

TPC
Disc Ceramic
Capacitors

Disc Ceramic Capacitors



Selection Guide

General Purpose			Professional Application			Class	Voltage (dc)	Capacitance C _R (min. - max.)		Tolerance	R isol Min.
Ref	TC	Page	Ref	TC	Page						
5WF 5YF	Y5P Y5U	17	6WF 6YF	Y5P Y5U	27	III	25V	4.7nF 4.7nF	100nF 200nF	±20% / -20 + 50% -20 + 80%	1... 12 M Ω
5WH 5YH	Y5P Y5U	17	6WH 6YH	Y5P Y5U	27	III	50V	4.7nF 4.7nF	100nF 100nF	±20% / -20 + 50% -20 + 80%	1... 12 M Ω
5ZH	Y5V	17	6ZH	Y5V	27	III	50V	4.7nF	100nF	-20 + 80%	100 M Ω
5AK 5GK 5HK	NP0 N750 N1500	8 9 9	6AK 6GK 6HK	NP0 N750 N1500	24	I	100V	1.0pF 1.5pF 6.0pF	180pF 270pF 330pF	C _R < 10pF → ±0.25pF / ±0.5pF C _R ≥ 10pF → ±5% / ±10%	10 G Ω
5MK 5NK 5OK 5SK 5TK 5UK	Y5E Y5F Y5P Y5U Y5V Z5V	14	6MK 6NK 6OK 6SK 6TK 6UK	X5E X5F X5P X5U X5V Z5V	25	II	100V	56pF 390pF 470pF 680pF 1.2nF 4.7nF	3.3nF 4.7nF 6.8nF 12nF 22nF 22nF	±10% / 20% ±10% / 20% ±10% / 20% ±20% / -20 + 50% -20 + 50% -20 + 50%	10 G Ω
5AQ 5GQ 5HQ	NP0 N750 N1500	8 9 9	6AQ 6GQ 6HQ	NP0 N750 N1500	24	I	500V	1.0pF 1.5pF 6.0pF	330pF 330pF 330pF	C _R < 10pF → ±0.25pF / ±0.5pF C _R ≥ 10pF → ±5% / ±10%	10 G Ω
5MQ 5NQ 5OQ 5SQ 5TQ	Y5E Y5F Y5P Y5U Y5V	14	6MQ 6NQ 6OQ 6SQ 6TQ	X5E X5F X5P X5U X5V	25	II	500V	56pF 390pF 470pF 680pF 1.2nF	3.3nF 4.7nF 6.8nF 12nF 22nF	±10% / 20% ±10% / 20% ±10% / 20% ±20% / -20 + 50% -20 + 50%	10 G Ω
5AR 5AS 5AT 5AU 5GR 5GS 5GT 5GU 5GW	NP0 NP0 NP0 NP0 N750 N750 N750 N750 N750	8 8 8 8 9 9 9 9 9				I	1kV 2kV 3kV 4kV 1kV 2kV 3kV 4kV 5kV	3.9pF 3.9pF 3.9pF 4.7pF 6.8pF 6.8pF 6.8pF 12pF 12pF	180pF 150pF 120pF 100pF 270pF 270pF 220pF 120pF 100pF	C _R < 10pF → ±0.25pF / ±0.5pF C _R ≥ 10pF → ±5% / ±10%	10 G Ω
5NR 5NS 5NT 5SR 5SS 5ST 5SU 5SW 5TR 5TS 5TT	Y5F Y5F Y5F Y5U Y5U Y5U Y5U Y5U Y5V Y5V Y5V	15				II	1kV 2kV 3kV 1kV 2kV 3kV 4kV 5kV 1kV 2kV 3kV	100pF 100pF 100pF 330pF 330pF 390pF 100pF 100pF 820pF 1.0nF 1.2nF	3.9nF 3.9nF 3.9nF 15nF 10nF 10nF 6.8nF 4.7nF 22nF 15nF 10nF	±10% and ±20% ±20% / -20 + 50% ±20% / -20 + 50% ±20% / -20 + 50% ±20% / -20 + 50% ±20% / -20 + 50% -20 + 50% -20 + 50% -20 + 50%	10 G Ω
61V 62O 65N	—	20				II	SAFETY	100pF 100pF 220pF	4.7nF 4.7nF 4.7nF	±20% / -20 + 50%	10 G Ω
6LR 6LS 6LT	Y5P Y5P Y5P	22				II	1kV 2kV 3kV	220pF 220pF 220pF	3.9nF 3.9nF 3.9nF	±10% / ±20% / -20 + 50%	10 G Ω
67S 68S	Y5U Y5V	22				II	2kV	1000pF 4.7nF	4.7nF 10nF	±20% / -20 + 50% -20 + 50%	10 G Ω
5KK 5KQ	P350... ...N1500	11				SL	100V 500V	1.0pF 1000pF	1000pF	C _R < 10pF → ±0.25pF / ±0.5pF C _R ≥ 10pF → ±5% / ±10% / ±20%	10 G Ω

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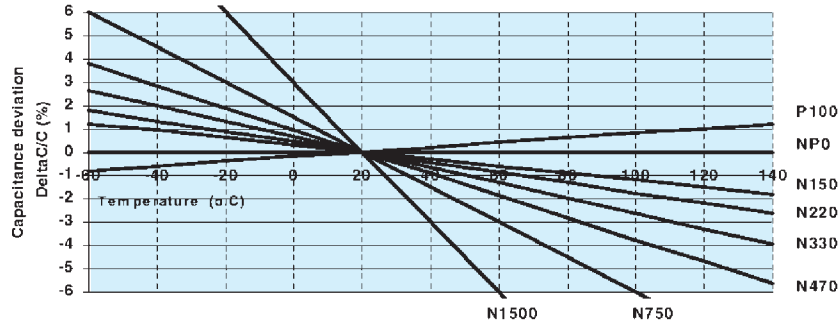


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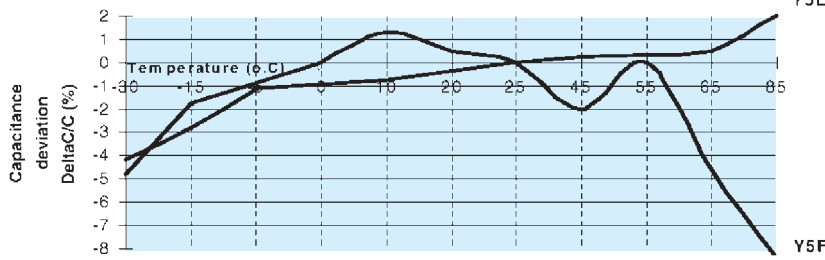
Temperature Coefficient - Typical Curves



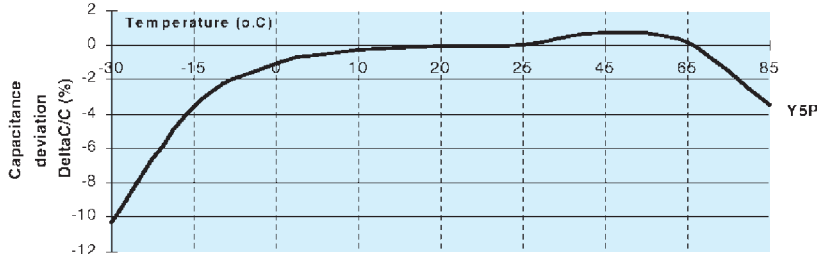
Class I



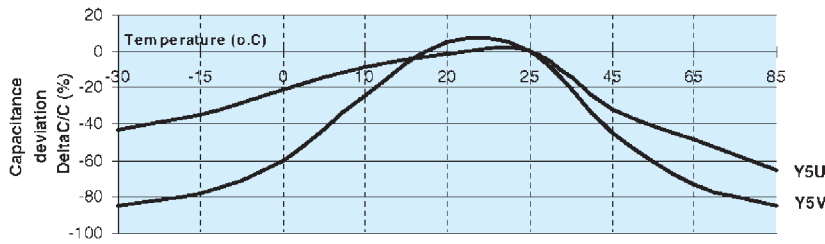
Class II



Class II / III



Class II / III



Disc Ceramic Capacitors



General Specifications

TEMPERATURE COEFFICIENT - CLASS I AND SL GENERAL PURPOSE AND PROFESSIONAL

DIG. 1&2	T.C. (ppm) = $10^{-6} \cdot C^{-1}$		Tolerance (ppm)				Aging $\Delta C/C/\log(10\text{hours})$
			$\leq 2\text{pF}$	$2\text{pF} < \dots \leq 3\text{pF}$	$3\text{pF} < \dots \leq 10\text{pF}$	$\geq 10\text{pF}$	
5B	*P100	+100 ppm	± 250	± 120	± 60	± 30	0 typical
5A	NP0	0 ppm	± 250	± 120	± 60	± 30	0 typical
5C	*N150	-150 ppm	± 250	± 120	± 60	± 30	0 typical
5D	*N220	-220 ppm	± 250	± 120	± 60	± 30	0 typical
5E	*N330	-330 ppm	± 250	± 120	± 60	± 60	0 typical
5F	*N470	-470 ppm	± 250	± 120	± 80	± 80	0 typical
5G	N750	-750 ppm	± 250	± 120	± 120	± 120	-0.1% typical
5H	N1500	-1500 ppm	± 250	± 250	± 250	± 250	-0.2% typical
5K	SL	+350... -1500 ppm	± 250	± 250	± 250	± 250	-0.5% typical

TEMPERATURE COEFFICIENT - CLASS II AND III GENERAL PURPOSE

DIG. 1&2		Temperature range		Capacitance deviation typical	Reference curve	Aging	
Class II	Class III	Class II	Class III			$\Delta C/C/\log(10\text{hours})$	
5M		-30... +85°C		$\pm 5\%$	Y5E	-1.5%	typical
5N		-30... +85°C		$\pm 8\%$	Y5F	-1.5%	typical
5O	5W	-30... +85°C	-30... +85°C	$\pm 12\%$	Y5P	-2.0%	typical
5S	5Y	-30... +85°C	-30... +85°C	+30 - 65%	Y5U	-3.5%	typical
5T	5Z	-30... +85°C	-30... +85°C	+30 - 85%	Y5V	-5%	typical
5U		+10... +85°C		+22 - 85%	Z5V	-5%	typical

TEMPERATURE COEFFICIENT - CLASS II AND III PROFESSIONAL

DIG. 1&2		Temperature range		Capacitance deviation	Reference curve		Aging	
Class II	Class III	Class II	Class III		Class II	Class III	$\Delta C/C/\log(10\text{hours})$	
6M		-55... +85°C		$\pm 5\%$	X5E		-1.5%	typical
6N		-55... +85°C		$\pm 8\%$	X5F		-1.5%	typical
6O	6W	-55... +85°C	-30... +85°C	$\pm 12\%$	X5P	Y5P	-2.0%	typical
6S	6Y	-55... +85°C	-30... +85°C	+30 - 65%	X5U	Y5U	-3.5%	typical
6T	6Z	-55... +85°C	-30... +85°C	+30 - 85%	X5V	Y5V	-5%	typical
6U		+10... +85°C		+22 - 85%	Z5V		-5%	typical

RECOMMENDED SHELF CONDITIONS

45°C	(max)
10°C	(min)
60%	relative humidity (max)
2	years (max)

