VISHAY INTERTECHNOLOGY, INC.

DATA BOOK

VISHAY CERA-MITE CAPACITORS & PTC THERMISTORS

PTC Thermistors

Ceramic Disc Capacitors

Special High Voltage Capacitors

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VISHAY INTERTECHNOLOGY, INC.

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MANUFACTURER OF THE WORLD'S BROADEST LINE OF DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS

Vishay Cera-Mite Capacitors and PTC Thermistors

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PTCR Technology and Application

PTCR TECHNOLOGY

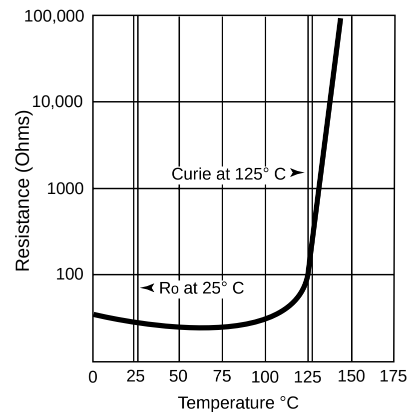
PTCRs (Positive Temperature Coefficient Resistors) are made from high purity semiconducting ceramics. Based on complex titanate chemical compositions ($BaTiO_3$, $SrTiO_3$, etc.), their specific performance is created by the addition of dopants and unique processing, including high force pressing into desired shapes and precision sintering. After the creation of the PTCR pellets, highly specialized metallurgical techniques are employed to create low ohmic contact systems. These electrodes are bonded to the ceramic with glass frit to provide great strength and high current carrying capacity.

What makes the PTCR such a useful device is its Resistance versus Temperature characteristic. It exhibits a low resistance over a wide temperature range, but upon reaching a certain temperature it undergoes a dramatic increase in resistance (several orders of magnitude). This temperature is called the “Curie Temperature” or “Switching Point”.

The increase in temperature can be caused by internal heat (I^2R loss) or from external ambient temperature increases. In applications, this rate of temperature change is often controlled to provide a time delay function. When the source of the heat is removed, the PTCR returns to its initial base resistance.

Fig T-1

TYPICAL PTCR RT CURVE

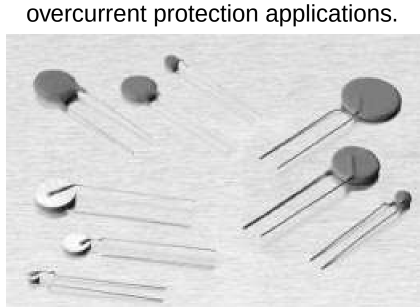


PTC THERMISTORS ARE AVAILABLE IN THREE CONFIGURATIONS

- As completely tested pellets for assembly into custom packages, utilizing high pressure mechanical contacts for refrigeration compressor motor starting and telecommunication overcurrent protection.

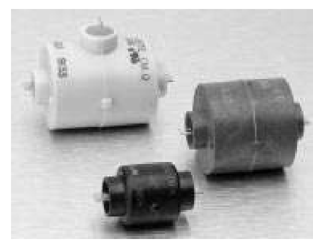
Unpackaged PTCR Pellets are supplied with silver electrodes suitable for custom mounting.

- As components with wire leads for fluorescent lighting and electronic overcurrent protection applications.



Resettable PTC Overcurrent Protectors and Fluorescent Lamp Starters.

- As part of rugged mechanical packages for PSC motor starting of HVAC compressors and other motor-start applications.



PTCRs used for PSC Motor Control in air conditioning applications.

PTCR APPLICATIONS

The unique properties of the PTCR have been optimized to provide reliable and economic products in several special areas.

PSC MOTOR START THERMISTORS

- PTCRs are applied with single phase compressor motors used in the HVAC and refrigeration industries. This severe duty cycle application requires the PTCR to repeatedly switch large currents at power line voltages.

  Vishay Cera-Mite PTCR devices have been engineered and perfected over 20 years to withstand thermal cycling and deliver reliable performance throughout the life of the refrigeration system. Both individual pellets and packaged devices are available.

FLUORESCENT BALLAST STARTING

- PTC Thermistors are used in electronic ballast applications to extend the life of fluorescent lamps by controlling preheat current and lamp ignition timing.

  A full range of standard devices are available and custom engineered samples can be rapidly created for special lamp designs.

  Vishay Cera-Mite PTC Thermistors are specified by major ballast manufacturers throughout the world.

