	6.3V	10V	6.3V	10V	16V	25V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	35V	50V	
1.0	105	L	L	N	N	N	N	B	B	B	B	B				C	C	C	I					P							
1.2	125																														
1.5	155							B						I	I	I	I			J	J				F	F	F				
1.8	185																														
2.2	225	L		N	N	K	K	B	B	B	B	B		I	I	I	I	I		J	J	P	P		F	F	F				
2.7	275																														
3.3	335							B	B					I	I	I	I			P	P	P									
3.9	395																														
4.7	475			K	K	K		B	B	B	B			I	I	I	I	I	P	P	P	P	P		F	F	F	F			
5.6	565																														
6.8	685																		P	P											
8.2	825																														
10.0	106			K	K			B	B	B	B			I	I	I	I	I	P	P	P	P	P		F	F	F	F	G	G	
22.0	226							B	B					I	I	I	I		P	P	P	P			G	G	G	G			
47.0	476													I	I				P	P					G	G	G				
100.0	107												I						P						G	G					
220.0	227																							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	B	B		X	X	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	B			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			B	B				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		F	C	C	C	C	
8.2	825																												
10.0	106							I	I	I				J	J	P				C	C	E	F	F	C	C	C	F	
22.0	226							I	I					P	P					F	F								
47.0	476												P							F	F					G			
100.0	107																			G									

### 7-4 X6S Dielectric

Dimension		0201		0402				0603					0805					1206					1210									
Cap(μF)	code	4V	6.3V	10V	16V	25V	4V	6.3V	10V	16V	25V	50V	4V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V	50V	6.3V	10V	16V	25V
1.0	105	L	N	K	K	K																										
1.2	125																															
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2.2	225		N	K	K						B																					
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3.3	335																															
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4.7	475								B		B	B											I	I								
5.6	565																															
6.8	685																															
8.2	825																															
10.0	106								B	B	B			I	I	I	I	I										E				
22.0	226						B	B																	P	P						G
47.0	476													I										P					G	G	G	
100.0	107																											G				

## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements																																																
1.	Visual and Dimensions	---	* No remarkable defect. * Dimensions to conform to individual specification sheet.																																																
2.	Capacitance	Class I:NP0	Shall not exceed the limits given in the detailed spec.																																																
3.	Q/ D.F. (Dissipation Factor)	Cap≤1000pF 1.0±0.2Vrms, 1MHz±10%	NP0: Cap≥30pF, Q≥1000; Cap<30pF,Q≥400+20C X7R, X5R: X6S <table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th colspan="2">Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td rowspan="3">50V</td> <td rowspan="3">2.5%</td> <td>3.5%</td> <td>0201(50V); 0603≥0.047μF; 0805≥0.10μF;1206≥0.47μF 0402≥0.01μF(X7R)</td> </tr> <tr> <td>5%</td> <td>0805≥1.0μF;1210≥4.7μF</td> </tr> <tr> <td>10%</td> <td>0402≥0.1μF;0603&gt;0.22μF; 0805≥0.1μF;1206≥1.0μF, 1210≥4.7μF</td> </tr> <tr> <td rowspan="2">35V</td> <td rowspan="2">5%</td> <td>5%</td> <td>0402≥0.1μF;0603&gt;1.0μF; 1210≥10μF</td> </tr> <tr> <td>10%</td> <td>0805≥2.2μF; 1210≥4.7μF</td> </tr> <tr> <td rowspan="3">25V</td> <td rowspan="3">3.5%</td> <td>5%</td> <td>0201≥0.01μF;0805≥1μF; 1210≥10μF 0402≥0.01μF;0603≥1μF; 1206≥4.7μF</td> </tr> <tr> <td>10%</td> <td>0402≥0.10μF;0603≥0.47μF; 0805≥2.2μF; 1206≥4.7μF ; 1210≥10μF</td> </tr> <tr> <td>12.5%</td> <td>0402≥1.0μF</td> </tr> <tr> <td rowspan="2">16V</td> <td rowspan="2">3.5%</td> <td>5%</td> <td>0201≥0.01μF;0402≥0.033μF;0603≥0.15μF; 0805≥0.68μF;1206≥2.2μF;1210≥4.7μF</td> </tr> <tr> <td>10%</td> <td>0201≥0.1μF; 0402≥ 0.22μF; 0603≥0.68μF;0805≥2.2μF; 1206≥4.7μF; 1210≥22μF</td> </tr> <tr> <td rowspan="2">10V</td> <td rowspan="2">5%</td> <td>10%</td> <td>0201≥0.012μF;0402≥0.1μF;0603≥0.33μF; 0805≥2.2μF, 1206≥2.2μF;1210≥22μF</td> </tr> <tr> <td>15%</td> <td>0201≥0.1μF; 0402≥1μF</td> </tr> <tr> <td rowspan="2">6.3V</td> <td rowspan="2">10%</td> <td>15%</td> <td>0201≥0.1μF;0402≥1μF;0603≥10μF; 0805≥4.7μF; 1206≥47μF ;1210≥100μF;</td> </tr> <tr> <td>20%</td> <td>0402≥2.2μF</td> </tr> <tr> <td>4V</td> <td>15%</td> <td>---</td> <td>---</td> </tr> </tbody> </table>	Rated vol.	D.F. ≤	Exception of D.F. ≤		50V	2.5%	3.5%	0201(50V); 0603≥0.047μF; 0805≥0.10μF;1206≥0.47μF 0402≥0.01μF(X7R)	5%	0805≥1.0μF;1210≥4.7μF	10%	0402≥0.1μF;0603>0.22μF; 0805≥0.1μF;1206≥1.0μF, 1210≥4.7μF	35V	5%	5%	0402≥0.1μF;0603>1.0μF; 1210≥10μF	10%	0805≥2.2μF; 1210≥4.7μF	25V	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	12.5%	0402≥1.0μF	16V	3.5%	5%	0201≥0.01μF;0402≥0.033μF;0603≥0.15μF; 0805≥0.68μF;1206≥2.2μF;1210≥4.7μF	10%	0201≥0.1μF; 0402≥ 0.22μF; 0603≥0.68μF;0805≥2.2μF; 1206≥4.7μF; 1210≥22μF	10V	5%	10%	0201≥0.012μF;0402≥0.1μF;0603≥0.33μF; 0805≥2.2μF, 1206≥2.2μF;1210≥22μF	15%	0201≥0.1μF; 0402≥1μF	6.3V	10%	15%	0201≥0.1μF;0402≥1μF;0603≥10μF; 0805≥4.7μF; 1206≥47μF ;1210≥100μF;	20%	0402≥2.2μF	4V	15%	---	---
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4V	15%	---	---																																																
4.	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> <tr> <td>X6S</td> <td>-55~105°C at 25°C</td> <td>X6S</td> <td>Within ±22%</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	Within +30%/-80%	X6S	-55~105°C at 25°C	X6S	Within ±22%																													
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## 8. RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Con.)

