

# FV EXTRA HIGH VOLTAGE CAPACITORS SERIES

## 1. INTRODUCTION

FV Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. Reliable performances are built-in through exact formulation of dielectric powders, preparation of conductive paste, advanced automatic manufacturing, and strict quality control to assure excellent control in dielectric thickness, electrode integrity, and electrode-to-termination continuity.

## 2. FEATURES

- a. Special interior design offers high voltage rating in a given case size.
- b. High reliability and stability.
- c. RoHS compliant

## 3. APPLICATIONS

- a. DC to DC converter.
- b. High voltage coupling/DC blocking.
- c. Back-lighting inverters.
- d. LAN/WLAN interface.
- e. Modem.
- f. Power supplies.

## 4. HOW TO ORDER

FV	2211	N	101	J	602	E	F	G
<u>FL Family</u>	<u>Size</u>	<u>Dielectric</u>	<u>Capacitance</u>	<u>Tolerance</u>	<u>Rated voltage</u>	<u>Packaging</u>	<u>Thiekness</u>	<u>Control Code</u>
	Inch (mm) 2211(5728)	N: NPO X: X7R	Two significant digits followed by no. of zeros. And R is in place of decimal point.  eg.: R47=0.47pF 0R5=0.5pF 1R0=1.0pF 100=10x10 <sup>0</sup> =10pF	B=±0.1pF C=±0.25pF D=±0.5pF F=±1% G=±2% J=±5% K=±10% M=±20%	Two significant digits followed by no. of zeros. And R is in place of decimal point.  402= 4000 VDC 502= 5000 VDC 602= 6000 VDC	E: Tape and Reel, Embossed Tape No Code: Bulk	E: 1.60±0.20mm F: 2.00±0.20mm G: 2.50±0.20mm	G: RoHS compliant

## 5. GENERAL ELECTRICAL DATA

<b>Dielectric</b>	NPO	X7R
<b>Size</b>	2211	2211
<b>Rated voltage (WVDC)</b>	6KV	4KV
<b>Capacitance range*</b>	4pF~100pF	100pF~1000pF
<b>Capacitance tolerance</b>	Cap $\leq$ 5pF: B ( $\pm$ 0.1pF) C ( $\pm$ 0.25pF) 5pF<Cap<10pF: C ( $\pm$ 0.25pF) D ( $\pm$ 0.5pF) Cap $\geq$ 10pF: F ( $\pm$ 1%), G ( $\pm$ 2%), J ( $\pm$ 5%), K ( $\pm$ 10%)	J ( $\pm$ 5%) K ( $\pm$ 10%) M ( $\pm$ 20%)
<b>Tan <math>\delta</math> *</b>	Cap<30pF: Q $\geq$ 400+20C Cap $\geq$ 30pF: Q $\geq$ 1000	$\leq$ 2.5%
<b>Insulation resistance at 500Vdc for 60 seconds</b>	$\geq$ 100G $\Omega$ or R-C $\geq$ 1000 whichever is smaller	10G $\Omega$ or R-C $\geq$ 500 whichever is smaller
<b>Operating temperature</b>	-55 to +125°C	-55 to +125°C
<b>Temperature coefficient</b>	$\pm$ 30ppm / °C	$\pm$ 15%
<b>Termination</b>	Ag/Ni/Sn (lead-free termination)	Ag/Ni/Sn (lead-free termination)

\* Measured at the condition of 30~70% related humidity.

NPO: Apply 1.0 $\pm$ 0.2Vrms, 1.0MHz $\pm$ 10% for Cap $\leq$ 1000pF and 1.0 $\pm$ 0.2Vrms, 1.0kHz $\pm$ 10% for Cap>1000pF, 25°C at ambient temperature.

X7R: Apply 1.0 $\pm$ 0.2Vrms, 1.0kHz $\pm$ 10%, at 25°C ambient temperature.

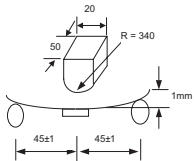
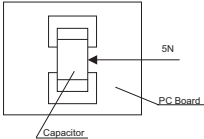
## 6. CAPACITANCE RANGE (NPO Dielectric)

6-1 2211 Sizes.