SELF-RESETTING OVER-CURRENT PROTECTORS

Vishay Cera-Mite PTC Thermistors have been developed to replace older overcurrent protection concepts in:

- Tip and Ring Protection Modules for telecommunication systems.
- Resettable Overcurrent Protectors for power supplies, data communication circuits, and automotive doorlocks. In overload situations, the ability of the ceramic PTCR to switch reliably, and later reset precisely to its initial resistance is considered paramount to safe application.

OTHER APPLICATIONS

- The relatively new PTCR technology is being specified by innovative engineers into a variety of application areas. Self-regulating heaters and time-delay current relays are several examples. Vishay Cera-Mite provides engineering assistance for custom applications.

PTCR Motor Start Packages
PSC Single Phase Motor Start Assist

- **ECONOMICAL SOLID STATE TORQUE ASSIST FOR HEAT PUMPS, ROOM AIR, COMMERCIAL AND RESIDENTIAL AIR CONDITIONING AND REFRIGERATION SYSTEMS**

Positive Temperature Coefficient Resistors have been used for many years in millions of HVAC applications to provide starting torque assistance to Permanent Split Capacitor (PSC) single phase compressor motors.

Sizes are available to cover the full range of 120/240 volt PSC compressor motors.

Safety Agency Recognition

Vishay Cera-Mite motor start PTCRs are recognized by Underwriter Laboratories file E97640 in accordance with Standard for Thermistor Type Devices UL 1434; and Canadian Standards C22.2 No. 0-1991.

RELATIVE COMPARISON OF VARIOUS MOTOR STARTING METHODS

Three methods have historically been employed to generate starting torque for PSC motors. All are well-proven technologies and may be compared relative to one another based upon categories shown below.

The importance of each category is dependent upon the motor application and industry sector.

In general, if the PTCR starter produces sufficient starting torque, it is considered the simplest and most economical choice.

Table 1

	MECHANICAL			ELECTRICAL					FINANCIAL		
STARTING METHOD	EASE OF WIRING	PANEL SPACE REQUIRED	SENSITIVE TO MOUNTING DIRECTION	ACCELERATION TORQUE PRODUCED	ACCELERATION (SWITCH) TIME	RESET TIME REQUIRED	EMI/RFI GENERATED	TECHNOLOGY	INVENTORY MIX REQUIRED	RELIABILITY	PURCHASED COST
PTCR Starter	Simple 2 Wire	Lowest	No	Lowest	Fixed	3 - 5 Minutes	No	Solid State	Lowest	Highest	Lowest
Start Cap with PTCR Acting as A Current Relay	Moderate 2 or 3 Wire	Medium	Yes	Medium	Fixed	2 - 5 Minutes	No	Solid State	Medium	Medium	Medium
Start Cap used With Potential or Current Relay	Difficult 4 or 5 Wire	Highest	Yes	Highest	Variable Based on Motor Speed	None	Yes	Electro Mechanical	Highest	Lowest	Highest

SIMPLIFIED PTCR STARTING DIAGRAM

Start Sequence. When starting the compressor, contactor (M) closes; the PTCR, which is at low resistance, provides starting current to the motor's auxiliary winding. After time delay (t), the current passing through the PTCR causes it to heat and "switch" to a very high resistance. At this point the motor is up to speed and the run capacitor (C_R) determines the current in the auxiliary winding. The PTCR remains hot and at high resistance as long as voltage remains on the circuit. When contactor (M) opens, shutting off voltage to the compressor, the PTCR cools to its initial low resistance and is again ready to provide torque assist on the next startup.

Restart. It is important to provide time between motor starts to allow the PTCR to cool to near its initial temperature. This time is usually 3 to 5 minutes and is determined by the thermostat (THERM) or separate time-delay relay (TR). Attempts to restart in less time may be successful depending on compressor equalization, line voltage, temperature, and other conditions. If the motor were to stall in a locked-rotor state, overload device (PD or TS) would open the line and a further time delay would occur until the motor overload is reset. Motor start PTCRs are applied to compressors having means to equalize pressure during shutdown.