INSPECTION LEVEL: II

Electrical	AQL	:	0.1%
Visual	AQL	:	1%

FOR SAFETY PARTS

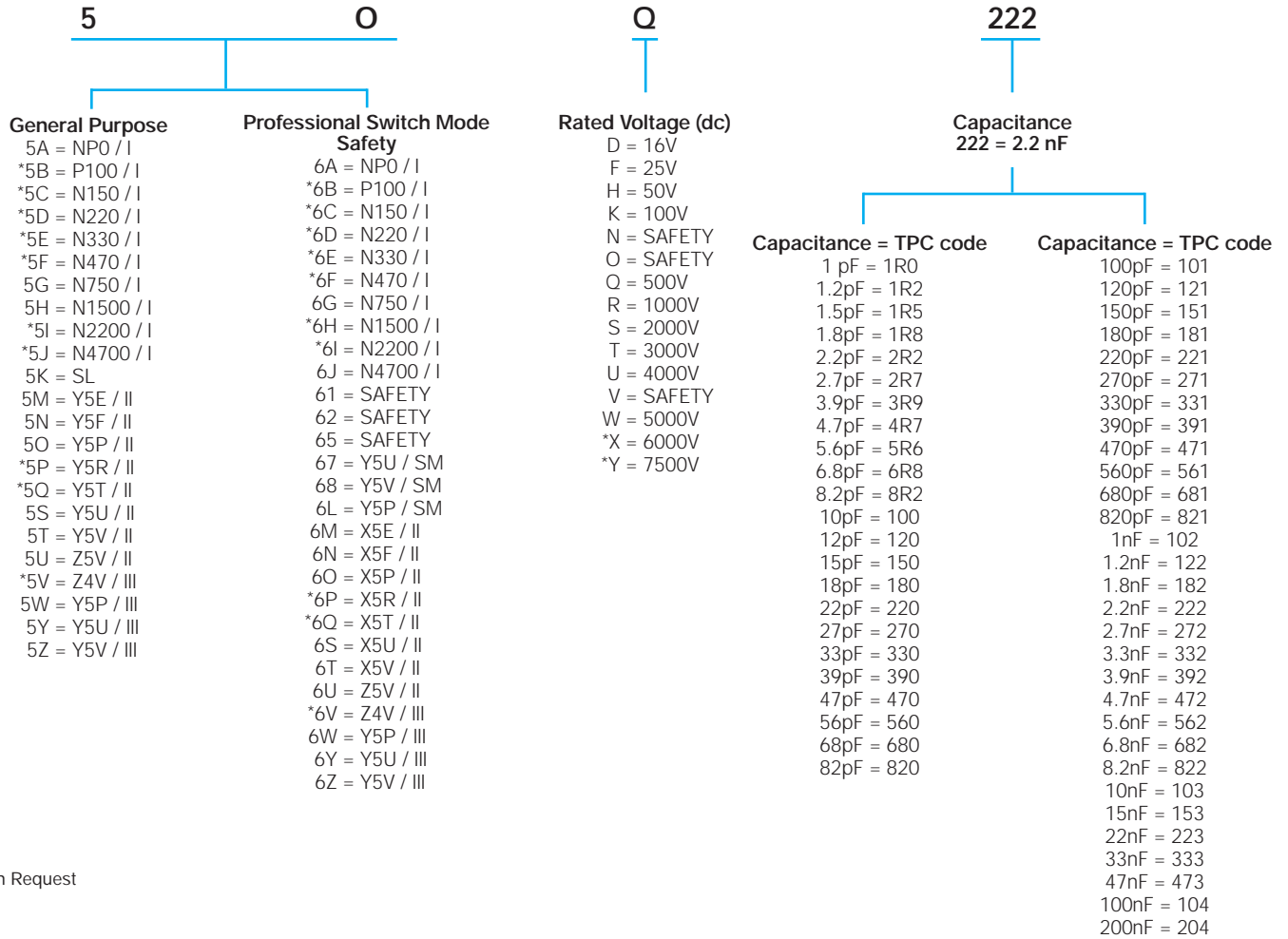
AQL	Electrical	Visual
Level II	0.065%	0.065%

Disc Ceramic Capacitors



Ordering Code

HOW TO ORDER



*Upon Request

Disc Ceramic Capacitors



Ordering Code

M

Tolerance
 C = ±0.25 pF
 D = ±0.50 pF
 J = ±5%
 K = ±10%
 M = ±20%
 S = -20+50%
 Z = -20+80%
 P = 0+100%

A

**Capacitor Diameter
 ± 2 (0.079)**
 A = 4 (0.157)
 B = 5 (0.197)
 C = 6 (0.236)
 D = 7 (0.276)
 E = 8 (0.315)
 F = 9 (0.354)
 G = 10 (0.394)
 H = 11 (0.433)
 J = 13 (0.512)
 K = 15 (0.591)
 M* = 19 (0.748)

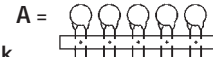
*Wire 0.8 (0.031) recommended

A

A

Packaging

Cardboard Strips



Bulk

E = 5 (0.197) ± 1 (0.039) free wire length
 C = 10 (0.394) ± 1 (0.039) free wire length
 D = 25 (0.984) ± 1 (0.039) free wire length

Taping

Reel



Avisert			Panaset		
H	L	L	J	L	L

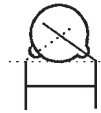


Avisert			Panaset		
I	M	M	K	M	M

Lead Forming				
mm	inches			
2.5 ±0.5	.1 ± .025	D	-	-
5 ^{+0.6} _{-0.2}	.2 ± .025	A	O	N
6 ^{+0.6} _{-0.2}	.25 ± .025	E	X	-
7.5 ⁺¹ _{-0.5}	.3 ± .05	B	R	Q
10 ^{+0.5} _{-1.0}	.4 ± .05	C	W	-
12.5 ⁺¹ _{-0.5}	.5 ± .05	P	-	-

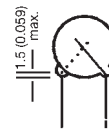
Finishing

Diam ≤ 9 (0.354) and
 F = 5.00 (0.197)



Coating does not surpass the bend

For every other:



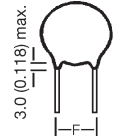
Low Voltage

A = Phenolic (General Purpose) Q = Waxed phenolic

S = Epoxy (Professional) cap. diameter ≤ 8 (0.315)

D = Epoxy (Professional) cap. diameter > 8 (0.315)

High Voltage



F = Measured from the center of leads

C = Epoxy wire diameter 0.6 ± 0.1 (0.024) ± (0.004)

I = Epoxy wire diameter 0.8 ± 0.1 (0.031) ± (0.004)

L = Phenolic wire diameter 0.6 ± 0.1 (0.024) ± (0.004)

Please note that not all code combinations are either possible or available.

Disc Ceramic Capacitors



General Specifications - Class I Temperature Compensating

DIELECTRIC - CLASS I

These ceramic capacitors have linear temperature coefficient, very low tolerances, low losses, high insulation resistance and are specially suitable for tuned circuits, timing and other precision circuits.

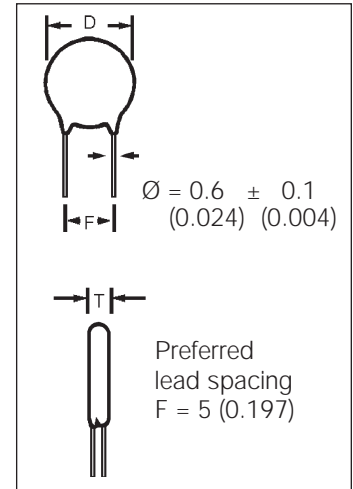
Meets IEC 384-8 (1988).

DIMENSIONS

millimeters (inches)

Digit 9 (ø)	D ± 2 (0.079)	T max.	Available Lead Spacing				
			100V - 500V	1000V	2000V	3000V	4000/5000V
A	4.0 (0.157)	3.0 (0.118)	A,B,D,E,O,R	A,B,E,N,R	A,B,E,N,R	B,E	
B	5.0 (0.197)	4.0 (0.157)	A,B,D,E,O,R,X	A,B,E,N,R,X	A,B,E,N,R	B,E	
C	6.0 (0.236)	4.0 (0.157)	A,B,C,D,E,O,R,X	A,B,C,E,N,R,X	A,B,C,E,N,R	B,C,E	C
D	7.0 (0.276)	4.0 (0.157)	A,B,C,D,E,O,R,X	A,B,C,E,N,Q,R,X	A,B,C,E,N,Q,R	B,C,E	C
E	8.0 (0.315)	4.0 (0.157)	A,B,C,D,E,O,R,X	A,B,C,E,N,Q,R,X	A,B,C,E,N,Q,R	B,C,E	C
F	9.0 (0.354)	5.0 (0.197)	A,B,C,E,O,R,X	A,B,C,E,N,R,X	A,B,C,E,N,R	B,C,E	C
G	10.0 (0.394)	5.0 (0.197)	A,B,C,E,O,R,X	A,B,C,E,N,R,X	A,B,C,E,N,R	B,C,E	C
H	11.0 (0.433)	5.0 (0.197)	A,B,C,E,O,R,W	A,B,C,E,N,P,R,W	A,B,C,E,N,P,R,W	B,C,E,P,W	C,P
J	13.0 (0.512)	6.0 (0.236)	B,C,R,W	B,C,N,P,R,W	B,C,N,P,R,W	B,C,P,W	C,P
K	15.0 (0.591)	6.0 (0.236)	B,C,R,W	B,C,N,P,R,W	B,C,N,P,R,W	B,C,P,W	C,P
M	19.0 (0.748)	7.0 (0.276)	B,C	B,C,P	B,C,P	B,C,P	C,P

(E), (X), (W): upon request



millimeters (inches)

Lead Spacing	Digit 8 of P.N.		
F			
2.5 (0.100)	D	—	
5 (0.200)	A	O	N
6 (0.250)	E	X	—
7.5 (0.300)	B	R	Q
10 (0.400)	C	W	—
12.5 (0.500)	P	—	—

Disc Ceramic Capacitors



General Specifications - Class I Temperature Compensating

PERFORMANCE CHARACTERISTICS

	100 V → 500 V	1kV → 5kV
Measured at	1.0 MHz @ 1.0 Vrms & 25°C	1.0 MHz @ 1.0 Vrms & 25°C
Dissipation Factor (%)	$C_R \leq 30 \text{ pF} \rightarrow \leq 1/C_R + 0.07$ $C_R > 30 \text{ pF} \rightarrow \leq 0.1\%$	$C_R \leq 30 \text{ pF} \rightarrow \leq 1/C_R + 0.07$ $C_R > 30 \text{ pF} \rightarrow \leq 0.1\%$
Tolerance	$C_R < 10 \text{ pF} \rightarrow \pm 0.25 \text{ pF}, \pm 0.5 \text{ pF}$ $C_R \geq 10 \text{ pF} \rightarrow \pm 5\%, \pm 10\%$	$C_R < 10 \text{ pF} \rightarrow \pm 0.25 \text{ pF}, \pm 0.5 \text{ pF}$ $C_R \geq 10 \text{ pF} \rightarrow \pm 5\%, \pm 10\%$
Insulation Resistance (IR)	@ $V_R \geq 10 \text{ G}\Omega$	@ 500V $\geq 10 \text{ G}\Omega$
Dielectric Strength NOTE: Charging current limited to 50 mA	@ $V_R = 100\text{V} \rightarrow V_t = 250\text{V (DC)}$ @ $V_R = 500\text{V} \rightarrow V_t = 1.25\text{kV (DC)}$	$1.5 \times V_R + 500 \text{ (DC)}$
Operating Temperature Range (°C)	-30 → +85	-30 → +85 Phenolic Coated -30 → +125 Epoxy Coated
Climatic Category	30 / 085 / 21 Phenolic Coated	30 / 085 / 21 Phenolic Coated 30 / 085 / 56 Epoxy Coated

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 21 days. No voltage to be applied.