No.	Item	Test Condition	Requirements																									
5.	Insulation Resistance	To apply rated voltage for max. 120 sec.	Class II ≥10GΩ or RxC≥100Ω-F whichever is smaller.																									
6.	Dielectric Strength	<table border="1"> <thead> <tr> <th>Rated vol.(V)</th> <th>Condition</th> </tr> </thead> <tbody> <tr> <td>≤ 250</td> <td>2.0 times of U<sub>R</sub></td> </tr> <tr> <td>250&lt;V≤500</td> <td>1.5 times of U<sub>R</sub></td> </tr> <tr> <td>630≤V≤3000V</td> <td>1.2 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	≤ 250	2.0 times of U <sub>R</sub>	250<V≤500	1.5 times of U <sub>R</sub>	630≤V≤3000V	1.2 times of U <sub>R</sub>	* No evidence of damage or flash over during test.																	
Rated vol.(V)	Condition																											
≤ 250	2.0 times of U <sub>R</sub>																											
250<V≤500	1.5 times of U <sub>R</sub>																											
630≤V≤3000V	1.2 times of U <sub>R</sub>																											
7.	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.																									
8.	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>Cap Change</th> <th>Q/D.F. &amp; IR</th> </tr> </thead> <tbody> <tr> <td>Class II(X7R,X6S)</td> <td>within ±7.5%</td> <td rowspan="2">To meet Initial requirement</td> </tr> <tr> <td>Class II(Y5V)</td> <td>within ±20%</td> </tr> </tbody> </table> <p>* 25% max. Leaching on each edge.</p>	Dielectric	Cap Change	Q/D.F. & IR	Class II(X7R,X6S)	within ±7.5%	To meet Initial requirement	Class II(Y5V)	within ±20%																	
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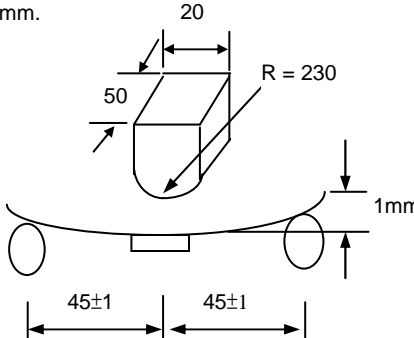
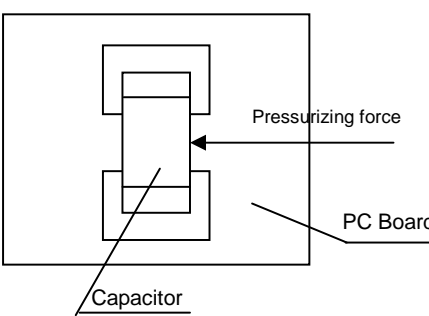
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16V (C<1.0μF)	≤10.0%	≤12.5%	0402≥0.068μF; 0603≥0.68μF																																																																																		
		≤20.0%	0402≥0.22μF																																																																																		
16V (C≥1.0μF)	≤12.5%	≤20.0%	0603≥2.2μF ;0805≥3.3μF; 1206≥10μ 1210≥22μF; 1812≥47μF																																																																																		
10V	≤20.0%	≤30.0%	0402≥0.47uF																																																																																		
		≤30.0%	---																																																																																		
6.3V	≤30.0%	---	---																																																																																		
12.	<b>Temperature Humidity Bias test (THB)</b>	<ul style="list-style-type: none"> <li>* Test temp.: 85±2°C</li> <li>* Humidity: 85% RH</li> <li>* Test time: 1000+24/-0hrs. (FQC: ≥168 hrs)</li> <li>* To apply voltage:200% rated voltage(Max 100Vdc)</li> <li>* Measurement to be made after keeping at room temp. for 48±4 hrs.(Class II)</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: X7R/X5R within ±12.5% ; X6S within ±20%</li> <li>* D.F.: ≤ 200% × Initial requirement</li> <li>* I.R.: ≥30% initial requirement.</li> </ul>																																																																																		