TYPICAL PTCR CHARACTERISTICS AS A MOTOR START DEVICE

Fig T-3

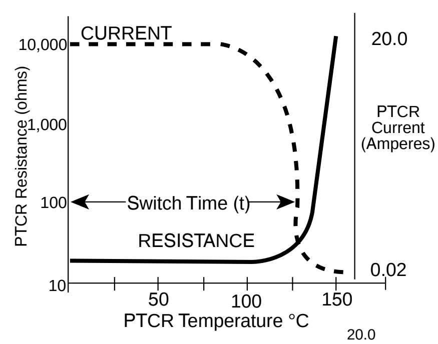
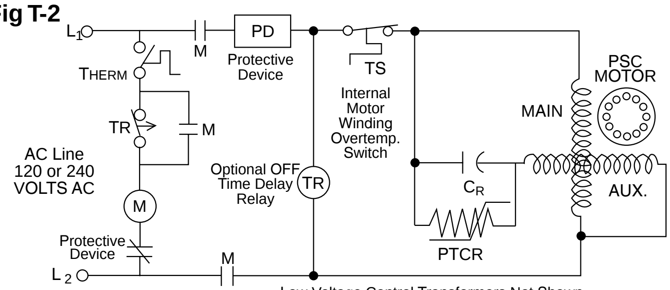


Fig T-2



START AND ACCELERATION TORQUES
SINGLE PHASE PSC HIGH EFFICIENCY COMPRESSORS

The use of a PTCR start assist insures sufficient acceleration torque to overcome not only breakaway friction, but also parasitic asynchronous torques associated with the 5th and 7th motor harmonics or lamination slot harmonics.

ACCELERATION TIME CONSIDERATIONS

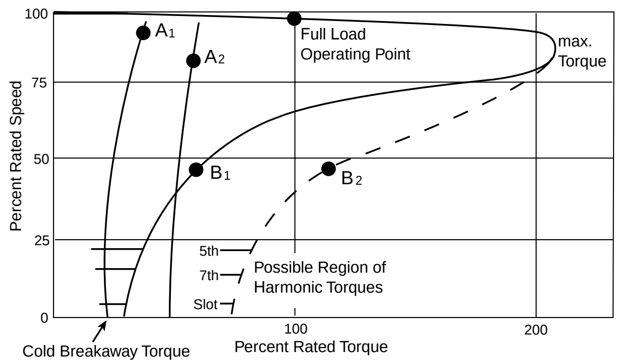
The time to accelerate a rotating machine is:

$$\text{Accelerating Time (Seconds)} = \frac{\text{RPM} \times WK^2 \text{ (lb ft}^2\text{)}}{\text{Avg. Torque (lb ft)} \times 308}$$

(Avg. Torque = Curve B - Curve A)

1. If (Curve B - Curve A) is zero or less, the motor may stall.
2. In calculating torque available from Curve B, allowance should be made for cusps in the torque curve due to harmonics. The time needed to accelerate from rest to 1/2 speed is critical, as the average torque available in this region is limited. Select a PTCR with sufficient switching time (t) to accelerate the compressor.
3. Scroll and rotary compressors may have less breakaway torque than shown.
4. A compressor with no equalization may require over 100% starting torqe and time as long as several seconds. PTCR starters not recommended.

Fig T-4



- **CURVE A1** Torque req'd to accelerate unloaded compressor
- **CURVE A2** Torque req'd to accelerate compressor at partial differential pressure
- **CURVE B1** Motor speed versus torque with run cap only
- **CURVE B2** Motor speed versus torque with run cap and PTCR

CONSIDERATIONS FOR CURRENT IN PTCR
APPROXIMATE EQUIVALENT CIRCUIT PSC MOTOR AT ZERO SPEED

$$I_L \text{ (run)} = \frac{\text{HP} \times 746}{V_M \times \text{pf} \times \text{eff}} \qquad I_L \text{ (start)} \approx 6 \times I_L \text{ run}$$

For running conditions:

If $V_{aux} = V_M$, then I_M and $I_{aux} = \dfrac{I_L}{\sqrt{2}}$

If $V_{aux} \neq V_M$, then $I_{aux} = \dfrac{I_L}{\sqrt{2}} \times \dfrac{V_M}{V_{aux}}$ and $Z_{aux} = \dfrac{V_M}{I_{aux}}$

For the greatest starting torque, PTCR should be chosen to make:
$V_M \times I_M = V_{aux} \times I_{aux}$. In many cases the auxiliary Volt-Amperes are limited to about 50% of the main winding Volt-Amperes to get 50% - 70% rated torque.

