

# MD series Monolithic (Multilayer) Ceramic Capacitors

### **Part Number**

**MD 471 X7R 500** <u>R</u> <u> 25</u> 1 **(4) (6)** 2 (3) **(5)** 

1 Type: MD = Monolithic (Multilayer) Ceramic Capacitors

### (2) Capacitance Value

Value	6.8pF	12pF	470pF	2200pF	100nF
Code	6P8	120	471	222	104

(3) Dielectric: NPO × X5R × X7R × Y5V × Z5U

### (4) Capacitance tolerance

Tolerance	±0.25pF	±0.5pF	±1%	±2%	±5%	±10%	±20%	+80%-20%
Code	С	D	F	G	J	K	М	Z

### (5) Rated Voltage (VDC)

Voltage	6.3V	10V	16V	25V	50V	100V	250V	500V	1000V	2000V	3000V
Code	6V3	100	160	250	500	101	251	501	102	202	302

### 6 Lead Type

Туре	Radial	Axial
Code	R	Α

### 7 Packing

Туре	Bulk	Taping (AMMO)	REEL
Code	В	Т	R

(mm)

### (8) Lead Spacing

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Lead Spacing	2.5 ± 0.8	5 ± 0.8	6.35 ± 0.8	7.5 ± 1.0	10 ± 1.0
Code	03	05	06	07	10

### (9) Lead Length

(mm)

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Lead Length	3.5 ± 1.0	6 ± 1.0	10 ± 1.0	16 +1.5/-1.0	20 +1.5/-1.0	25 (Min.)	30 (Min.)
Code	04	06	10	16	20	25	30

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**NPO** 

### **Electrical Characteristics**

Item	Temperature Compensating	Measuring Condition	
Operating Temperature Range	-55 ~ +125°C		
Temperature Characteristics	0 ± 30 ppm/°C		
Capacitance	Within the specified tolerance	Shall be measured at 25°C± 2°C at the frequency and	
Q	$C \ge 30 pF : Q \ge 1000$ $C < 30 pF : Q \ge 400 + 20 \times C$ (C is nominal capacitance)	voltage.  C ≦ 1000pF @ 1MHz ± 20%, 1± 0.2Vrms  C > 1000pF @ 1KHz ± 10%, 1± 0.2Vrms	
Withstanding Voltage	No defects	Applied voltage:  Rated voltage ×3  500V Rated voltage(over) ×2  Duration: 1 to 5 sec.  The charge/discharge current is less than 50mA.	
Insulation Resistance	More than $10G\Omega$ or $500M\Omega$ ' $\mu$ F , whichever is less $16Vdc$ product : More than $10G\Omega$ or $100M\Omega$ ' $\mu$ F , whichever is less	Apply rated voltage for 1 minute at 25°C ± 2°C and 70% R.H. max.  16Vdc product :  Measurement voltage is 25Vdc	



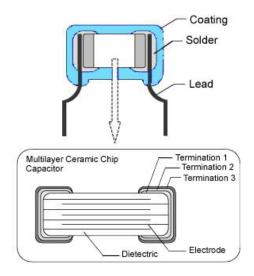
# **Electrical Characteristics** X7R/X5R/Y5V/Z5U

Item	Hig	h Dielectric Constant	Measuring Condition
Operating Temperature Range	$X7R = -55 \sim +7$ $X5R = -55 \sim +8$ $Y5V = -30 \sim +8$ $Z5U = +10 \sim +85$	85°C 85°C	
Temperature Characteristics	X7R/X5R= ± 15 Y5V= +22 to - 82 Z5U= +22 to - 56	2%	
Capacitance	Within the specif	ied tolerance	
	25V min	X7R=0.03max. Y5V=0.075max. Z5U=0.09max.	Shall be measured at 25°C± 2°C at the frequency and voltage.
Dissipation Factor (tan $\delta$ )	16V X7R/X5R=0.05max. Y5V=0.10max.		X7R/X5R/Y5V @ 1KHz ± 10%, 1± 0.2Vrms
	10V max.	X7R/X5R=0.05max. Y5V=0.125max.	Z5U @ 1KHz ± 10%, 0.5± 0.2Vrms
	6.3V	X5R=0.075max.	
Withstanding Voltage		No defects	Applied voltage:  Rated voltage ×2.5  500V Rated voltage(over) ×2  Duration: 1 to 5 sec.  The charge/discharge current is less than 50mA
Insulation Resistance	whichever is less 16Vdc product :	$\Omega$ or 100M $\Omega$ • uF ,	Apply rated voltage for 1 minute at 25°C ± 2°C and 70% R.H. max.  16Vdc product :  Measurement voltage is 25Vdc

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### Material List



# Storage

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» The storage conditions should be:

Temperature = Lower than 40°C

Humidity = Lower than 70% R.H.