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

No.	Item	Test Condition	Requirements																									
13.	High Temperature Load (Endurance)	* Test temp.: X7R: 125±3°C X6S: 105±3°C X5R, Y5V: 85±3°C	* Cap change: X7R, X5R, X6S: ≥10V**, within ±12.5%; 6.3V within ±25%; **10V: 0603≥4.7µF; 0402≥1µF; 0201≥0.1µF, within ±25%; Y5V: ≥10V, within ±30%; 6.3V, within +30/-40%																									
		Rated vol.(V)	Apply Voltage																									
		≤ 250	2 times of U <sub>R</sub>																									
		250 <V ≤ 500	1.5 times of U <sub>R</sub>																									
		= 630	1.2 times of U <sub>R</sub>																									
		Exception item:		* Q/D.F Value: X7R, X5R, X6S:																								
		Rated vol.(V)	Dielectric	Size	Cap. Range	Apply Voltage	Rated vol.	D.F. ≤	Exception of D.F. ≤																			
		4 & 6.3	X7R/X6S	All	All	150% times of U <sub>R</sub>	≥ 50V	3%	6% 0201(50V); 0603 ≥ 0.047µF; 0805 ≥ 0.18µF; 1206 ≥ 0.47µF 10% 1210 ≥ 4.7µF 20% 0603 ≥ 1µF; 0805 ≥ 1µF; 1206 ≥ 4.7µF; 1210 ≥ 10µF																			
		10	X5R	0402	C ≥ 0.22µF																							
				0603	C ≥ 1.0µF																							
				0805	C ≥ 2.2µF																							
		16	X5R	0402	C ≥ 0.22µF																							
				0603	C ≥ 1.0µF																							
0402	C ≥ 0.47µF																											
16	Y5V	0603	C ≥ 2.2µF																									
		0805	C ≥ 4.7µF																									
		25	X5R	0402	C ≥ 0.22µF																							
100	X7R/X6S	0805	C ≥ 0.22µF																									
		1206	C ≥ 1.0µF																									
		1210																										
		1825																										
		2220																										
2225																												
200 & 250	X7R/X6S	1210	C ≥ 0.22µF																									
		1812	C ≥ 0.47µF																									
		X7R/X6S	1825	C ≥ 1.0µF																								
			2220																									
			2225																									
6.3	X5R	All	C ≥ 10µF																									
		0201	C ≥ 0.1µF																									
		0402	C ≥ 1.0µF																									
		0603	C ≥ 4.7µF																									
		0805	C ≥ 2.2µF																									
		1206	C ≥ 47µF																									
10	Y5V	0402	C ≥ 1.0µF																									
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			0402	C ≥ 1.0µF																								
0603	C ≥ 4.7µF																											
	Y5V	0402	C ≥ 1.0µF																									
* Test time: 1000+24/-0 hrs.		* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.																										
* Measurement to be made after keeping at room temp. for 48±4 hrs (Class II).		Y5V: Rated vol. D.F. ≤ Exception of D.F. ≤																										
		<table border="1"> <thead> <tr> <th>Rated vol.</th> <th>D.F. ≤</th> <th>Exception of D.F. ≤</th> </tr> </thead> <tbody> <tr> <td>≥ 50V</td> <td>7.5%</td> <td>10% 0603 ≥ 0.1µF; 0805 ≥ 0.47µF; 1206 ≥ 4.7µF</td> </tr> <tr> <td>35V</td> <td>10%</td> <td>---</td> </tr> <tr> <td rowspan="2">25V</td> <td rowspan="2">7.5%</td> <td>10% 0402 ≥ 0.047µF; 0603 ≥ 0.1µF; 0805 ≥ 0.33µF; 1206 ≥ 1µF; 1210 ≥ 4.7µF</td> </tr> <tr> <td>15% 0402 ≥ 0.068µF; 0603 ≥ 0.47µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF</td> </tr> <tr> <td>16V (C&lt;1.0µF)</td> <td>10%</td> <td>12.5% 0402 ≥ 0.068µF; 0603 ≥ 0.68µF 20% 0402 ≥ 0.22µF</td> </tr> <tr> <td>16V (C ≥ 1.0µF)</td> <td>12.5%</td> <td>20% 0603 ≥ 2.2µF; 0805 ≥ 3.3µF; 1206 ≥ 10µF; 1210 ≥ 22µF; 1812 ≥ 47µF;</td> </tr> <tr> <td>10V</td> <td>20%</td> <td>30% 0402 ≥ 0.47µF</td> </tr> <tr> <td>6.3V</td> <td>30%</td> <td>---</td> </tr> </tbody> </table>		Rated vol.	D.F. ≤	Exception of D.F. ≤	≥ 50V	7.5%	10% 0603 ≥ 0.1µF; 0805 ≥ 0.47µF; 1206 ≥ 4.7µF	35V	10%	---	25V	7.5%	10% 0402 ≥ 0.047µF; 0603 ≥ 0.1µF; 0805 ≥ 0.33µF; 1206 ≥ 1µF; 1210 ≥ 4.7µF	15% 0402 ≥ 0.068µF; 0603 ≥ 0.47µF; 1206 ≥ 4.7µF; 1210 ≥ 22µF	16V (C<1.0µF)	10%	12.5% 0402 ≥ 0.068µF; 0603 ≥ 0.68µF 20% 0402 ≥ 0.22µF	16V (C ≥ 1.0µF)	12.5%	20% 0603 ≥ 2.2µF; 0805 ≥ 3.3µF; 1206 ≥ 10µF; 1210 ≥ 22µF; 1812 ≥ 47µF;	10V	20%	30% 0402 ≥ 0.47µF	6.3V	30%	---
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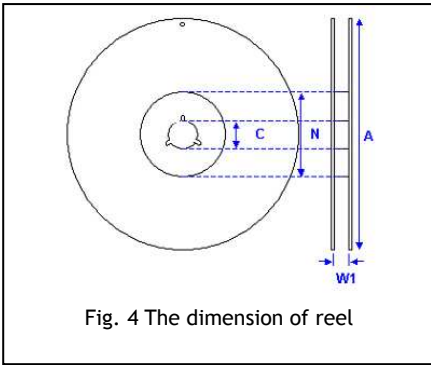
## RELIABILITY TEST CONDITIONS AND REQUIREMENTS(Con.)