Then at start, with PTCR in series: $Z'_{aux} = \overline{R_{PTCR}} + \overline{Z_{aux}}$

$I_{R\ start}$ through PTCR = $\dfrac{V_M}{Z'_{aux}}$

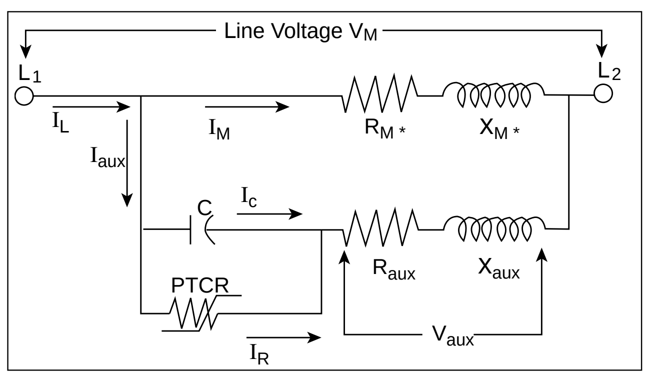
$I_{C\ start}$ through Run Cap = $\dfrac{V_M}{X_C}$; $X_C = \dfrac{1}{2\pi f C}$ ohms

$I_{aux\ start} = \overline{I_{R\ start}} + \overline{I_{C\ start}}$

If Z_{aux} is low impedance, less than 10% of R_{PTCR} then it can be ignored and I_{PTCR} at start = $\dfrac{V_M}{R_{PTCR}}$

This closely approximates the condition for motors over 1/2 HP.

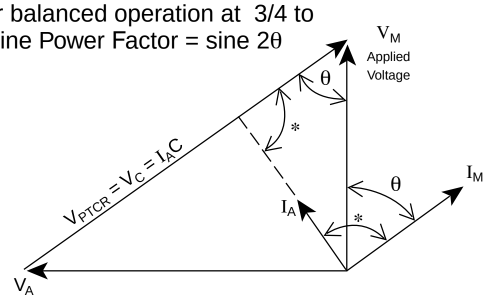
Fig T-5



*R and X are total of stator and rotor

Fig T-6
Simplified Voltage Diagram of the PSC Motor at Operating Speed

*I_A (auxiliary current) leads I_M (main current) by 80° to 90° when C (run capacitor) is chosen for balanced operation at 3/4 to full load. Line Power Factor = sine 2θ



EFFECT OF PTC RESISTANCE ON STARTING TORQUE OF PSC MOTORS

Table 2

MOTOR HP (TABLE 4) (NOTE 7)	LOCKED ROTOR TORQUE WITH RUN CAP ONLY % RATED TORQUE (SEE A)	STARTING TORQUE WITH RUN CAP AND PTCR (% RATED TORQUE) (SEE B) RESISTANCE (Rdyn)				
		50 ohm	25 ohm	20 ohm	12.5 ohm	10 ohm
0.5	25% to 35%	70 - 100%	80 - 100%	NA	NA	NA
1	25% to 35%	50 - 70%	70 - 100%	NA	NA	NA
2	20% to 30%	40 - 60%	60 - 90%	70 - 100%	70 - 100%	80 - 100%
3.5	20% to 30%	NA	40 - 60%	50 - 85%	60 - 90%	70 - 100%
5	15% to 25%	NA	NA	40 - 60%	50 - 75%	60 - 90%
6.5	15% to 25%	NA	NA	NA	40 - 70%	50 - 80%

A. Rated torque is the torque at full speed rated load. It is calculated as:

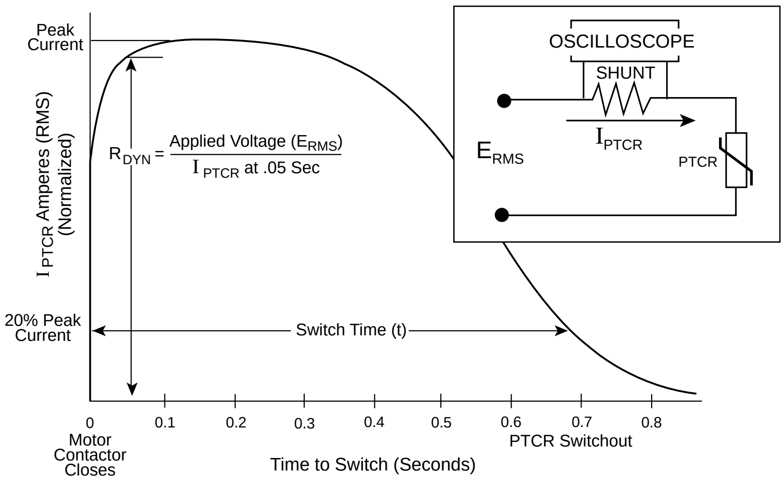
$$\text{Torque (lb - ft)} = \frac{\text{HP x 5250}}{\text{RPM}}$$

The range shown includes both normal slip and high efficiency low slip motors. Starting torque varies as: $(\text{Line Voltage})^2$.