» After opening the package, please store in desiccators.

### Environmental and Test Characteristics

Item	Temperature Compensating	Measuring Condition
Strength of termination	Termination not to be broken or loosened  Force: 2 LB min.  Keep time: 10 ± 1 sec.	
Solderability of leads	Lead wire to be soldered vertically up to the coating end point.  At least 75% of lead surface is covered.	Solder temperature : 270 ± 5°C  Dipping : 2 ± 0.5 sec.  (Containing Ag 2 ~ 5%)  (Flux shall be used)

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### **Environmental and Test Characteristics**

# **NPO**

ltem	Temperature Compensating	Measuring Condition			
Resistance to Soldering heat					
ΔC	± 2.5% or ± 0.25pF (Whichever is greater)				
Q	$C \ge 30pF : Q \ge 1000$ $C < 30pF : Q \ge 400 + 20 \times C$ (C is nominal capacitance)	The lead wire is immersed in the melted solder 1.5mm to 2mm from the main body at 260 $\pm$ 5°C for			
I.R.	More than $10G\Omega$ or $500M\Omega$ $\mu$ F , whichever is less. 16Vdc product :	10 ± 0.5sec.  Let sit at room temperature for 24 ± 2 hrs. then measure.			
	More than $10G\Omega$ or $100M\Omega$ $^{\bullet}$ $\mu$ F , whichever is less.	Perform the initial measurement.			
Withstanding voltage	No defects				
Exterior	No abnormalities				
Thermal shock					
ΔC	± 2.5% or ± 0.25pF (Whichever is greater)	Fix the capacitor to the supporting jig in the same			
Q	C ≧ 30pF : Q ≧ 1000 C < 30pF : Q ≧ 400 + 20 × C (C is nominal capacitance)	manner and under the same conditions as (10).  Perform the five cycles according to the four heat treatments listed in the following table. Remove and let sit at room temperature for 24 ± 2 hrs., then measure.			
	More than $10G\Omega$ or $500M\Omega$ $^{ullet}$ $\mu$ F ,	Step         1         2         3         4			
I.R.	whichever is less.  16Vdc product :  More than 10GΩ or 100MΩ μ F.	Temp. (°C) Min. Room Operating Temp. Temp. Temp. Room Temp.			
	whichever is less.	Time 30±3 15 30±3 15			
Withstanding voltage	No defects	Perform the initial measurement.			
Exterior	No abnormalities	renorm the initial measurement.			



### **Environmental and Test Characteristics**

# **NPO**

Item	Temperature Compensating	Measuring Condition
Moisture resistance (Steady state)		
Δc	± 5% or ± 0.5pF (Whichever is greater) C ≧ 30pF : Q ≧ 350	
Q	10pF > C < 30pF : Q $\ge$ 275 +2/5 × C C $\le$ 10pF : Q $\ge$ 200 + 10 × C (C is nominal capacitance)	Apply the rated DC voltage at 40 $\pm$ 2°C and 90 to 95% R.H. for 500 +24/-0 hrs.
I.R.	More than $1000 M\Omega$ or $50 M\Omega$ $^{\bullet}$ $\mu$ F , whichever is less. $16 Vdc \ product : \\ More than 1000 M\Omega or 10 M\Omega ^{\bullet} \mu F , whichever is less.$	
Withstanding voltage	No defects	
Exterior	No abnormalities	
High temperature loading		
ΔC	± 3% or ± 0.3pF (Whichever is greater)	
Q	$C \ge 30pF : Q \ge 350$ $10pF > C < 30pF : Q \ge 275 + 2/5 \times C$ $C \le 10pF : Q \ge 200 + 10 \times C$ (C is nominal capacitance)	Apply 200% of the rated DC voltage for 1000+48/-0 hrs. at the maximum operating temperature ± 2°C. Remove and let sit at room
I.R.	More than $1000M\Omega$ or $50M\Omega$ $^{\bullet}$ $\mu$ F , whichever is less. $16Vdc$ product : More than $1000M\Omega$ or $10M\Omega$ $^{\bullet}$ $\mu$ F ,	temperature for 24 ± 2 hrs., then measure.  The charge/discharge current is less than 50mA.  Perform initial measurement.  * 150% for 500V over.
	whichever is less.	
Withstanding voltage	No defects	
Exterior	No abnormalities	