No.	Item	Test Condition	Requirements										
14.	<b>Resistance to Flexure of Substrate</b>	<p>* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1mm per second until the deflection becomes 1mm.</p> 	<p>* No remarkable damage.</p> <table border="1"> <thead> <tr> <th>Dielectric</th> <th>Cap Change</th> </tr> </thead> <tbody> <tr> <td>Class I(NPO)</td> <td>within <math>\pm 3.0\%</math> or <math>\pm 0.3\text{pF}</math> whichever is larger</td> </tr> <tr> <td>Class II(X7R)</td> <td>within <math>\pm 12.5\%</math></td> </tr> <tr> <td>Class II(X6S)</td> <td>within <math>\pm 20\%</math></td> </tr> <tr> <td>Class II(Y5V)</td> <td>within <math>\pm 30\%</math></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 I(NPO)	within $\pm 3.0\%$ or $\pm 0.3\text{pF}$ whichever is larger	Class II(X7R)	within $\pm 12.5\%$	Class II(X6S)	within $\pm 20\%$	Class II(Y5V)	within $\pm 30\%$
Dielectric	Cap Change												
Class I(NPO)	within $\pm 3.0\%$ or $\pm 0.3\text{pF}$ whichever is larger												
Class II(X7R)	within $\pm 12.5\%$												
Class II(X6S)	within $\pm 20\%$												
Class II(Y5V)	within $\pm 30\%$												
15.	<b>Adhesive Strength of Termination</b>	<p>* Capacitors mounted on a substrate. A force of 5N(<math>\leq 0603</math>) or 10N(<math>&gt; 0603</math>) applied perpendicular to the place of substrate and parallel the line joining the center of terminations for <math>10 \pm 1</math> second.</p> 	<p>* No remarkable damage or removal of the terminations.</p>										
16.	<b>Vibration Resistance</b>	<p>* Vibration frequency: 10~55 Hz/min.            * Total amplitude: 1.5mm            * Test time: 6 hrs. (Two hrs each in three mutually perpendicular directions.)</p>	<p>* No remarkable damage.            * Cap change and Q/D.F.: To meet initial spec.</p>										

## 9. PACKAGING STYLE AND QUANTITY

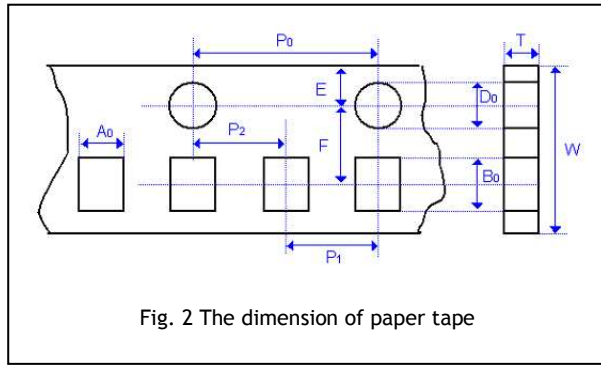
Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
0201 (0603)	0.30±0.05	15k	70K	-	-
0402 (1005)	0.50±0.05	10k	50k	-	-
0603 (1608)	0.80±0.07	4k	15k	-	-
	0.80+0.15/-0.10	4k	15k	-	-
0805 (2012)	0.80±0.10	4k	15k	-	-
	1.25±0.10	-	-	3k	10k
	1.25±0.20	-	-	3k	10k
1206 (3216)	0.95±0.10	-	-	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

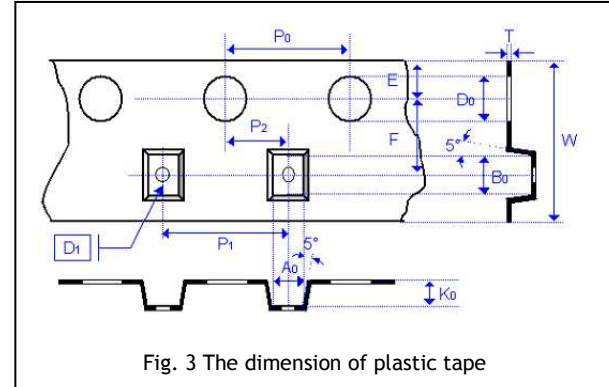


Size	0201,0402, 0603, 0805, 1206, 1210			1812, 1825, 2220, 2225
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W <sub>1</sub>	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	330.0±1.0	178.0±0.10
N	60.5±1.0	100.0±1.0	100±1.0	60.5±1.0