B. Figure T-4 shows effect of using PTCR to increase starting torque. For reciprocating compressors, it is advised to choose a resistance value that gives at least 50% rated torque at locked rotor. Scroll and rotary compressors may require less torque.

TYPICAL PTCR CURRENT VS. TIME SHOWING DEFINITION OF RDYN AND SWITCH TIME (T)

Fig T-7



$$\text{Time (t)} \approx \text{KM } (130°\text{C} - T_0)\ \frac{R_{DYN}}{V^2_{PTCR}}$$

M = PTCR mass
T_0 = PTCR temp at time 0
K = 0.75 J/g/°C

START CAPACITOR REPLACEMENT

Capacitor Starting Comparison

Some PSC motors have historically been started with a capacitor and relay. To deliver the same starting current as a start capacitor, a PTCR resistance is available for approximately equal ohms. Table 3 can be used for conversion.

Even though the start current may be the same, the start torques may differ depending on the motor design. The PTCR has a fixed time built in. The start capacitor will stay in the circuit until a relay switches it out. The longer time provided by the capacitor and relay may be needed on applications where equalization is not present or adequate reset time is not available.

STARTING CURRENT APPROXIMATION BASED ON

$$X_c = \frac{1}{2\pi fC}$$

Table 3

START CAPACITOR	PTCR VALUE
50 microfarads	50 ohms
75 microfarads	37.5 ohms
100 microfarads	25 ohms
125 microfarads	20 ohms
200 microfarads	12.5 ohms
250 microfarads	10 ohms

PTCR SELECTION

- Choosing the best PTCR for an application is a simple matter. See Table 4 and Table 2. Vishay Cera-Mite PTCRs are available in three case sizes (A, B, and C).
- Table 4 indicates the correct case size for the application. Table 2 shows how to choose the correct resistance value.
- Using a device too small or resistance too high will give inadequate starting performance. An oversize device will not harm the motor, but may not be optimum with regards to acceleration dynamics, or power dissipation.
- The PTCR is generally self protecting when applied within the voltage and current ratings.

Table 4

PTCR MOTOR START SELECTION CHART

VISHAY CERA-MITE PART NUMBER	CASE STYLE	RESISTANCE (OHMS) R_{DYN} ± 20%	R_0 ± 30%	SWITCH TIME (T) SECONDS @ 230V	CURRENT RATING AMPERES	MAX. VOLTAGE RATING VOLTS, RMS	AVG. POWER DISSIPATION WATTS	COMPRESSOR RANGE BTU (000)	HP
305C20*	C	25	35	0.25	10	410	3.5	10 - 28	0.75 - 2.0
305C21	C	35	50	0.35	8	410	3.5	8 - 18	0.5 - 1.5
305C22*	C	50	75	0.50	6	410	3.5	5 - 12	0.25 - 1.0
305C19*	B	20	30	0.50	18	500	7	20 - 50	1.5 - 4.0
305C12*	B	25	40	0.60	15	500	7	18 - 42	1.5 - 3.5
305C2	B	50	85	1.00	12	500	7	10 - 25	1.0 - 2.5
305C9*	A	10	15	0.50	36	500	9	28 - 68	3.0 - 7.0
305C11	A	12.5	20	0.60	30	500	9	28 - 62	3.0 - 6.0
305C1*	A	25	42.5	1.00	24	500	9	14 - 36	1.5 - 3.5
Note 1		Note 2		Note 3	Note 4	Note 5	Note 6	Note 7	

* Preferred Values

Note 1

Part number is stamped on the device for UL recognition. The customer part number will also include 1 or 3 character alpha-numeric suffix to designate mounting bracket, customer marking, wire jumper, or other accessory furnished. The suffix is not marked on the part. Certified outline drawing and complete part number will be furnished on request for specific applications. (Example: 305C19K01.) Mounting brackets and other accessories are shipped in separate boxes to simplify installation in end use equipment.