# **♦** Environmental and Test Characteristics X7R/X5R/Y5V/Z5U

ltem	Т		Measuring Condition					
Resistance to Soldering heat			,					
ΔC	X7R/X5R= ± Y5V= ± 20% Z5U= ± 20%	6						
	25V min.	X7R=0.03max. Y5V=0.075max. Z5U=0.09max.	1.5mm to	e lead wire is immersed in the melted solder from the main body at 260 $\pm$ 5°C				
D.F	16V	X7R/X5R=0.05max. Y5V=0.10max.			ature for 48	3 ± 4hrs., th	en	
	10V max.	X7R/X5R=0.05max. Y5V=0.125max.	measure.	asurement for	· Perform a	a heat treatme	ent at	
	6.3V	X5R=0.075max.				i noat troatin	one de	
I.R.	whichever is 16Vdc produ		150+0/-10 °C for 1 hour.  Remove and let sit for 48 ± 4 hours at room temperature.  Perform the initial measurement.					
Withstanding voltage	whichever is  No defects	less						
Exterior		No abnormalities						
Thermal Shock	110 0011011110							
ΔC	X7R/X5R= ± Y5V= ± 20% Z5U= ± 30%	6	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform the five cycles according to the four heat treatments					
	25V min.	X7R=0.03max. Y5V=0.075max. Z5U=0.09max.	listed in the following table.  Remove and let sit at room temperature for 48 ± 4 hrs., then measure.					
D.F	16V	X7R/X5R=0.05max. Y5V=0.10max.	Step	1	2	3	4	
	10V max.	X7R/X5R=0.05max. Y5V=0.125max.	Temp.	Min. Operating	Room Temp.	Max. Operating	Room Temp.	
	6.3V	X5R=0.075max.	( 0)	Temp.	remp.	Temp.	remp.	
I.R.	More than 10 whichever is 16Vdc produ		Time 30±3 15 30±3 15					
	More than $10G\Omega$ or $100M\Omega \cdot \mu F$ ,		Initial measurement for Perform a heat treatment at					
	whichever is less.		150+0/-10 °C for 1 hour.  Remove and let sit for 48 ± 4 hrs. At room temperature.					
Withstanding voltage	No defects		Remove and let sit for 40 ± 4 files. At room temperature.					
Exterior	No abnormal	ities.	Perform th	ne initial mea	surement.			
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# **♦** Environmental and Test Characteristics X7R/X5R/Y5V/Z5U

Item	Temp	perature Compensating	Measuring Condition			
Moisture resistance (Steady State)						
ΔC	X7R/X5R= ± Y5V= ± 30% Z5U= ± 30%	, )				
	25V min.	X7R=0.06max. Y5V=0.1125max. Z5U=0.135max.	Apply the rated DC voltage at 40 ± 2°C and 90 to 95% R.H. for 500+24/-0 hrs.			
D.F	16V	X7R/X5R=0.10max. Y5V=0.15max.	Remove and let sit at room temperature for 48 ± 4 hrs., then measure.			
	10V max.	X7R/X5R=0.10max. Y5V=0.1875max.	Initial measurement for perform a heat treatment at			
	6.3V	X5R=0.15max.	150+0/-10 °C for 1 hour.			
I.R.	More than 10 whichever is 16Vdc produc		Remove and let sit for 48 ± 4 hrs. At room temperature.  Perform the initial measurement.			
	More than 10 whichever is	$00MΩ$ or $10MΩ$ $\mu$ F , less.				
Withstanding voltage	No defects					
Exterior	No abnormali	ities				
High temperature loading						
ΔC	X7R/X5R= ± Y5V= ± 30% Z5U= ± 30%	, )				
	25V min.	X7R=0.06max. Y5V=0.1125max. Z5U=0.135max.	Apply 200% of the rated DC voltage for 1000 +48/-0 hrs. at the maximum operating temperature ± 2°C. Remove and let sit at room			
D.F	16V	X7R/X5R=0.10max. Y5V=0.15max.	temperature for 48 ± 4 hrs. , then measure.  The charge/discharge current is less than 50mA.			
	10V max.	X7R/X5R=0.10max. Y5V=0.1875max.	Initial measurement for Apply 200% of the rated DC			
	6.3V	X5R=0.15max.	voltage for 1 hour at the maximum operating			
	whichever is		temperature $\pm 2$ °C . Remove and let sit at room temperature for 48 $\pm$ 4 hrs.			
I.R.	16Vdc produ	ct :	Perform initial measurement			
	More than whichever is	1000M $\Omega$ or 10M $\Omega$ · $\mu$ F ,	* 150% for 500V			
Withstanding voltage	No defects					
Exterior	No abnormal	ities				
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# **Electrical Characteristics**