Disc Ceramic Capacitors



Dimension Table - Class I Temperature Compensating

CLASS I - CAPACITANCE VS. DISC DIAMETER

millimeters (inches)

Temp. Coefficient	NPO					
Digits 1, 2, 3 of P.N.	5AK	5AQ	5AR	5AS	5AT	5AU
Rated Voltage (V _R)	100 VDC	500 VDC	1000 VDC 130 VAC	2000 VDC 250 VAC	3000 VDC 380 VAC	4000 VDC 440 VAC
C _R (pF)						
1.0	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)	6.0 (0.236)	6.0 (0.236)
1.2						
1.5						
1.8						
2.0						
2.2						
2.7						
3.0						
3.3						
3.9						
4.0						
4.7						
5.0						
5.6						
6.0						
6.8						
7.0						
8.0						
8.2						
9.0						
10						
12						
15						
18						
20	5.0 (0.197)	5.0 (0.197)	6.0 (0.236)	6.0 (0.236)	8.0 (0.315)	10.0 (0.394)
22						
27						
33	7.0 (0.276)	7.0 (0.276)	7.0 (0.276)	7.0 (0.276)	9.0 (0.354)	11.0 (0.433)
39						
47						
50	8.0 (0.315)	8.0 (0.315)	8.0 (0.315)	8.0 (0.315)	11.0 (0.433)	13.0 (0.512)
56						
68						
82	9.0 (0.354)	9.0 (0.354)	9.0 (0.354)	9.0 (0.354)	13.0 (0.512)	15.0 (0.591)
100						
120						
150	11.0 (0.433)	11.0 (0.433)	11.0 (0.433)	11.0 (0.433)	15.0 (0.591)	19.0 (0.748)
180						
220						
270	19.0 (0.748)	19.0 (0.748)	15.0 (0.591)	15.0 (0.591)	19.0 (0.748)	19.0 (0.748)
330						

Disc Ceramic Capacitors



Dimension Table - Class I Temperature Compensating

CLASS I - CAPACITANCE VS. DISC DIAMETER

millimeters (inches)

Temp. Coefficient Digits 1, 2, 3 of P.N.	N750						N1500				
	5GK	5GQ	5GR	5GS	5GT	5GU	5GW	5HK	5HQ		
Rated Voltage (V _R)	100 VDC	500 VDC	1000 VDC 130 VAC	2000 VDC 250 VAC	3000 VDC 380 VAC	4000 VDC 440 VAC	5000 VDC 550 VAC	100 VDC	500 VDC		
C _R (pF)											
1.0											
1.2											
1.5											
1.8											
2.0											
2.2											
2.7											
3.0											
3.3											
3.9											
4.0											
4.7											
5.0	4.0 (0.157)	4.0 (0.157)	Use NP0	Use NP0	Use NP0						
5.6											
6.0											
6.8											
7.0								Use NP0	Use NP0		
8.0											
8.2											
9.0											
10					5.0 (0.197)	5.0 (0.197)	6.0 (0.236)			4.0 (0.157)	4.0 (0.157)
12											
15											
18											
20						8.0 (0.315)					
22											
27					7.0 (0.276)		11.0 (0.433)				
33			6.0 (0.236)	6.0 (0.236)							
39											
47	5.0 (0.197)	5.0 (0.197)	7.0 (0.276)	7.0 (0.276)	8.0 (0.315)	11.0 (0.433)					
50											
56										5.0 (0.197)	
68		6.0 (0.236)	8.0 (0.315)	8.0 (0.315)	9.0 (0.354)	15.0 (0.591)			6.0 (0.236)		
82	6.0 (0.236)					15.0 (0.591)		5.0 (0.197)			
100		7.0 (0.276)	9.0 (0.354)	9.0 (0.354)	11.0 (0.433)		19.0 (0.748)				
120	7.0 (0.276)	8.0 (0.315)		11.0 (0.433)	13.0 (0.512)	19.0 (0.748)			7.0 (0.276)		
150			11.0 (0.433)		13.0 (0.512)					8.0 (0.315)	
180	8.0 (0.315)				15.0 (0.591)			7.0 (0.276)			
220	9.0 (0.354)	11.0 (0.433)	13.0 (0.512)						9.0 (0.354)		
270	11.0 (0.433)	13.0 (0.512)						8.0 (0.315)	11.0 (0.433)		
330		15.0 (0.591)						9.0 (0.354)			

Disc Ceramic Capacitors



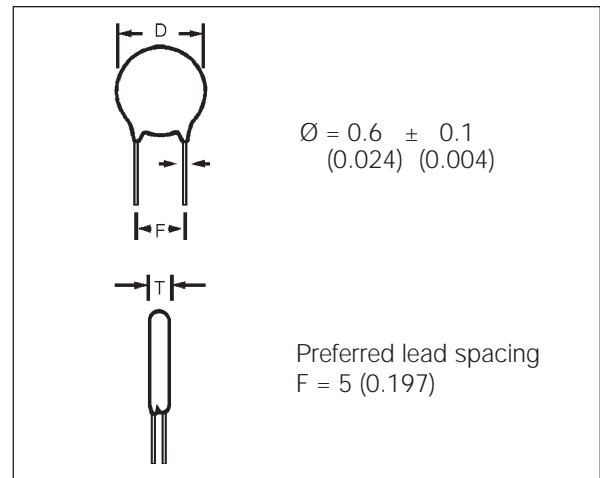
General Specifications - SL

CAPACITORS - CLASS SL

These capacitors have wide temperature characteristics but still offer low loss and linear type TC's.

They are specially designed to be smaller alternative to standard Class I capacitors of linear temperature coefficient.

Typical application is RF tuning and decoupling.



DIMENSIONS

millimeters (inches)

Digit 9 of P.N. (\varnothing)	D \pm 2 (0.079)	T max.	Available Lead Spacing
A	4.0 (0.157)	3.0 (0.118)	A,B,D,E,O,R
B	5.0 (0.197)	3.0 (0.118)	A,B,D,E,O,R,X
C	6.0 (0.236)	3.0 (0.118)	A,B,C,D,E,O,R,X
D	7.0 (0.276)	3.0 (0.118)	A,B,C,D,E,O,R,X
E	8.0 (0.315)	3.0 (0.118)	A,B,C,D,E,O,R,X

millimeters (inches)

Lead Spacing	Digit 8 of P.N.	
F		
2.5 (0.100)	D	—
5 (0.200)	A	O
6 (0.250)	E	X
7.5 (0.300)	B	R
10 (0.400)	C	W

PERFORMANCE CHARACTERISTICS

Measured at	$C_R \leq 100 \text{ pF} \rightarrow 1\text{MHz}/1.0 \text{ Vrms} / 25^\circ\text{C}$ $C_R > 100 \text{ pF} \rightarrow 1\text{kHz}/0.3 \text{ Vrms} / 25^\circ\text{C}$
Dissipation Factor	$C_R \leq 100 \text{ pF} \dots 0.25\%$ 1MHz @ 1.0 Vrms $C_R > 100 \text{ pF} \dots 1.0\%$ 100kHz @ 0.3 Vrms $C_R > 100 \text{ pF} \dots 0.25\%$ 1kHz @ 0.3 Vrms
Tolerance	$C_R < 10 \text{ pF} \rightarrow \pm 0.25 \text{ pF}, \pm 0.5 \text{ pF}$ $C_R \geq 10 \text{ pF} \rightarrow \pm 5\%, \pm 10\%, \pm 20\%$
Temperature Coefficient	+350 ppm... -1500 ppm (P350... N1500)
Insulation Resistance	@ $V_R \rightarrow \geq 10 \text{ G}\Omega$
Dielectric Strength NOTE: Charging current limited to 50 mA	$V_R = 100\text{V} \rightarrow V_t = 250\text{V (DC)}$ $V_R = 500\text{V} \rightarrow V_t = 1.25\text{kV (DC)}$
Operating Temperature Range ($^\circ\text{C}$)	-30... +85
Climatic Category	30 / 085 / 21

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 21 days. No voltage to be applied.

Disc Ceramic Capacitors

Dimension Table - SL



SL - CAPACITANCE VS. DISC DIAMETER PHENOLIC COATED

millimeters (inches)

Temp. Coefficient		
Digits 1,2,3 of P.N.	5KK	5KQ
Rated Voltage C_R (pF) (V_R)	100 VDC 50 VAC	500 VDC 100 VAC
1.0	4.0 (0.157)	4.0 (0.157)
1.5		
2.2		
3.3		
4.7		
5.6		
8.2		
10		
12		
15		
18		
22		
33		
47		
56		
68		
82		
100		
150		
180		
220		
270	5.0 (0.197)	6.0 (0.236)
330		
470	6.0 (0.236)	7.0 (0.276)
560		
680		
820	7.0 (0.276)	8.0 (0.315)
1000		

Diameter (φ) = 9th Part Number Digit

Disc Ceramic Capacitors



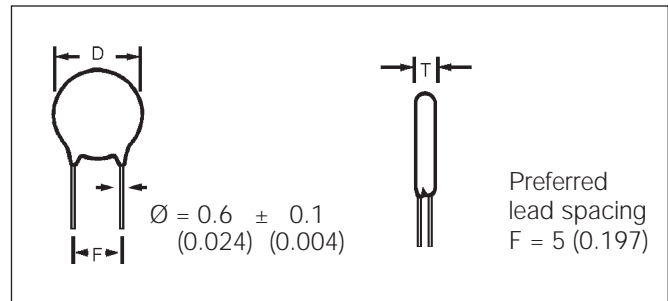
General Specifications - Class II General Purpose

DIELECTRIC - CLASS II

These ceramic capacitors have a high dielectric constant, what makes possible a high capacitance values in reduced dimensions, however temperature coefficient and loss factor are greater than Class I.

Typical applications are decoupling and by pass.

Meets IEC 384-9 (1988).



DIMENSIONS

millimeters (inches)

Digit 9 (ø)	D ± 2 (0.079)	T max.	Available Lead Spacing				
			Vn = 100V/500V	Vn = 1000V	Vn = 2000V	Vn = 3000V	Vn = 4000/5000V
A	4.0 (0.157)	3.0 (0.118)	A,B,D,E,O,R	A,B,E,N,R	A,B,E,N,R	B,E	
B	5.0 (0.197)	4.0 (0.157)	A,B,D,E,O,R,X	A,B,E,N,R,X	A,B,E,N,R	B,E	
C	6.0 (0.236)	4.0 (0.157)	A,B,C,D,E,O,R,X	A,B,C,E,N,R,X	A,B,C,E,N,R,	B,C,E	C
D	7.0 (0.276)	4.0 (0.157)	A,B,C,D,E,O,R,X	A,B,C,E,N,Q,R,X	A,B,C,E,N,Q,R	B,C,E	C
E	8.0 (0.315)	4.0 (0.157)	A,B,C,D,E,O,R,X	A,B,C,E,N,Q,R,X	A,B,C,E,N,Q,R	B,C,E	C
F	9.0 (0.354)	5.0 (0.197)	A,B,C,E,O,R,X	A,B,C,E,N,R,X	A,B,C,E,N,R	B,C,E	C
G	10.0 (0.394)	5.0 (0.197)	A,B,C,E,O,R,X	A,B,C,E,N,R,X	A,B,C,E,N,R	B,C,E	C
H	11.0 (0.433)	5.0 (0.197)	A,B,C,E,O,R,X	A,B,C,E,N,P,R,W	A,B,C,E,N,P,R,W	B,C,E,P,W	C,P
J	13.0 (0.512)	6.0 (0.236)	B,C,R,W	B,C,N,P,R,W	B,C,P,W	B,C,P,W	C,P
K	15.0 (0.591)	6.0 (0.236)	B,C,R,W	B,C,N,P,R,W	B,C,P,W	B,C,P,W	C,P
M	19.0 (0.748)	7.0 (0.276)	B,C	B,C,P	B,C,P	B,C,P	C,P

(E), (X), (W): upon request

LEAD SPACING – DIGIT 8 OF P.N. millimeters (inches)

	100V/500V		1kV...5kV/100Vac...150Vac		
F					
2.5 (0.100)	D	—	—	—	—
5 (0.200)	A	O	A	—	N
6 (0.250)	E	X	E	X	—
7.5 (0.300)	B	R	B	R	Q
10 (0.400)	C	W	C	W	—
12.5 (0.500)	P	—	P	—	—

Disc Ceramic Capacitors



General Specifications - Class II General Purpose

100V / 500V PERFORMANCE CHARACTERISTICS CLASS II

Voltage Rating	100V and 500V
Measured at	1.0 kHz / 0.3 Vrms / 25°C
Dissipation Factor	Y5E / Y5F / Y5P ≤ 2.5% Y5U / Y5V / Z5V ≤ 3.0%
Capacitance Tolerance	Y5E / Y5F / Y5P → ±10% Y5E / Y5E / Y5P / Y5U → ±20% Y5U / Y5V / Z5V → -20% +50%
Insulation Resistance	@ V_R → ≥ 10 GΩ
Dielectric Strength NOTE: Charging current limited to 50 mA	$V_R = 100V \rightarrow V_t = 250V$ (DC) $V_R = 500V \rightarrow V_t = 1250V$ (DC)
Operating Temperature Range (°C)	-30... +85
Climatic Category	30 / 085 / 21 Phenolic Coated

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 21 days. No voltage to be applied.