Note 2

R_{DYN} is nominal resistance equal to E/I when 230 volts, 60 Hz is applied **(See Fig T-7**). This resistance determines current and starting torque at the moment of application of voltage to the motor and can be measured with an oscilloscope.

For receiving inspection or routine trouble shooting, the D.C. resistance (Ro) as measured with an ohmmeter is approximately 50% greater. For example: 305C20 measured with an ohm meter would be 35 ohms ± 30% tolerance.

Note 3

Resistance values are duplicated in several case sizes (ie: 305C20, C12, and C1) to provide longer switch time (t) and higher current ratings **(See Fig T-7)**. Larger parts may be needed for more difficult starting conditions (voltage or temperature) or may be used for accelerating fans against back pressure.

Note 4

Maximum current in the PTCR is determined by

$$\frac{\text{Max Line Voltage}}{\text{Min } R_{DYN}}$$

Motor auxiliary winding impedance is usually small compared to PTCR resistance, and does not materially affect PTCR current.

Current in PTCR is a percentage of the full motor inrush (locked rotor) current; usually 30% to 50% **(See Fig T-5).**

Note 5

In application, the maximum voltage is the voltage that appears across the run capacitor at rated speed, high line, light load. This is not the applied line voltage **(See Fig T-6).**

THESE DEVICES ARE INTENDED FOR APPLICATION ON 240 VOLT LINES OR SYSTEMS WITH MAXIMUM LINE VOLTAGE UP TO 264 VOLTS. The 305C20, 21 and 22 are also used on 120 volt systems where the motor is designed to use same run capacitor and PTCR as equivalent 230 volt compressor.

Note 6

This is the power used to keep the PTCR switched off under full load running conditions at typical ambient temperature.

Note 7

BTU and horsepower ranges are for reference only. PTCR may be applied outside those ranges as long as maximum voltage and maximum current are not exceeded. Scroll and rotary compressors may require less starting assistance allowing use of smaller devices.

DIMENSIONS FOR PTCR MOTOR START DEVICES - IN INCHES

- **PACKAGED MOTOR START PTCRs ARE OFFERED IN THREE DIFFERENT CASE SIZES TO ACCOMMODATE THE RANGE OF PSC COMPRESSOR MOTORS SERVED.**

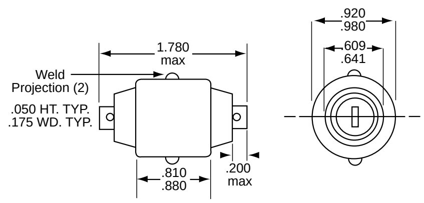
CASE STYLE C

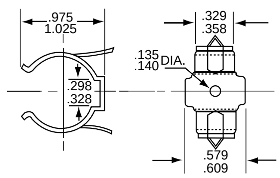
Case Style C is a 2-terminal single pellet device with current carrying capacity up to 10 amperes. It is furnished with a round mounting bracket.

CASE C
305C20 — Black
305C21 — Black
305C22 — Black

MOUNTING BRACKET
36-520M — Round

Fig T-8





Round Bracket — Spring Steel Phosphate & Oil Finish. Accepts #6 Sheet Metal Screw

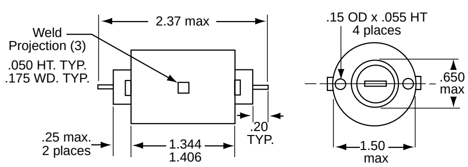
CASE STYLE B

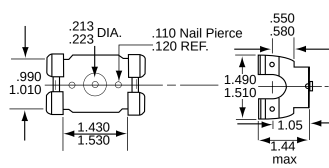
Case Style B is a 2-terminal single pellet unit with current carrying capacity up to 18 amperes. Depending upon the model, either a U-shaped or round bracket is furnished.