# **NPO**

Item	Temperature Compensating	Measuring Condition				
Operating Temperature Range	- 55 ~ +125℃					
Temperature Characteristics	0 ± 30 ppm/°C					
Capacitance	Within the specified tolerance	Shall be measured at 25°C $\pm$ 2°C at the frequency and				
Q	$C \ge 30pF : Q \ge 1000$ $C < 30pF : Q \ge 400 + 20 \times C$ (C is nominal capacitance)	voltage.  C ≦ 1000pF @ 1MHz ± 20%, 1± 0.2Vrms  C > 1000pF @ 1KHz ± 10%, 1± 0.2Vrms				
Withstanding Voltage	No defects	Applied voltage:  Rated voltage ×3  500V Rated voltage (over) ×2  Duration: 1 to 5 sec.  The charge/discharge current is less than 50mA.				
Insulation Resistance	More than $10G\Omega$ or $500M\Omega \cdot \mu$ F , whichever is less $16Vdc$ product : More than $10G\Omega$ or $100M\Omega \cdot \mu$ F , whichever is less	Apply rated voltage for 1 minute at 25°C ± 2°C and 70% R.H. max.  16Vdc product :  Measurement voltage is 25Vdc				

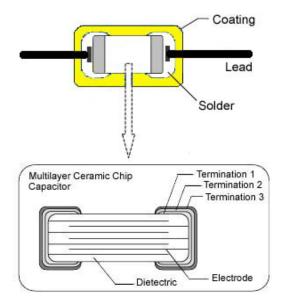


# **Electrical Characteristics** X7R/X5R/Y5V/Z5U

ltem	Hig	h Dielectric Constant	Measuring Condition			
Operating Temperature Range	X7R = - 55 ~ - X5R = - 55 ~ - Y5V = - 30 ~ - Z5U = +10 ~ -	+85°C -85°C				
Temperature Characteristics	X7R/X5R= ± Y5V= +22 to - Z5U= +22 to -	82%				
Capacitance	Within the spe	cified tolerance				
	25V min	X7R=0.03max. Y5V=0.075max. Z5U=0.09max.	Shall be measured at 25°C± 2°C at the frequency and voltage			
Dissipation Factor $( an \delta)$			X7R/X5R/Y5V @ 1KHz ± 10%, 1± 0.2Vrms			
	10V max.	X7R/X5R=0.05max. Y5V=0.125max.	Z5U @ 1KHz ± 10%, 0.5± 0.2Vrms			
	6.3V	X5R=0.075max.				
Withstanding Voltage	No defects		Applied voltage:  Rated voltage ×2.5  500V Rated voltage(over) ×2  Duration: 1 to 5 sec.  The charge/discharge current is less than 50mA.			
Insulation Resistance	whichever is lo	t: GΩ or100MΩ·μF,	Apply rated voltage for 1 minute at 25°C± 2°C and 70% R.H. max.  16Vdc product:  Measurement voltage is 25Vdc.			



### ◆ Material List



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# Storage

» The storage conditions should be:

Temperature = Lower than 40°C

**Humidity = Lower than 70% R.H.** 

» After opening the package, please store in desiccators.