1kV ... 5kV PERFORMANCE CHARACTERISTICS CLASS II

Voltage Rating	1kV ... 5kV
Measured at	1.0 kHz / 0.3 Vrms / 25°C
Dissipation Factor	Y5F → ≤ 2.5% Y5U / Y5V ≤ 3.0%
Capacitance Tolerance	Y5F → ±10% / ±20% Y5U → ±20% / -20 +50% Y5V → -20 +50%
Insulation Resistance	@ 500V → ≥ 10 GΩ
Dielectric Strength NOTE: Charging current limited to 50 mA	$1.5 \times V_R + 500$ (DC)
Operating Temperature Range (°C)	-30... +85 Phenolic Coated -30... +125 Epoxy Coated
Climatic Category	30 / 085 / 21 Phenolic Coated 30 / 085 / 56 Epoxy Coated

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 21 days. No voltage to be applied.

Disc Ceramic Capacitors

Dimension Table - Class II

Low and Medium Voltage General Purpose



100V / 500V CLASS II – CAPACITANCE VS. DISC DIAMETER

millimeters (inches)

Temp. Coefficient	Y5E		Y5F		Y5P		Y5U		Y5V		Z5V
Digits 1,2,3 of P.N.	5MK	5MQ	5NK	5NQ	5OK	5OQ	5SK	5SQ	5TK	5TQ	5UK
Rated Voltage (V _R)	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC
C _R (pF)											
56	4.0 (0.157)	4.0 (0.157)	Use Y5E	Use Y5E	Use Y5E	Use Y5E	Use Y5E	Use Y5E	Use Y5E	Use Y5E	Use Y5E
68											
82											
100											
120											
150											
180											
220											
270											
330											
390	5.0 (0.197)	5.0 (0.197)	4.0 (0.157)	4.0 (0.157)	Use Y5F	Use Y5F	Use Y5F	Use Y5F	Use Y5F	Use Y5F	Use Y5F
470		6.0 (0.236)	5.0 (0.197)	5.0 (0.197)	4.0 (0.157)	4.0 (0.157)	Use Y5P	Use Y5P	Use Y5P	Use Y5P	Use Y5P
560	7.0 (0.276)			6.0 (0.236)	5.0 (0.197)	6.0 (0.236)	5.0 (0.197)	6.0 (0.236)	4.0 (0.157)	4.0 (0.157)	Use Y5U
680		8.0 (0.315)	8.0 (0.315)								6.0 (0.236)
820	9.0 (0.354)			9.0 (0.354)	7.0 (0.276)	8.0 (0.315)	7.0 (0.276)	7.0 (0.276)	5.0 (0.197)	6.0 (0.236)	
1,000		11.0 (0.433)	15.0 (0.591)								9.0 (0.354)
1,200	11.0 (0.433)			15.0 (0.591)	9.0 (0.354)	13.0 (0.512)	9.0 (0.354)	9.0 (0.354)	6.0 (0.236)	8.0 (0.315)	
1,500		11.0 (0.433)	15.0 (0.591)								11.0 (0.433)
1,800	11.0 (0.433)			15.0 (0.591)	11.0 (0.433)	15.0 (0.591)	11.0 (0.433)	13.0 (0.512)	7.0 (0.276)	9.0 (0.354)	
2,200		11.0 (0.433)	15.0 (0.591)								11.0 (0.433)
2,700	11.0 (0.433)			15.0 (0.591)	11.0 (0.433)	15.0 (0.591)	11.0 (0.433)	13.0 (0.512)	9.0 (0.354)	11.0 (0.433)	
3,300		11.0 (0.433)	15.0 (0.591)								11.0 (0.433)
3,900	11.0 (0.433)			15.0 (0.591)	11.0 (0.433)	15.0 (0.591)	11.0 (0.433)	13.0 (0.512)	9.0 (0.354)	11.0 (0.433)	
4,700		11.0 (0.433)	15.0 (0.591)								11.0 (0.433)
5,600	11.0 (0.433)			15.0 (0.591)	11.0 (0.433)	15.0 (0.591)	11.0 (0.433)	13.0 (0.512)	9.0 (0.354)	11.0 (0.433)	
6,800		11.0 (0.433)	15.0 (0.591)								11.0 (0.433)
8,200	11.0 (0.433)			15.0 (0.591)	11.0 (0.433)	15.0 (0.591)	11.0 (0.433)	13.0 (0.512)	9.0 (0.354)	11.0 (0.433)	
10,000		11.0 (0.433)	15.0 (0.591)								11.0 (0.433)
12,000	11.0 (0.433)			15.0 (0.591)	11.0 (0.433)	15.0 (0.591)	11.0 (0.433)	13.0 (0.512)	9.0 (0.354)	11.0 (0.433)	
15,000		11.0 (0.433)	15.0 (0.591)								11.0 (0.433)
22,000	11.0 (0.433)			15.0 (0.591)	11.0 (0.433)	15.0 (0.591)	11.0 (0.433)	13.0 (0.512)	9.0 (0.354)	11.0 (0.433)	

Diameter (φ) = 9th Part Number Digit

Disc Ceramic Capacitors

Dimension Table

High Voltage - Class II General Purpose



1kV / 5kV CLASS II – CAPACITANCE VS. DISC DIAMETER

millimeters (inches)

Temp. Coefficient	Y5F			Y5U					Y5V		
Digits 1,2,3 of P.N.	5NR	5NS	5NT	5SR	5SS	5ST	5SU	5SW	5TR	5TS	5TT
Rated Voltage (V _r)	1000 VDC 100 VAC	2000 VDC 150 VAC	3000 VDC 150 VAC	1000 VDC 100 VAC	2000 VDC 150 VAC	3000 VDC 150 VAC	4000 VDC 150 VAC	5000 VDC 150 VAC	1000 VDC 150 VAC	2000 VDC 150 VAC	3000 VDC 150 VAC
C _R (pF)											
100	4.0 (0.157)	4.0 (0.157)		Use Y5F	Use Y5F	Use Y5F	8.0 (0.315)	11.0 (0.433)	Use Y5F	Use Y5F	Use Y5F
120											
150											
180											
220											
270		5.0 (0.197)	6.0 (0.236)								
330		6.0 (0.236)	7.0 (0.276)								
390	5.0 (0.197)	7.0 (0.276)	8.0 (0.315)	4.0 (0.157)	5.0 (0.197)	7.0 (0.276)	10.0 (0.394)	13.0 (0.512)	Use Y5U	Use Y5U	Use Y5U
470											
560											
680	6.0 (0.236)	8.0 (0.315)	9.0 (0.354)		6.0 (0.236)						
820	7.0 (0.276)	9.0 (0.354)	10.0 (0.394)	5.0 (0.197)	7.0 (0.276)	8.0 (0.315)	11.0 (0.433)	15.0 (0.591)	4.0 (0.157)	6.0 (0.236)	7.0 (0.276)
1,000											
1,200											
1,500	8.0 (0.315)	10.0 (0.394)	13.0 (0.512)	6.0 (0.236)	8.0 (0.315)	9.0 (0.354)	11.0 (0.433)	13.0 (0.512)	5.0 (0.197)	6.0 (0.236)	7.0 (0.276)
1,800	9.0 (0.354)	11.0 (0.433)	15.0 (0.591)	7.0 (0.276)	9.0 (0.354)	10.0 (0.394)	13.0 (0.512)	19.0 (0.748)	7.0 (0.276)	8.0 (0.315)	8.0 (0.315)
2,200	11.0 (0.433)	13.0 (0.512)	19.0 (0.748)	8.0 (0.315)	10.0 (0.394)	11.0 (0.433)	13.0 (0.512)	19.0 (0.748)	8.0 (0.315)	9.0 (0.354)	9.0 (0.354)
2,700	13.0 (0.512)	15.0 (0.591)	19.0 (0.748)	8.0 (0.315)	10.0 (0.394)	11.0 (0.433)	13.0 (0.512)	15.0 (0.591)	7.0 (0.276)	8.0 (0.315)	9.0 (0.354)
3,300											
3,900											
4,700											
5,600											
6,800											
8,200											
10,000											
12,000											
15,000											
22,000				9.0 (0.354)	11.0 (0.433)	13.0 (0.512)	15.0 (0.591)	19.0 (0.748)	9.0 (0.354)	11.0 (0.433)	13.0 (0.512)
				10.0 (0.394)	13.0 (0.512)	15.0 (0.591)	19.0 (0.748)	15.0 (0.591)	10.0 (0.394)	13.0 (0.512)	15.0 (0.591)
				11.0 (0.433)	15.0 (0.591)	19.0 (0.748)	19.0 (0.748)	19.0 (0.748)	11.0 (0.433)	13.0 (0.512)	15.0 (0.591)
				13.0 (0.512)	15.0 (0.591)	19.0 (0.748)			13.0 (0.512)	15.0 (0.591)	19.0 (0.748)
				15.0 (0.591)					15.0 (0.591)		
									15.0 (0.591)		

Diameter (φ) = 9th Part Number Digit

Disc Ceramic Capacitors

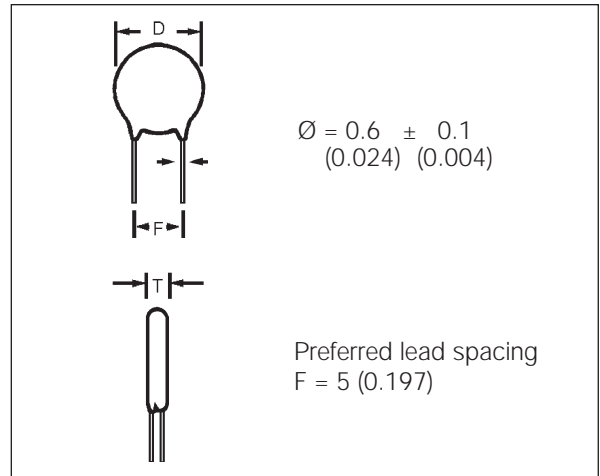


General Specifications - Class III General Purpose

DIELECTRIC - CLASS III

A thin dielectric layer is grown on a disc of conductive ceramic. Very large capacitances can be obtained due to reduced thickness of this barrier layer and its inherently high dielectric constant. Due its small dimensions, they are a less expensive replacement of multilayer ceramic or polyester capacitors. An equivalent circuit is shown below:

Meets IEC 324 (1970).