CASE B
305C2 — Black
305C12 — Black or Blue
305C19 — Blue

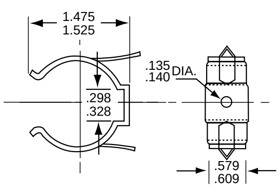
MOUNTING BRACKET
7-36-5C — U-Shaped
36-520H — Round

Fig T-9





U-Bracket — Spring Steel Zinc Dichromate Finish. Accepts #8 Sheet Metal Screw



Round Bracket — Spring Steel Phosphate & Oil Finish. Accepts #6 Sheet Metal Screw

CASE STYLE A

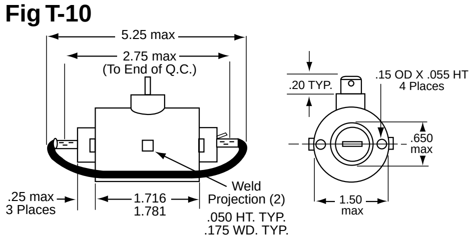
Case Style A is a 3-terminal device that incorporates two pellets in parallel, resulting in lower resistance values and current carrying capacity up to 36 amperes. A jumper wire to complete the parallel connection with the two internal pellets is required.

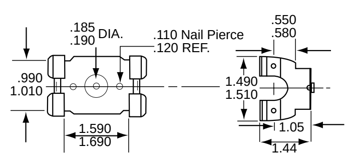
CASE A
305C1 — Blue
305C9 — Tan
305C11 — Tan

MOUNTING BRACKET
7-36-4C — U-Shaped
36-520H — Round

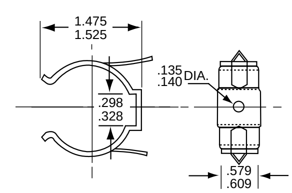
WIRE JUMPER
50-1278 — 9.75" Long 105°C Wire

Fig T-10





U-Bracket — Spring Steel Zinc Dichromate Finish. Accepts #8 Sheet Metal Screw



Round Bracket — Spring Steel Phosphate & Oil Finish. Accepts #6 Sheet Metal Screw

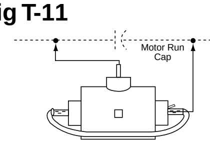
OPERATING TEMPERATURE

Under normal operation, the ceramic pellet inside the case reaches a temperature of 150°C. The plastic case material has been recognized by UL for operation up to this temperature. The actual temperature on the outside of the case will be approximately 100°C while the motor is running. An appropriate mounting location and 105°C, 600 volt wiring are recommended.

CONNECTION DIAGRAMS

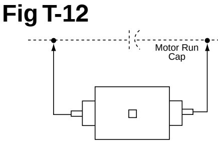
PTCR Motor Start units are connected directly across the PSC motor's "run" capacitor. Case style A is a 3-terminal device and uses an external jumper wire to connect the two internal pellets in parallel. A special "piggyback" terminal on the jumper wire provides for two connections on one side of the A-style case.

Fig T-11



A Style
3-Terminal Case

Fig T-12



B & C Style
2-Terminal Case

VISHAY CERA-MITE MOTOR START FEATURES

ADVANCED CERAMIC ENGINEERING FOR HVAC

Vishay Cera-Mite's capability in large diameter ceramic pellets, unique formulations tailored to motor starting, and heavy duty electrode systems, have been developed and proven with the cooperation of HVAC industry experts over a period of 20 years.

INHERENT PERFORMANCE

Large diameter pellets make possible low resistance start devices needed to match torque requirements of high efficiency compressor motors.

Various package sizes offer selection of timing intervals, providing optimum switching time without dependence on sensing speed, counter EMF, or current.

RUGGED MECHANICAL CONSTRUCTION

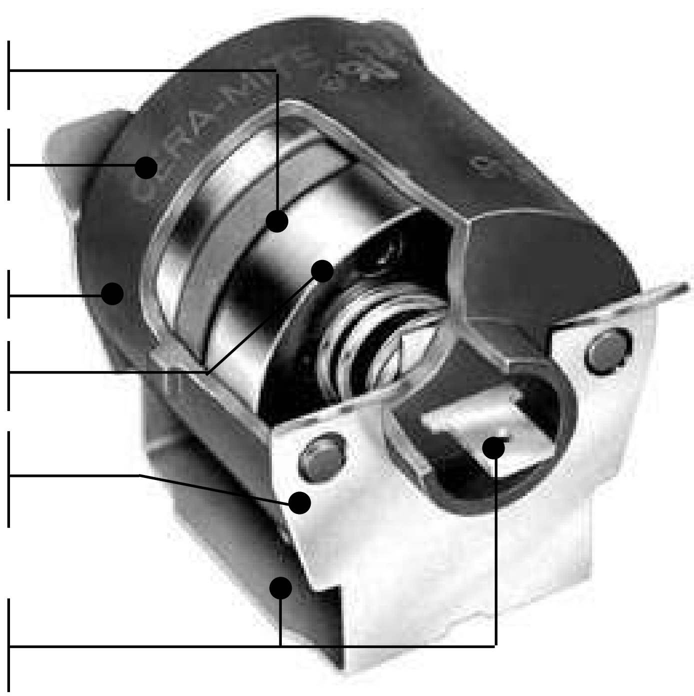
Vishay Cera-Mite PTCR cases are molded from a UL94V0 high temperature, engineered plastic/glass composite.