### **♦** Environmental and Test Characteristics

Item	Temperature Compensating	Measuring Condition		
Strength of termination	Termination not to be broken or loosened.  Force: 2 LB min.  Keep time: 10 ± 1 sec.	F.		
Solderability of leads	Lead wire to be soldered vertically up to the coating end point.  At least 75% of lead surface is covered	Solder temperature : $270 \pm 5^{\circ}$ C  Dipping : $2 \pm 0.5$ sec.  (containing Ag $2 \sim 5^{\circ}$ )  (Flux shall be used)		

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# **Environmental and Test Characteristics**

### **NPO**

Item	Temperature Compensating	ndition						
Resistance to Soldering heat								
ΔC	± 2.5% or ± 0.25pF (Whichever is greater)							
Q	$C \ge 30pF : Q \ge 1000$ $C < 30pF : Q \ge 400 + 20 \times C$ (C is nominal capacitance)	The lead wire is immersed in the melted solder 1.5mm to 2mm from the main body at 260 $\pm$ 5°C for 10 $\pm$ 0.5sec.  Let sit at room temperature for 24 $\pm$ 2 hrs. then measure.  Perform the initial measurement.						
I.R.	More than $10G\Omega$ or $500M\Omega \cdot \mu$ F , whichever is less. $16Vdc$ product : More than $10G\Omega$ or $100M\Omega \cdot \mu$ F , whichever is less.							
Withstanding voltage	No defects							
Exterior	No abnormalities							
Thermal Shock								
ΔC	± 2.5% or ± 0.25pF (Whichever is greater)		pacitor to the					
Q	$C \ge 30pF : Q \ge 1000$ $C < 30pF : Q \ge 400 + 20 \times C$ (C is nominal capacitance)	cycles according to the four heat treatments listed in the following table.  Remove and let sit at room temperature for						
	More than $10G\Omega$ or $500M\Omega \cdot \mu$ F ,							
I.R.	16Vdc product :	Step	1	2	3	4		
	More than $10G\Omega$ or $100M\Omega \cdot \mu$ F , whichever is less.	Temp.	Min. Operating	Room Temp.	Max. Operating	Room Temp.		
Withstanding voltage	No defects	(0)	Temp.	Tomp.	Temp.	remp.		
Exterior	M. J. W.		30±3	15	30±3	15		
Extensi	No abnormalities	Perform the initial measurement.						



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# **Environmental and Test Characteristics**

### **NPO**

Item	Temperature Compensating	Measuring Condition				
Moisture resistance (Steady state)						
ΔC	± 5% or ± 0.5pF (Whichever is greater)					
Q	C ≥ 30pF : Q ≥ 350 10pF > C < 30pF : Q ≥ 275 + 2/5 × C C ≤ 10pF : Q ≥ 200 + 10 × C (C is nominal capacitance)	Apply the rated DC voltage at 40 ± 2°C and 90 to 95% R.H. for 500+24/-0 hrs.  Remove and let sit at room temperature for 24 ± 2 hrs., then measure.  Perform the initial measurement.				
I.R.	More than $1000 M\Omega$ or $50 M\Omega \cdot \mu$ F , whichever is less. $16 Vdc \ product :$ More than $1000 M\Omega$ or $10 M\Omega \cdot \mu$ F , whichever is less.					
Withstanding voltage	No defects					
Exterior	No abnormalities					
High temperature loading						
ΔC	± 3% or ± 0.3pF (Whichever is greater)					
Q	C ≥ 30pF : Q ≥ 350 $10pF > C < 30pF : Q ≥ 275 + 2/5 \times C$ C ≤ $10pF : Q ≥ 200 + 10 \times C$ (C is nominal capacitance)	Apply 200% of the rated DC voltage for 1000+48/-0 hrs. at the maximum operating temperature $\pm$ 2°C. Remove and let sit at room temperature for 24 $\pm$ 2 hrs., then				
I.R.	More than 1000MΩ or $50$ MΩ · $\mu$ F , whichever is less. 16Vdc product : More than $1000$ MΩ or $10$ MΩ · $\mu$ F , whichever is less.	measure.  The charge/discharge current is less than 50mA.  Perform initial measurement.  * 150% for 500V over.				
Withstanding voltage	No defects					
Exterior	No abnormalities					



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# **Environmental and Test Characteristics** X7R/X5R/Y5V/Z5U