DIMENSIONS

millimeters (inches)

Digit 9 of P.N. (\varnothing)	D \pm 2 (0.079)	T max.	Available Lead Spacing
A	4.0 (0.157)	3.0 (0.118)	A,B,D,E,O,R
B	5.0 (0.197)	3.0 (0.118)	A,B,D,E,O,R,X
C	6.0 (0.236)	3.0 (0.118)	A,B,C,D,E,O,R,X
D	7.0 (0.276)	3.0 (0.118)	A,B,C,D,E,O,R,X
E	8.0 (0.315)	3.0 (0.118)	A,B,C,D,E,O,R,X
F	9.0 (0.354)	3.0 (0.118)	A,B,C,E,O,R,X
G	10.0 (0.394)	3.0 (0.118)	A,B,C,E,O,R,X
H	11.0 (0.433)	3.0 (0.118)	A,B,C,E,O,R,W
J	13.0 (0.512)	3.5 (0.138)	B,C,R,W
K	15.0 (0.591)	4.0 (0.157)	B,C,R,W

millimeters (inches)

Lead Spacing	Digit 8 of P.N.	
F		
2.5 (0.100)	D	—
5 (0.200)	A	O
6 (0.250)	E	X
7.5 (0.300)	B	R
10 (0.400)	C	W

PERFORMANCE CHARACTERISTICS CLASS III

Measured at	1.0 kHz / 0.1 Vrms / 25°C	
Dissipation Factor	$C_R \leq 22 \text{ nF} \rightarrow \text{Y5V, Y5U} \leq 7.5\%$ $C_R > 22 \text{ nF} \rightarrow \text{Y5V, Y5P} \leq 5.0\%$	
Capacitance Tolerance	Y5P $\rightarrow \pm 20\% / -20 + 50\%$ Y5U $\rightarrow \pm 20\% / -20 + 80\%$ Y5V $\rightarrow \pm 20\% / -20 + 80\%$	
Climatic Category	30 / 085 / 21	
Insulation Resistance @ V_R	Y5P	$\geq 12 \text{ M}\Omega$
	Y5U	$4.7 \text{ nF} \dots 100 \text{ nF} \rightarrow \geq 10 \text{ M}\Omega$ $200 \text{ nF} \rightarrow \geq 1 \text{ M}\Omega$
	Y5V	$\geq 100 \text{ M}\Omega$
Dielectric Strength NOTE: Charging current limited to 50 mA	Between leads	$V_t = 1.25 V_R$
	Body insulation	$V_R = 25\text{V } V_t = 100\text{V (DC)}$ $V_R = 50\text{V } V_t = 150\text{V (DC)}$
Operating Temperature Range (°C)	-30... +85	

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 21 days. No voltage to be applied.

Disc Ceramic Capacitors

Dimension Table

Barrier Layer Capacitors - Class III General Purpose



PHENOLIC COATED – CAPACITANCE VS. DISC DIAMETER

millimeters (inches)

Class III	$\Delta C/C$ (max.) $\pm 12\%$		Range -30... +85°C		$\Delta C/C$ (max.) +30 -65%		Range -30... +85°C		$\Delta C/C$ (max.) +22 -85%		Range -30... +85°C	
Temp. Coefficient	Y5P				Y5U				Y5V			
Digits 1,2,3 of P.N.	5WF		5WH		5YF		5YH		5ZH			
Rated Voltage (V_R)	25 VDC		50 VDC		25 VDC		50 VDC		50 VDC			
C_R (pF)												
4,700	4.0 (0.157)		4.0 (0.157)		4.0 (0.157)		4.0 (0.157)		4.0 (0.157)			
10,000	6.0 (0.236)		6.0 (0.236)									
22,000	7.0 (0.276)		8.0 (0.315)		5.0 (0.197)		6.0 (0.236)					
33,000	8.0 (0.315)		9.0 (0.354)		6.0 (0.236)		7.0 (0.276)					
47,000			11.0 (0.433)									
50,000	10.0 (0.394)		—		7.0 (0.276)		8.0 (0.315)		5.0 (0.197)			
68,000	11.0 (0.433)		13.0 (0.512)									
100,000	13.0 (0.512)		15.0 (0.591)		8.0 (0.315)		9.0 (0.354)		7.0 (0.276)			
200,000	—		—		13.0 (0.512)		—					

Y5U, Y5V - Preferences

Diameter (ϕ) = 9th Part Number Digit

Disc Ceramic Capacitors



Safety Ceramic Capacitors

DEFINITIONS (IEC 384-14 1993)

X FUNCTION: applications where the capacitor failure does not lead to danger of electrical shock. There are three subclasses related to the peak voltage of the impulses superimposed to the mains voltage:

Subclass X1: impulses up to 4000V

Subclass X2: impulses up to 2500V

Subclass X3: impulses up to 1200V

Y FUNCTION: applications where the capacitor failure may lead to danger of electrical shock. There are four subclasses related to the peak voltage of the impulses applied before the life test:

Subclass Y1: impulses up to 8000V

Subclass Y2: impulses up to 5000V

Subclass Y3: rated 250Vac without impulses

Subclass Y4: impulses up to 2500V

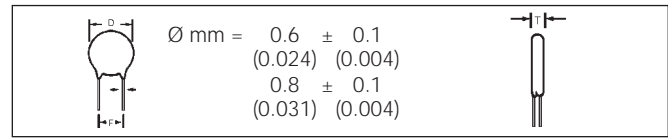
ANTENNA: the capacitors are used to decouple the antenna leads of video and audio equipment, whose failure may lead to danger of electrical shock.

TPC Safety Capacitors:

61V (GZO): meets subclasses X1, Y1 Test voltage 4000 VAC

620 (GKO): meets subclasses X1, Y2 Test voltage 2500 VAC

65N (GAY): meets subclasses X2, Y3 Test voltage 1800 VAC



DIMENSIONS

millimeters (inches)

Digit 9 (ø)	D ± 1 (0.039)	T max.	Available Lead Spacing		
			65N	620	61V
C	6.0 (0.236)	4.0 (0.157)	B,C,E	B,C	C
D	7.0 (0.276)	4.0 (0.157)	B,C,E	B,C	C
E	8.0 (0.315)	4.0 (0.157)	B,C,E,Q	B,C,Q	C
F	9.0 (0.354)	5.0 (0.197)	B,C,E	B,C	C
G	10.0 (0.394)	5.0 (0.197)	B,C,E	B,C	C
H	11.0 (0.433)	5.0 (0.197)	B,C,E,P,W	B,C,P	C,P
J	13.0 (0.512)	6.0 (0.236)	B,C,P,W	B,C,P	C,P
K	15.0 (0.591)	6.0 (0.236)	B,C,P,W	B,C,P	C,P
M	19.0 (0.748)	7.0 (0.276)	B,C,P	B,C,P	C,P

(E), (X), (M): upon request

millimeters (inches)

Lead Spacing	Digit 8		
F			
6 (0.250)	E	—	—
7.5 (0.300)	B	—	Q
10 (0.400)	C	W	—
12.5 (0.500)	P	—	—

PERFORMANCE CHARACTERISTICS

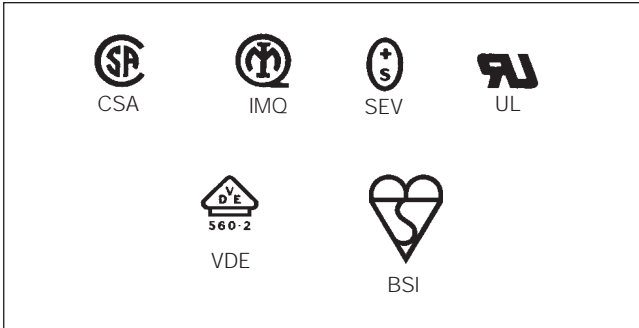
	61V	620	65N
Measured at	1.0 kHz / 0.3 Vrms / 25°C	1.0 kHz / 0.3 Vrms / 25°C	1.0 kHz / 0.3 Vrms / 25°C
Capacitance Tolerance	±20% / -20 +50%	±20% / -20 +50%	±20% / -20 +50%
D.F max. @ 25°C	1.5%	1.5%	1.5%
Insulation Resistance	≥ 10 GΩ	≥ 10 GΩ	≥ 10 GΩ
Test Voltage Between Leads	4.000 VAC	2.500 VAC	1.800 VAC
Test Voltage Leads to Body	4.000 VAC	2.300 VAC	2.000 VAC
Operating Temperature Range (°C)	-40 +125	-40 +125	-40 +125

Disc Ceramic Capacitors



Safety Ceramic Capacitors

APPROVED LOGOS



CERTIFICATION BODY APPROVALS

	61V				62O			
	Standard	Certificate Number	Rated Voltage	Climatic Category	Standard	Certificate Number	Rated Voltage	Climatic Category
UL	UL 1414	E 147842 (N)	250 VAC		UL 1414	E 147842 (N)	250 VAC	
CSA	CAN/CSA - C22.2 No 1-94	LR 100430-2	250 VAC		CAN/CSA - C22.2 No 1-94	LR 100430-1	250 VAC	
SEV	SEV 1016	93-100959.10	400 VAC	40/085/21	SEV 1016 SEV 1055	93-100959.12	400 VAC	40/125/21
VDE	DIN EN 132400: 1995 IEC 384-14: 1993	94612	X1 : 400 VAC Y1 : 250 VAC	40/085/21/C	DIN VDE 0560 - part 2	76830 76804	400 VAC	25/085/21
		94610 94634			DIN EN 132400: 1995 IEC 384-14: 1993	101384	X1 : 400 VAC Y2 : 250 VAC	40/085/21/C
BSI	BS EN 60065: 1994 IEC 384-14: 1993 BS EN 132400: 1995	228237	X1 : 400 VAC Y1 : 250 VAC	40/125/21/C	BS EN 60065: 1994 IEC 384-14: 1993 BS EN 132400: 1995	228197	X1 : 400 VAC Y2 : 250 VAC	40/125/21/C
IMQ	EN 132400: 1994 IEC 384-14: 1993	V4551	X1 : 400 VAC Y1 : 250 VAC	40/125/21/C	EN 132400: 1994 IEC 384-14: 1993	V4635	X1 : 400 VAC Y2 : 250 VAC	40/125/21/C

Disc Ceramic Capacitors



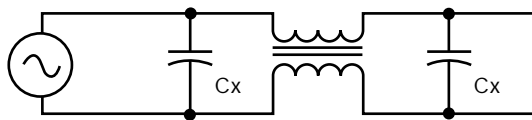
Safety Ceramic Capacitors Epoxy Coated

CAPACITANCE VS. DISC DIAMETER

Digits 1, 2, 3 of P.N. C_R (pF)	61V	62O	65N
100	6.0 (0.236)	6.0 (0.236)	6.0 (0.236)
120			
150			
220	7.0 (0.276)	7.0 (0.276)	6.0 (0.236)
330			
390			
470			
560	8.0 (0.315)	8.0 (0.315)	7.0 (0.276)
680			
820	9.0 (0.354)	8.0 (0.315)	8.0 (0.315)
1000			
1200			
1500	11.0 (0.433)	9.0 (0.354)	8.0 (0.315)
2200			
3300	13.0 (0.512)	10.0 (0.394)	9.0 (0.354)
3900			
4700	19.0 (0.748)	13.0 (0.512)	11.0 (0.433)
		15.0 (0.591)	13.0 (0.512)

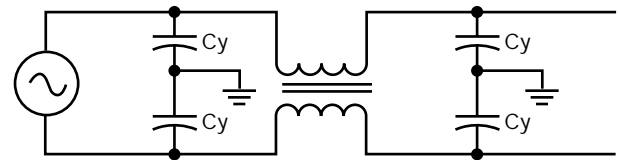
TYPICAL APPLICATION FOR SAFETY CERAMIC DISCS AND SWITCH MODE

Across the line capacitors for noise suppression



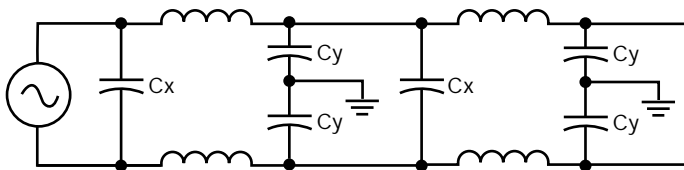
C_x =TPC 61V or 62O series

Line by-pass for noise suppression



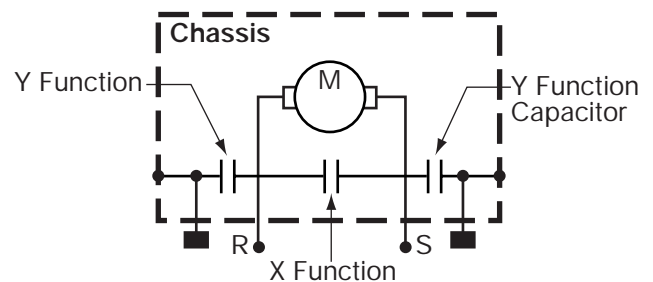
C_y =TPC 61V or 62O series

Typical X and Y function application



Thompson 61V or 62O series

Protection and suppression of a motor (X and Y function)



Disc Ceramic Capacitors



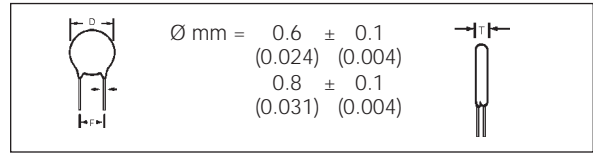
AC and Switch Mode Epoxy Coated

CAPACITORS FOR AC AND SWITCH MODE APPLICATIONS

These capacitors are made of a new dielectric compound specially developed for AC or switch mode circuits that can generate dielectric heat which is limiting factor on other ceramic disc capacitors.