DIELECTRIC		NPO (C0G)
SIZE		2211
RATED VOLTAGE (VDC)		6000
Capacitance	4.0pF (4R0)	
	4.7pF (4R7)	
	5.0pF (5R0)	
	5.6pF (5R6)	
	6.8pF (6R8)	
	8.2pF (8R2)	
	10pF (100)	
	12pF (120)	
	15pF (150)	
	18pF (180)	
	22pF (220)	
	27pF (270)	
	33pF (330)	
	39pF (390)	
	47pF (470)	
	56pF (560)	
	68pF (680)	
	82pF (820)	
100pF (101)		

DIELECTRIC		X7R
SIZE		2211
RATED VOLTAGE (VDC)		4000
Capacitance	68pF (680)	
	82pF (820)	
	100pF (101)	
	120pF (121)	
	150pF (151)	
	180pF (181)	
	220pF (221)	
	270pF (271)	
	330pF (331)	
	390pF (391)	
	470pF (471)	
	560pF (561)	
	680pF (681)	
	820pF (821)	
	1000pF (102)	

## 7. RELIABILITY TEST CONDITIONS AND REQUIREMENTS

No.	Item	Test Condition	Requirements															
1.	Visual and Mechanical	---	<ul style="list-style-type: none"> <li>* No remarkable defect.</li> <li>* Dimensions to conform to individual specification sheet.</li> </ul>															
2.	Capacitance	Class I: (COG) Cap $\leq$ 1000pF, 1.0 $\pm$ 0.2Vrms, 1MHz $\pm$ 10% Cap $>$ 1000pF, 1.0 $\pm$ 0.2Vrms, 1KHz $\pm$ 10%	<ul style="list-style-type: none"> <li>* Shall not exceed the limits given in the detailed spec.</li> </ul>															
3.	Q/ D.F. (Dissipation Factor)	Class II:(X7R) 1.0 $\pm$ 0.2Vrms, 1KHz $\pm$ 10%	<ul style="list-style-type: none"> <li>NP0: Cap<math>\geq</math>30pF, Q<math>\geq</math>1000; Cap<math>&lt;</math>30pF, Q<math>\geq</math>400+20C</li> <li>X7R: <math>\leq</math>2.5%</li> </ul>															
4.	Temperature Coefficient	With no electrical load. <table border="1"> <thead> <tr> <th>T.C.</th> <th>Operating Temp</th> </tr> </thead> <tbody> <tr> <td>NP0</td> <td>-55°C~125°C at 25°C</td> </tr> <tr> <td>X7R</td> <td>-55°C~125°C at 25°C</td> </tr> </tbody> </table>	T.C.	Operating Temp	NP0	-55°C~125°C at 25°C	X7R	-55°C~125°C at 25°C	<table border="1"> <thead> <tr> <th>T.C.</th> <th>Capacitance Change</th> </tr> </thead> <tbody> <tr> <td>NP0</td> <td>Within <math>\pm</math>30ppm/°C</td> </tr> <tr> <td>X7R</td> <td>Within <math>\pm</math>15%</td> </tr> </tbody> </table>	T.C.	Capacitance Change	NP0	Within $\pm$ 30ppm/°C	X7R	Within $\pm$ 15%			
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5.	Dielectric Strength	* To apply voltage: 1 times of $U_n$	* No evidence of damage or flashover during test.															
6.	Insulation Resistance	* To apply voltage at 500VDC for 60 sec.	Class I (NP0) : $\geq$ 100G $\Omega$ or Rx $C \geq$ 1000 $\Omega$ -F whichever is smaller. Class II (X7R): $\geq$ 10G $\Omega$ or Rx $C \geq$ 500 $\Omega$ -F whichever is smaller.															
7.	Solderability	<ul style="list-style-type: none"> <li>* Solder temperature: 245<math>\pm</math>5°C</li> <li>* Dipping time: 5<math>\pm</math>0.5 sec.</li> </ul>	75% min. coverage of all metalized area.															
8.	Resistance to Soldering Heat	<ul style="list-style-type: none"> <li>* Solder temperature: 260<math>\pm</math>5°C</li> <li>* Dipping time: 10<math>\pm</math>1 sec</li> <li>* Preheating: 120 to 150°C for 1 minute before immerse the capacitor in a eutectic solder.</li> <li>* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48<math>\pm</math>4 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: NP0: within <math>\pm</math>2.5% or <math>\pm</math>0.25pF whichever is larger. X7R: within <math>\pm</math>7.5%</li> <li>* 25% max. leaching on each edge.</li> </ul>															