Item	Tem	perature Compensating	Measuring Condition						
Resistance to Soldering Heat									
Δ¢	X7R/X5R= Y5V= ± 20 Z5U= ± 20	0%							
D.F	25V min	X7R=0.03max. Y5V=0.075max. Z5U=.0.09max. X7R/X5R=0.05max. Y5V=0.10max.	to 2mm from the main b 0.5sec.		in body a	ed in the melted solder 1.5ml body at 260 $\pm$ 5°C for 10 rature for 48 $\pm$ 4hrs. , the			
	10V max.	X7R/X5R=0.05max. Y5V=0.125max.	measure.	asurement fo	or Perforn	n a heat tre	atment a		
	6.3V	X5R=0.075max.	150+0/-10	°C for 1 hou	r.				
I.R.	whichever i 16Vdc prod	luct : 10GΩ or 100MΩ · μ F ,	Remove and let sit for $48 \pm 4$ hours at room temperature.  Perform the initial measurement.						
NATish atomating a valence		3 1633.							
Withstanding voltage		No defects							
Exterior	No abnorm	No abnormalities							
Thermal Shock	_								
ΔC	X7R/X5R = $Y5V = \pm 20$ $Z5U = \pm 20$	)%	Fix the capacitor to the supporting jig in the same manner and under the same conditions as (10). Perform						
	25V min	X7R=0.03max. Y5V=0.075max. Z5U=0.09max.	the five cycles according to the four heat treatments listed in the following table.  Remove and let sit at room temperature for 48 ± 4 hrs., then measure.						
D.F	16V	X7R/X5R=0.05max. Y5V=0.10max.	Step	1	2	3	4		
	10V max.	X7R/X5R=0.05max. Y5V=0.125max.	Temp.	Min. Operating	Room	Max. Operating	Room		
	6.3V	X5R=0.075max.	(°C)	Temp.	Temp.	Temp.	Temp.		
I.R.	is less. 16Vdc prod	16Vdc product : More than 10GΩ or 100MΩ· $\mu$ F , whichever		°C for 1 ho	ur.	30±3  n a heat tre			
Withstanding voltage	No defects								
Exterior	No abnorm	alitias	Perform the initial measurement.						



# **Environmental and Test Characteristics** X7R/X5R/Y5V/Z5U

İtem	Temp	perature Compensating	Measuring Condition			
Moisture resistance (Steady state)						
ΔC	X7R/X5R= ± Y5V= ± 30% Z5U= ± 30%	0				
	25V min	X7R=0.06max. Y5V=0.1125max. Z5U=0.135max.	Apply the rated DC voltage at 40 ± 2°C and 90 to 95%			
D.F	16V	X7R/X5R=0.10max. Y5V=0.15max.	R.H. for 500 +24/-0hrs.  Remove and let sit at room temperature for			
	10V max.	X7R/X5R=0.10max. Y5V=0.1875max.	48 ± 4 hrs. , then measure.  Initial measurement for Perform a heat treatment at			
	6.3V	X5R=0.15max.	150+0/-10 °C for 1 hour.			
I.R.	whichever is 16Vdc produ	ct: 1000ΜΩ or 10ΜΩ·μF,	Remove and let sit for 48±4 hrs. At room temperature.  Perform the initial measurement.			
Withstanding voltage	No defects					
Exterior	No abnormalities					
High Temperature loading						
ΔC	X7R/X5R= ± Y5V= ± 30% Z5U= ± 30%	0	Arraba 000% of the rate   DO   II   1000 W			
	25V min	X7R=0.06max. Y5V=0.1125max. Z5U=0.135max.	Apply 200% of the rated DC voltage for 1000+48/-0 hrs.  At the maximum operating temperature ± 2°C.  Remove and let sit at room temperature for 48±4 hrs.,			
D.F	16V	X7R/X5R=0.10max. Y5V=0.15max.	then measure.  The charge/discharge current is less than 50mA.			
	10V max.	X7R/X5R=0.10max. Y5V=0.1875max.	Initial measurement for Apply 200% of the rated DC			
	6.3V	X5R=0.15max.	voltage for 1 hour at the maximum operating			
	whichever is		temperature $\pm 2$ °C . Remove and let sit at room temperature for 48 $\pm$ 4 hrs.			
I.R.	16Vdc produ More than 10 whichever is	$000M\Omega$ or $10M\Omega$ · $\mu$ F ,	Perform initial measurement * 150% for 500V			
Withstanding voltage	No defects					
Exterior	No abnormal	ities				



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