This new series adds the advantages of class I (low loss factor) with the advantages of class II capacitors (small sizes and lower costs).

The capacitors are epoxy coated, flame retardant class UL 94-V0. They meet the standards of the telecom and data processing industry. They are particularly suited for TV deflection and power supply circuits.



Lead Spacing	Digit 8		
F			
5 (0.200)	A	—	N
6 (0.250)	E	X	—
7.5 (0.300)	B	R	Q
10 (0.400)	C	W	—
12.5 (0.500)	P	—	—

DIMENSIONS

millimeters (inches)

Digit 9 (ø)	D ± 2 (0.079)	T max.	Available Lead Spacing		
			Vn = 1000V	Vn = 2000V	Vn = 3000V
A	4.0 (0.157)	4.0 (0.157)	A,B,E,N,R	A,B,E,N,R	B,E
B	5.0 (0.197)	4.0 (0.157)	A,B,E,N,R,X	A,B,E,N,R	B,E
C	6.0 (0.236)	4.0 (0.157)	A,B,C,E,N,R,X	A,B,C,E,N,R,	B,C,E
D	7.0 (0.276)	4.0 (0.157)	A,B,C,E,N,Q,R,X	A,B,C,E,N,Q,R	B,C,E
E	8.0 (0.315)	4.0 (0.157)	A,B,C,E,N,Q,R,X	A,B,C,E,N,Q,R	B,C,E
F	9.0 (0.354)	5.0 (0.197)	A,B,C,E,N,R,X	A,B,C,E,N,R	B,C,E
G	10.0 (0.394)	5.0 (0.197)	A,B,C,E,N,R,X	A,B,C,E,N,R	B,C,E
H	11.0 (0.433)	5.0 (0.197)	A,B,C,E,N,P,R,W	A,B,C,E,N,P,R,W	B,C,E,P,W
J	13.0 (0.512)	6.0 (0.236)	B,C,N,P,R,W	B,CN,P,R,W	B,C,P,W
K	15.0 (0.591)	6.0 (0.236)	B,C,N,P,R,W	B,CN,P,R,W	B,C,P,W
M	19.0 (0.748)	7.0 (0.276)	B,C,P	B,C,P	B,C,P

(E), (X), (W): upon request

PERFORMANCE CHARACTERISTICS

Measured at	1.0 kHz / 0.3 Vrms / 25°C					
Dissipation Factor	6LR / 6LS / 6LT ≤ 0.3% 67S / 68S ≤ 0.8%					
Capacitance Tolerance	±10%	6LR X	6LS X	6LT X	67S X	68S X
	±20%	X	X	X	X	
	-20 +50%	X	X	X	X	
Insulation Resistance	@ 500V → ≥ 10 GΩ					
Dielectric Strength NOTE: Charging current limited to 50 mA	1.5 x V _R + 500 (DC) Between leads and body insulation					
Operating Temperature Range (°C)	-40... +125					
Climatic Category	30 / 085 / 56					
Max. Temp. rise on the external surface of the capacitor related to ambient	Measured at 20mm from the capacitor					Tmax. = Tamb + 20°C

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 56 days. No voltage to be applied.

Disc Ceramic Capacitors



AC and Switch Mode Epoxy Coated

CAPACITANCE VS. DISC DIAMETER

millimeters (inches)

Temp. Coefficient	Y5P			Y5U	Y5V	
Digits 1, 2, 3 of P.N.	6LR	6LS	6LT	67S	68S	
Rated Voltage (V _R)	1000 VDC 130 VAC	2000 VDC 250 VAC	3000 VDC 380 VAC	2000 VDC 250 VAC	2000 VDC 250 VAC	
C _R (pF)						
220	7.0 (0.276)	7.0 (0.276)	7.0 (0.276)			
270						
330		8.0 (0.315)	8.0 (0.315)			9.0 (0.354)
390						
470						
560	9.0 (0.354)	9.0 (0.354)	10.0 (0.394)			
680				8.0 (0.315)	10.0 (0.394)	11.0 (0.433)
820						
1000	9.0 (0.354)	11.0 (0.433)	13.0 (0.512)	8.0 (0.315)		
1200						
1500	11.0 (0.433)	13.0 (0.512)	15.0 (0.591)			
1800						
2200					13.0 (0.512)	15.0 (0.591)
2700						
3300	15.0 (0.591)	15.0 (0.591)	10.0 (0.394)			
3900						
4700				19.0 (0.748)	19.0 (0.748)	11.0 (0.433)
10000						

Diameter (φ) = 9th Part Number Digit

Disc Ceramic Capacitors



Professional Ceramic Capacitors - Class I, II and III

MIL-STD-202F

The professional ceramic disc capacitors were specially developed for applications in severe environmental conditions, high humidity, temperature, gas, vapor and solvents.

The capacitors are flame retardant epoxy coated, meeting UL 94-V0 flammability specifications. The capacitors are 100% screened on following electrical parameters:

Capacitance, loss factor, test voltage. After the 100% test, the capacitors are audited on its electrical and mechanical parameters with following AQL:

Electrical parameters: 0.065% level II

Mechanical parameters: 0.65% level II

The capacitors withstand the following reliability essays:

Terminal strength: method 211 – condition A

Resistance to solvents: method 215

Resistance to soldering heat: method 210 – condition B

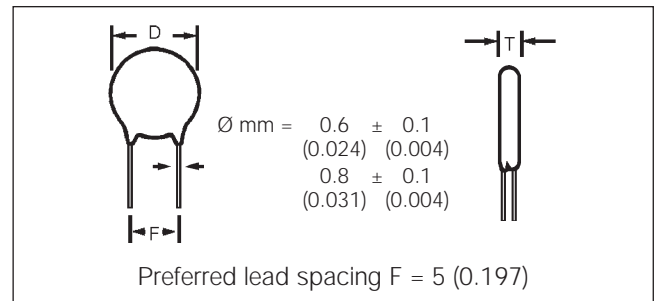
Solderability: method 208

Thermal shock: method 107 – condition A

Humidity (steady state): method 103 – condition D

Life (at elevated ambient temperature): method 108 – condition D

Operating temperature and storage: -55... +125° C



millimeters (inches)

Lead Spacing	Digit 8	
F		
2.5 (0.100)	D	—
5 (0.200)	A	O
6 (0.250)	E	X
7.5 (0.300)	B	R
10 (0.400)	C	W

DIMENSIONS

millimeters (inches)

Digit 9 (ø)	D ± 2 (0.079)	T max.	Available Lead Spacing
A _{1pF... 2.7 pF} NPO	4.0 (0.157)	3.0 (0.118)	A,B,D,E,O,R
A _{5.6pF... 8.2 pF} N1500	4.0 (0.157)	3.0 (0.118)	A,B,D,E,O,R
A Others	4.0 (0.157)	3.0 (0.118)	A,B,D,E,O,R
B	5.0 (0.197)	3.0 (0.118)	A,B,D,E,O,R,X
C	6.0 (0.236)	3.0 (0.118)	A,B,C,D,E,O,R,X
D	7.0 (0.276)	3.0 (0.118)	A,B,C,D,E,O,R,X
E	8.0 (0.315)	3.0 (0.118)	A,B,C,D,E,O,R,X
F	9.0 (0.354)	3.0 (0.118)	A,B,C,E,O,R,X
G	10.0 (0.394)	3.0 (0.118)	A,B,C,E,O,R,X
H	11.0 (0.433)	3.0 (0.118)	A,B,C,E,O,R,W
J	13.0 (0.512)	3.5 (0.138)	B,C,R,W
K	15.0 (0.591)	3.5 (0.138)	B,C,R,W
M	19.0 (0.748)	4.0 (0.157)	B,C

(E), (X), (W): upon request

Disc Ceramic Capacitors



General Specifications - Class I and II Professional

DIELECTRIC - CLASS I

These ceramic capacitors have linear temperature coefficient, very low tolerances, low losses, high insulation resistance and are specially suitable for tuned circuits, timing and other precision circuits.

100V ... 500V PERFORMANCE CHARACTERISTICS CLASS I

Measured at %	1.0 MHz / 1.0 Vrms / 25°C	Dielectric Strength NOTE: Charging current limited to 50 mA	V _R = 100V → Vt = 250V (DC) V _R = 500V → Vt = 1.25kV (DC) Between leads and body insulation
Dissipation Factor	C _R ≤ 30 pF → ≤ 1/C _R + 0.07 C _R > 30 pF → ≤ .1%		
Tolerance	C _R < 10 pF → ±0.25 pF, ±0.5 pF C _R ≥ 10 pF → ±5%, ±10%	Operating Temperature Range (°C)	-55... +125 Epoxy Coated
Insulation Resistance	@ V _R → ≥ 10 GΩ	Climatic Category	55 / 085 / 56

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 56 days. No voltage to be applied.

DIMENSION TABLE - CLASS I LOW AND MEDIUM VOLTAGE PROFESSIONAL

100V / 500V CLASS I EPOXY COATED – CAPACITANCE VS. DISC DIAMETER millimeters (inches)

Temp. Coefficient	NP0		N750		N1500	
Digits 1, 2, 3 of P.N.	6AK	6AQ	6GK	6GQ	6HK	6HQ
Rated Voltage	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC	500 VDC
C _R (pF)						
1.0	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)
1.2						
1.5						
1.8						
2.0						
2.2						
2.7						
3.0						
3.3						
3.9						
4.0						
4.7						
5.0						
5.6						
6.0						
6.8						
7.0						
8.0						
8.2						
9.0						
10						
12						
15						
18						
20						
22						
27						
33						
39						
47						
50						
56						
68						
82						
100						
120						
150						
180						
220						
270						
330						
	5.0 (0.197)	5.0 (0.197)	5.0 (0.197)	5.0 (0.197)	5.0 (0.197)	5.0 (0.197)
		6.0 (0.236)				
	7.0 (0.276)	7.0 (0.276)	7.0 (0.276)	7.0 (0.276)	7.0 (0.276)	7.0 (0.276)
	8.0 (0.315)	8.0 (0.315)	8.0 (0.315)	8.0 (0.315)	8.0 (0.315)	8.0 (0.315)
		9.0 (0.354)	9.0 (0.354)	9.0 (0.354)	9.0 (0.354)	9.0 (0.354)
	9.0 (0.354)	11.0 (0.433)	11.0 (0.433)	11.0 (0.433)	11.0 (0.433)	11.0 (0.433)
	11.0 (0.433)	15.0 (0.591)	15.0 (0.591)	15.0 (0.591)	15.0 (0.591)	15.0 (0.591)
		19.0 (0.748)	19.0 (0.748)	19.0 (0.748)	19.0 (0.748)	19.0 (0.748)

Diameter (φ) = 9th Part Number Digit

Disc Ceramic Capacitors

Dimension Table - Class II

Low and Medium Voltage Professional



DIELECTRIC - CLASS II

These ceramic capacitors have a high dielectric constant, making possible high capacitance values in reduced dimensions, however temperature coefficient and loss factor are greater than Class I.