9.	Temperature Cycle	<ul style="list-style-type: none"> <li>* Conduct the five cycles according to the temperatures and time.</li> </ul> <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<math>\pm</math>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<math>\pm</math>3</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>2~3</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>* Before initial measurement (Class II only): Perform 150+0/-10°C for 1 hr and then set for 48<math>\pm</math>4 hrs at room temp.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>	Step	Temp. (°C)	Time (min.)	1	Min. operating temp. +0/-3	30 $\pm$ 3	2	Room temp.	2~3	3	Max. operating temp. +3/-0	30 $\pm$ 3	4	Room temp.	2~3	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: NP0: within <math>\pm</math>2.5% or <math>\pm</math>0.25pF whichever is larger. X7R: within <math>\pm</math>15%</li> <li>* Q/D.F.:</li> <li>NP0: <math>\leq</math>2.0 <math>\times</math> Initial requirement</li> <li>X7R: <math>\leq</math>1.5 <math>\times</math> Initial requirement</li> <li>* I.R. <math>\geq</math> 0.25 <math>\times</math> initial requirement</li> </ul>
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1	Min. operating temp. +0/-3	30 $\pm$ 3																
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3	Max. operating temp. +3/-0	30 $\pm$ 3																
4	Room temp.	2~3																
10.	Humidity (Damp Heat) Steady State	<ul style="list-style-type: none"> <li>* Test temp.: 40<math>\pm</math>2°C</li> <li>* Humidity: 90~95% RH</li> <li>* Test time: 500+24/-0hrs.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: NP0 within <math>\pm</math>5% or <math>\pm</math>2pF whichever is larger X7R: within <math>\pm</math>15%</li> <li>* Q/D.F Value: NP0: Cap<math>\geq</math>30pF, Q<math>\geq</math>350; 10pF<math>\leq</math>Cap<math>&lt;</math>30pF, Q<math>\geq</math>275+2.5C Cap<math>&lt;</math>10pF; Q<math>\geq</math>200+10C X7R: <math>\leq</math>7.0%</li> <li>* I.R.: <math>\geq</math>1G<math>\Omega</math> or Rx<math>C \geq</math>50<math>\Omega</math>-F whichever is smaller.</li> </ul>															
11.	High Temperature Load (Endurance)	<ul style="list-style-type: none"> <li>* Test temp.: 125<math>\pm</math>3°C</li> <li>* To apply voltage: 100% of rated voltage.</li> <li>* Test time: 1000+24/-0 hrs.</li> <li>* Measurement to be made after keeping at room temp. for 24<math>\pm</math>2 hrs (Class I) or 48<math>\pm</math>4 hrs (Class II).</li> </ul>	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: NP0: within <math>\pm</math>3% or <math>\pm</math>3pF whichever is larger. X7R: within <math>\pm</math>20%</li> <li>* Q/D.F value: NP0: Cap<math>\geq</math>30pF, Q<math>\geq</math>350 10pF<math>\leq</math>Cap<math>&lt;</math>30pF, Q<math>\geq</math>275+2.5C Cap<math>&lt;</math>10pF, Q<math>\geq</math>200+10C X7R: <math>\leq</math>7.0%</li> <li>* I.R.:</li> <li><math>\geq</math>10V, <math>\geq</math>1G<math>\Omega</math> or Rx<math>C \geq</math>50<math>\Omega</math>-F whichever is smaller.</li> </ul>															
12.	Bending Test	<ul style="list-style-type: none"> <li>* 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.</li> </ul> 	<ul style="list-style-type: none"> <li>* No remarkable damage.</li> <li>* Cap change: within <math>\pm</math>10% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)</li> </ul>															
13.	Adhesive Strength of Termination	<ul style="list-style-type: none"> <li>* Capacitors mounted on a substrate. A force of 5N applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10<math>\pm</math>1 sec.</li> </ul> 	* No remarkable damage or removal of the terminations.															