**9-1 CARDBOARD TAPE DIMENSIONS**



**9-2 EMBOSSED TAPE DIMENSIONS**



Size	0201	0402	0603		0805			1206			1210	
Chip Thickness	0.30 ± 0.03	0.50±0.05	0.80±0.07	0.80 +0.15/-0.10	0.60±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>	0.38±0.05	0.62±0.05	1.00 +0.05/-0.10	1.02 +0.05/-0.10	1.50±0.10	1.50±0.10	<1.65	2.00±0.10	<2.00	<2.00	<3.05	<3.10
B <sub>0</sub>	0.68±0.05	1.12±0.05	1.80±0.10	1.80±0.10	2.30±0.10	2.30±0.10	<2.40	3.50±0.10	<3.60	<3.70	<3.80	<4.00
T	0.42±0.05	0.60±0.05	0.95±0.05	0.97±0.05	0.75±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	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±0.10	4.00±0.10	4.00±0.10	4.00±0.10
10xP <sub>0</sub>	40.0±0.10	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	40.00±0.20	40.0±0.10
P <sub>1</sub>	2.00±0.05	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	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	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	1.55±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±0.05	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	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 0201, 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.

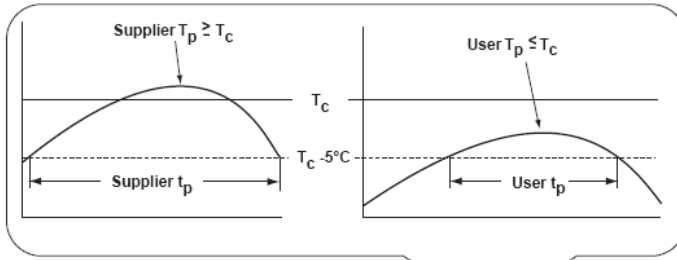
Lead-free : Soldering temperature = 235 to 260°C, depending on product.

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).

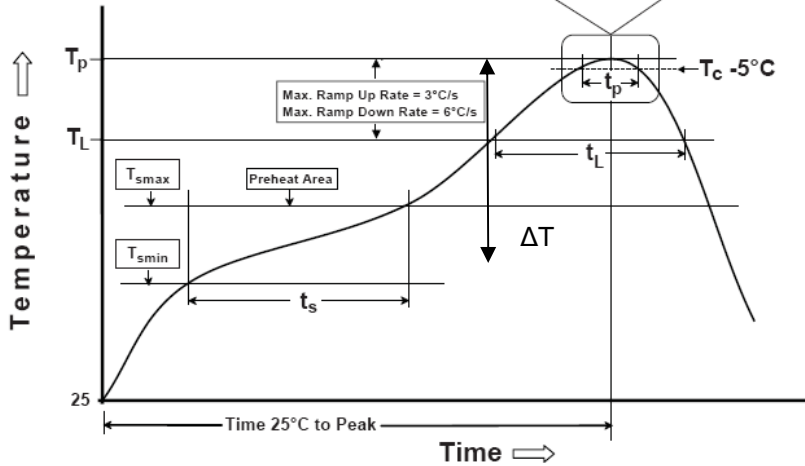


Classification Reflow Profiles



Chip Size	$\Delta T$
0201, 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>32</u>	<u>X</u>	<u>225</u>	<u>K</u>	<u>101</u>	<u>E</u>	<u>G</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

Table 1 PDC family			
Code	Description	Code	Description
FS	Size $\leq$ 2225 , Ur < 1000V Capacitance $\geq$ 1.0 $\mu$ F Series Product		

Table 2 EIA size			
General Purpose			
Code	Description	Code	Description
03	0201(0603)	42	1808 (4520)
15	0402(1005)	43	1812 (4532)
18	0603 (1608)	46	1825 (4563)
21	0805 (2012)	52	2211 (5728)
31	1206 (3216)	55	2220 (5750)
32	1210 (3225)	56	2225 (5763)

Table 3 Dielectric Material Characteristics			
Code	Description	Code	Description
N	C0G(NPO)	X	X7R
B	X5R	F	Y5V
S	X6S		

Table 4 Capacitance Rule Code					
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> =10 $\mu$ F

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

Table 6 Rated voltage							
General Purpose							
Code	Description	Code	Description	Code	Description	Code	Description
6R3	6.3VDC	101	100VDC	102	1000VDC	402	4000VDC
100	10VDC	201	200VDC	152	1500VDC	502	5000VDC
160	16VDC	251	250VDC	202	2000VDC	602	6000VDC
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	D	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		