Typical applications are decoupling and by pass.

100V AND 500V PERFORMANCE CHARACTERISTICS CLASS II

Measured at	1.0 kHz / 0.3 Vrms / 25°C	Dielectric Strength NOTE: Charging current limited to 50 mA	$V_R = 100V \rightarrow V_t = 250V$ (DC) $V_R = 500V \rightarrow V_t = 1250V$ (DC) Between leads and body insulation
Dissipation Factor	X5E / X5F / X5P $\rightarrow \leq 2.5\%$ X5U / X5V / Z5V $\leq 3.0\%$		
Capacitance Tolerance	X5E / X5F / X5P $\rightarrow \pm 10\%$ X5U / X5V / Z5V $\rightarrow -20 +50\%$ X5E / X5F / X5P / X5U / $\rightarrow \pm 20\%$	Operating Temperature Range (°C)	-55... +125 Epoxy Coated
Insulation Resistance	@ $V_R \rightarrow \geq 10 G\Omega$	Climatic Category	55 / 085 / 56

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 56 days. No voltage to be applied.

DIMENSION TABLE - CLASS II LOW AND MEDIUM VOLTAGE PROFESSIONAL

100V / 500V CLASS II EPOXY COATED

millimeters (inches)

Temp. Coefficient Digits 1,2,3 of P.N.	X5E		X5F		X5P		X5U		X5V		Z5V
	6MK	6MQ	6NK	6NQ	6OK	6OQ	6SK	6SQ	6TK	6TQ	6UK
Rated Voltage (V_R)	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC	500 VDC	100 VDC
C_R (pF)											
56	4.0 (0.157)	4.0 (0.157)	Use X5E	Use X5E	Use X5E	Use X5E	Use X5E	Use X5E	Use X5E	Use X5E	Use X5E
68											
82											
100											
120											
150											
180											
220											
270	5.0 (0.197)	5.0 (0.197)	Use X5F	Use X5F	Use X5F	Use X5F	Use X5F	Use X5F	Use X5F	Use X5F	Use X5F
330											
390											
470											
560											
680											
820											
1,000											
1,200											
1,500											
1,800	9.0 (0.354)	11.0 (0.433)	8.0 (0.315)	11.0 (0.433)	8.0 (0.315)	11.0 (0.433)	8.0 (0.315)	11.0 (0.433)	9.0 (0.354)	11.0 (0.433)	Use X5V
2,200											
2,700											
3,300											
3,900											
4,700											
5,600											
6,800											
8,200											
10,000											
12,000	11.0 (0.433)	13.0 (0.512)	9.0 (0.354)	13.0 (0.512)	9.0 (0.354)	13.0 (0.512)	9.0 (0.354)	13.0 (0.512)	11.0 (0.433)	13.0 (0.512)	8.0 (0.315)
15,000											
22,000											

Diameter (φ) = 9th Part Number Digit

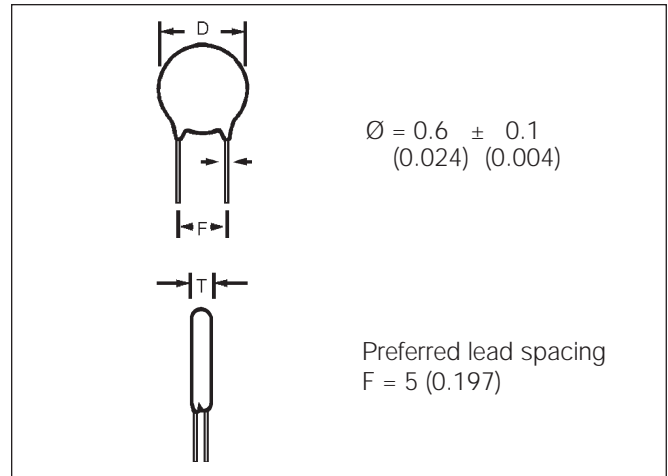
Disc Ceramic Capacitors



General Specifications - Class III Professional

DIELECTRIC - CLASS III

A thin dielectric layer is grown on a disc of conductive ceramic. Very large capacitances can be obtained due to reduced thickness of this barrier layer and its inherently high dielectric constant. Due its small dimensions, they are a less expensive replacement of multilayer ceramic or polyester capacitors.



DIMENSIONS

millimeters (inches)

Digit 9 of P.N. (ø)	D ± 2 (0.079)	T max.	Available Lead Spacing
A	4.0 (0.157)	3.0 (0.118)	A,B,D,E,O,R
B	5.0 (0.197)	3.0 (0.118)	A,B,D,E,O,R,X
C	6.0 (0.236)	3.0 (0.118)	A,B,C,D,E,O,R,X
D	7.0 (0.276)	3.0 (0.118)	A,B,C,D,E,O,R,X
E	8.0 (0.315)	3.0 (0.118)	A,B,C,D,E,O,R,X
F	9.0 (0.354)	3.0 (0.118)	A,B,C,E,O,R,X
G	10.0 (0.394)	3.0 (0.118)	A,B,C,E,O,R,X
H	11.0 (0.433)	3.0 (0.118)	A,B,C,E,O,R,W
J	13.0 (0.512)	3.5 (0.138)	B,C,R,W
K	15.0 (0.591)	4.0 (0.157)	B,C,R,W

(E), (X), (W): upon request

millimeters (inches)

Lead Spacing	Digit 8 of P.N.	
F		
2.5 (0.100)	D	—
5 (0.200)	A	O
6 (0.250)	E	X
7.5 (0.300)	B	R
10 (0.400)	C	W

PERFORMANCE CHARACTERISTICS CLASS III

Measured at	1.0 kHz / 0.1 Vrms / 25°C	
Dissipation Factor	$C_R \leq 22 \text{ nF} \rightarrow Y5V, Y5U \leq 7.5\%$ $C_R > 22 \text{ nF} \rightarrow Y5V, Y5P \leq 5.0\%$	
Capacitance Tolerance	Y5P $\rightarrow \pm 20\% / -20 + 50\%$ Y5U $\rightarrow \pm 20\% / -20 + 80\%$ Y5V $\rightarrow \pm 20\% / -20 + 80\%$	
Climatic Category	55 / 085 / 56	
Insulation Resistance @ V_R	Y5P	$\geq 12 \text{ M}\Omega$
	Y5U	$4.7 \text{ nF} \dots 100 \text{ nF} \rightarrow \geq 10 \text{ M}\Omega$ $200 \text{ nF} \rightarrow \geq 1 \text{ M}\Omega$
	Y5V	$\geq 100 \text{ M}\Omega$
Dielectric Strength NOTE: Charging current limited to 50 mA	Between leads	$V_t = 1.25 V_R$
	Body insulation	$V_R = 25V \quad V_t = 100V \text{ (DC)}$ $V_R = 50V \quad V_t = 150V \text{ (DC)}$
Operating Temperature Range (°C)	-55... +125 Epoxy Coated	

Note: Damp Heat Steady State: 90... 95% R.H. 40°C / 21 days. No voltage to be applied.

Disc Ceramic Capacitors

Dimension Table

Barrier Layer Capacitors - Class III Professional



EPOXY COATED – CAPACITANCE VS. DISC DIAMETER

millimeters (inches)

Class III	$\Delta C/C$ (max.) $\pm 12\%$	Range -30... +85°C	$\Delta C/C$ (max.) +30 -65%	Range -30... +85°C	$\Delta C/C$ (max.) +22 -85%	Range -30... +85°C
Temp. Coefficient	Y5P		Y5U		Y5V	
Digits 1,2,3 of P.N.	6WF	6WH	6YF	6YH	6ZH	
Rated Voltage (V_R)	25	50	25	50	50	
C_R (pF)						
4,700	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)	4.0 (0.157)	
10,000	6.0 (0.236)	6.0 (0.236)				
22,000	7.0 (0.276)	8.0 (0.315)	5.0 (0.197)	6.0 (0.236)		
33,000	8.0 (0.315)	9.0 (0.354)	6.0 (0.236)	7.0 (0.276)		
47,000	10.0 (0.394)	11.0 (0.433)	7.0 (0.276)	8.0 (0.315)		
50,000		—				
68,000	11.0 (0.433)	13.0 (0.512)			5.0 (0.197)	
100,000	13.0 (0.512)	15.0 (0.591)			7.0 (0.276)	
200,000	—	—	13.0 (0.512)	—		

Y5U, Y5V - Preferences

Diameter (ϕ) = 9th Part Number Digit

Disc Ceramic Capacitors



Marking

DIG. 2		Logo: Only in diam. \geq 6mm	Capacitance		EIA	
O				1pF = 109	100pF = 101	
TC / Class		1.2pF = 129		120pF = 121		
General Purpose	Professional	1.5pF = 159		150pF = 151		
A = NP0 / I	A = NP0 / I	1.8pF = 189		180pF = 181		
*B = P100 / I	B = P100 / I	2.2pF = 229		220pF = 221		
*C = N150 / I	C = N150 / I	2.7pF = 279		270pF = 271		
*D = N220 / I	D = N220 / I	3.9pF = 399		390pF = 391		
*E = N330 / I	E = N330 / I	4.7pF = 479		470pF = 471		
*F = N470 / I	F = N470 / I	5.6pF = 569		560pF = 561		
G = N750 / I	G = N750 / I	6.8pF = 689		680pF = 681		
H = N1500 / I	H = N1500 / I	8.2pF = 829	820pF = 821			
*I = N2200 / I	I = N2200 / I	10pF = 100	1nF = 102			
*J = N4700 / I	J = N4700 / I	12pF = 120	1.2nF = 122			
K = SL	7 = Y5U / SM	15pF = 150	1.8nF = 182			
M = Y5E / II	8 = Y5V / SM	18pF = 180	2.2nF = 222			
N = Y5F / II	L = Y5P / SM	22pF = 220	2.7nF = 272			
O = Y5P / II	M = X5E / II	27pF = 270	3.9nF = 392			
P = Y5R / II	N = X5F / II	39pF = 390	4.7nF = 472			
Q = Y5T / II	O = X5P / II	47pF = 470	5.6nF = 562			
S = Y5U / II	P = X5R / II	56pF = 560	6.8nF = 682			
T = Y5V / II	Q = X5T / II	68pF = 680	8.2nF = 822			
U = Z5V / II	S = X5U / II	82pF = 820	10nF = 103			
V = Z4V / III	T = X5V / II		15nF = 153			
*W = Y5P / II	U = Z5V / II		22nF = 223			
*X = Y5R / II	V = Z4V / III		33nF = 333			
Y = Y5U / II	W = Y5P / III		47nF = 473			
Z = Y5V / II	X = Y5R / III		100nF = 104			
	Y = Y5U / III		200nF = 204			
	Z = Y5V / III					

DIG. 3	DIG. 7
Q	M
Rated Voltage	Tolerance
D = 16V	C = $\pm 0.25\text{pF}$
F = 25V	D = $\pm 0.5\text{pF}$
H = 50V	J = $\pm 5\%$
K = 100V	K = $\pm 10\%$
Q = 500V	M = $\pm 20\%$
R = 1000V	S = -20 +50%
S = 2000V	Z = -20 +80%
T = 3000V	P = 0 +100%
U = 4000V	
W = 5000V	
X = 6000V	
Y = 7500V	

*Upon Request

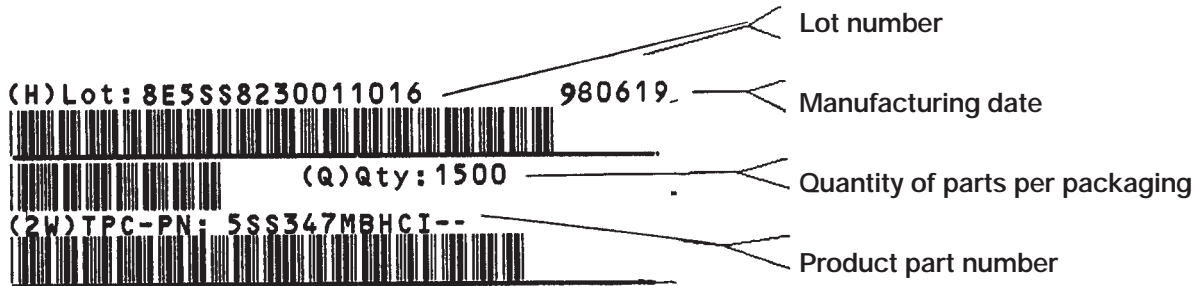
Safety Front	Type
	61V
	620
	65N
Capacitance	Tolerance
As above	As above
Back: (Approval marks)	

TC – Temperature coefficient.

DIG – for better understanding, check pages 3 and 4.

IDENTIFICATION AND TRACEABILITY

On all TPC ceramic capacitors packages, you will find a bar code label with the following information:



TAPED PARTS QUANTITY TABLE

millimeters (inches)

Rated Voltage (Vr)	Diameter D	Quantities	
		Ammopack	Reel
Vr ≤ 500V	D ≤ 7 (0.276)	2000	2500
	7 < D ≤ 11 (0.433)	2000	2000
500V < Vr ≤ 2KV	D ≤ 11 (0.433)	1500	2000
2KV < Vr = 5KV	D ≤ 11 (0.433)	1000	1500

CARDBOARD STRIPS QUANTITY TABLE

millimeters (inches)

Rated Voltage (Vr)	Diameter D	Lead Space	
		< = 5 (0.197)	> 5 (0.197)
Vr ≤ 500V	D ≤ 8 (0.315)	2500	1500
	8 (0.315) ≤ D ≤ 11 (0.433)	1500	-
	8 (0.315) ≤ D ≤ 13 (0.512)	-	1000
	11 (0.433) ≤ D ≤ 15 (0.591)	1000	-
	13 (0.512) ≤ D ≤ 19 (0.748)	-	500
	D ≤ 19 (0.748)	500	-
500V < Vr ≤ 2KV	D ≤ 9 (0.354)	1500	1000
	9 (0.354) ≤ D ≤ 11 (0.433)	-	1000
	9 (0.354) ≤ D ≤ 13 (0.512)	1000	-
	11 (0.433) ≤ D ≤ 19 (0.748)	-	500
	13 (0.512) ≤ D ≤ 19 (0.748)	500	-
2KV < Vr ≤ 5KV Safety 65N 62O	D ≤ 9 (0.354)	1500	-
	D ≤ 11 (0.433)	-	1000
	D ≤ 13 (0.512)	500	500
Safety 61V	D ≤ 6 (0.236)	1500	1500
	7 (0.275) ≤ D ≤ 9 (0.354)	1000	1000
	9 (0.354) ≤ D	500	500

Quantities for other package alternative, upon request.

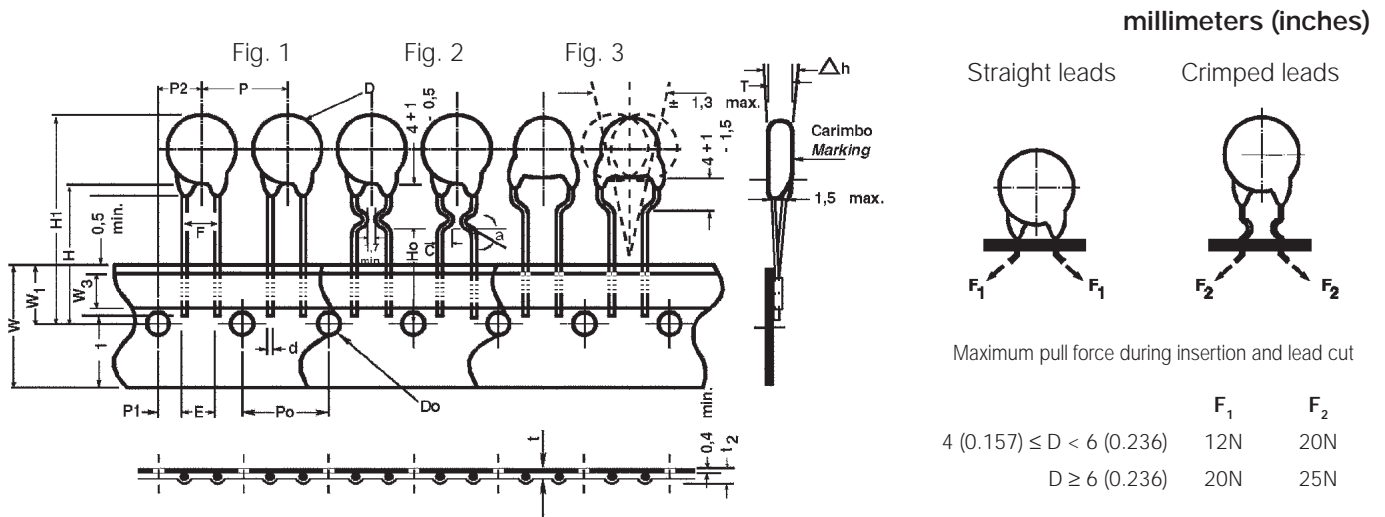
Disc Ceramic Capacitors



Tape and Reel Specifications

There are two types of taped disc ceramic capacitors:
Straight or crimped leads.

Both types can be shipped on reels or ammopack.
The standard packaging quantities are shown below:



Digit 11	Available Tapings	Digit 9
L	→ Sizes $4 (0.157) \leq D \leq 11 (0.433)$	A... H
M		
J H	→ Sizes $6 (0.236) \leq D \leq 11 (0.433)$	C... H
K I		

TPC Code Digit 11

Packaging	Avisert	Panasert
Reel 	 H L L FIGURE 1 FIGURE 2 FIGURE 3	 J L L FIGURE 1 FIGURE 2 FIGURE 3
Ammopack 	 I M M FIGURE 1 FIGURE 2 FIGURE 3	 K M M FIGURE 1 FIGURE 2 FIGURE 3

Figure 2: Inside Crimp 100V... 1000V

Figure 3: Outside Crimp 1000V

Disc Ceramic Capacitors

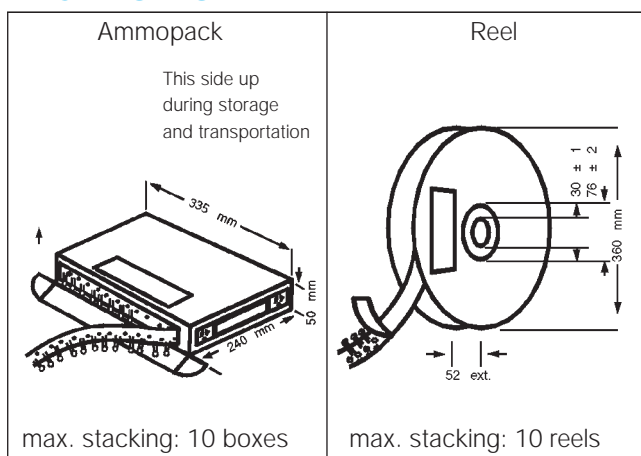


Tape and Reel Specifications

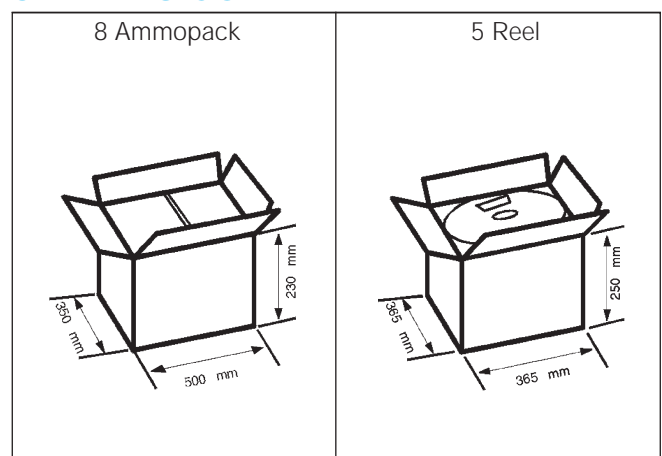
millimeters (inches)

Description of Symbols		Straight Leads		Crimped
		Figure 1		Figure 2 & 3
		A (Avisert)	P (Panaset)	Avisert & Panaset
Crimp angle	∞	—	—	20°...45°
Crimp length	C	—	—	1.7 min.
Lead diameter	d	0.60 ± 0.1		
Disc diameter	D	11 max.		
Lead hole diameter	Do	4.0 ± 0.2		
Disc thickness	T	See Catalog		
Lead spacing	F	5.0 $^{+0.6}_{-0.2}$		
Component alignment, front-rear	Δh	0 ± 1		
Height of component from tape center	H	19.5 ± 0.5	16.5 ± 0.5 - 0	—
Height from tape center to crimp	Ho	—	—	16 + 0.5 - 0
Component height	H1	32.25 max.	>23.5 <32.25	32.25 max.
Distance from component leads to tape bottom	ℓ_1	12 max.		
Tape width	W	18 $^{+1}_{-0.5}$		
Bonding tape width	W ₃	5.5 min.		
Feed hole position	W ₁	9.0 ± 0.5		
Pitch between discs	P	12.7 ± 1		
Feed hole pitch	Po	12.7 ± 0.3		
Hole center to lead	P1	3.85 ± 0.7		
Feed hole center to component center	P2	6.35 ± 1		
Tape + bonding tape thickness	t	0.7 ± 0.2		
Total tape thickness, including lead	t ₂	1.5 max.		

PACKAGING



SHIPPING CONTAINER



Normalized Series and Associated Values

E 6 ±20%	E 12 ±10%	E 24 ±5%	E 48 ±2%	E 96 ±1%		
100	100	100	100	100		
			102	102		
			105	105		
				107	107	
			110	110	110	
				113	113	
				115	115	
				118	118	
			120	120	121	
				121		
				124		
			127	127		
		130		130		
			133	133		
				137	137	
			140	140		
				143	143	
				147	147	
150	150	150	150	150		
			154	154		
			158	158		
			160	162	162	
				165	165	
				169	169	
			174	174		
		180	180	178	178	
					182	182
					187	187
				191	191	
				196	196	
			200	200		
220	220	220	205	205		
			210	210		
			215	215		
			221	221		
			226	226		
				232	232	
			240	237	237	
					243	243
					249	249
				255	255	
				261	261	
		270	270	267	267	
					274	274
					280	280
				287	287	
			294	294		
			301	301		
		309	309			

E 6 ±20%	E 12 ±10%	E 24 ±5%	E 48 ±2%	E 96 ±1%		
330	330	330	316	316		
					324	324
					332	332
					340	340
				348	348	
				357	357	
				365	365	
				374	374	
			390	390	383	383
				392	392	
			402	402		
			412	412		
			422	422		
			432	432		
			442	442		
			453	453		
	470	470	470	464	464	
						475
					487	487
				499	499	
				511	511	
				523	523	
		560	560	536	536	
					549	549
					562	562
				576	576	
				590	590	
				604	604	
			619	619		
680		680	680	649	649	
						665
					681	681
				698	698	
				715	715	
			732	732		
		820	750	750	750	
					768	768
				787	787	
			806	806		
		825	825			
		845	845			
		866	866			
		887	887			
		909	909			
		931	931			
		953	953			
		976	976			

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