Heavy duty aluminum contact plates and stainless steel force springs are scaled to the pellet sizes and current ratings to insure no internal arcing and to enhance quick reset time.

Unbreakable metal mounting brackets attach securely with a single screw. The NEW "U" - brackets developed by Vishay Cera-Mite feature lower power consumption and greater reliability by maximizing case to ground thermal impedance.

SIMPLE AND ECONOMICAL

A solid state device requiring only 2 quick connect wires and one bracket screw to install. Compared to the alternative start capacitor and relay, PTCR start devices save several wires, occupy less panel space, mount more easily, and cost less.



OUTSTANDING RELIABILITY

Over a fifteen year period, with an installed base of millions of Vishay Cera-Mite PTCR start devices, experience has demonstrated reliability at 1.0 FITS or less. Users have benefited from very low warranty expense.

RESTART CONSIDERATIONS

A properly sized PTCR will provide adequate starting current and starting time with a cool down time of 3 to 5 minutes, coordinating perfectly with standard "off delay" equalization timers Restart characteristics of the three case sizes are shown.

Fig T-13

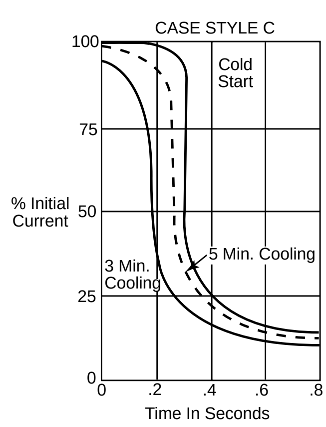


Fig T-14

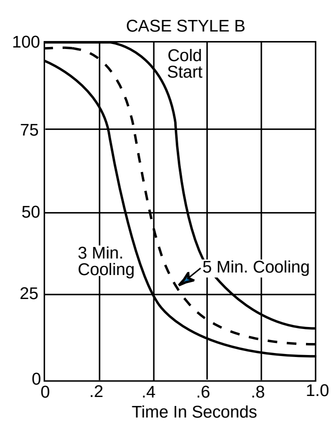
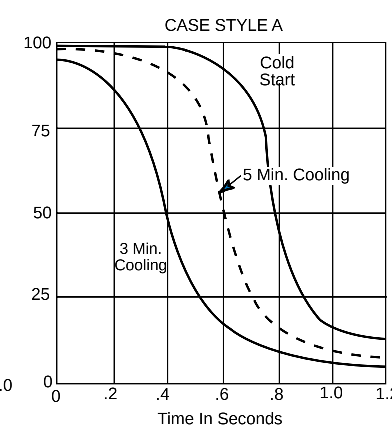
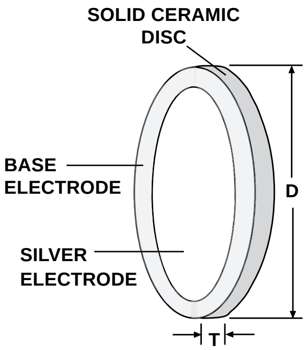


Fig T-15



PTCR Motor Start Pellets



Vishay Cera-Mite offers a complete line of PTCR motor start pellets designed for OEM pressure contact mounting. Compressor and refrigerator manufacturers, as well as selected HVAC after-market distributors have chosen to design and build their own proprietary motor start devices. Such cost effective units allow for unique mounting styles, special terminal arrangements, and combination devices including start capacitors or overload protectors.

FOR USE IN:

Motor Start Relays

Combination Assemblies

APPLICATION DATA

- Complete range of size/resistance combinations for 120 and 240 volt compressor motors.
- Rugged silver electrodes well suited for long life pressure contact mounting.
- Withstand voltage is 2 times Voltage Max. rating.
- Application engineering assistance provided for custom pellet designs.

PTCR MOTOR START PELLETS

RESISTANCE		VOLTAGE MAX. (V_{RMS})	CURRENT MAX. (A_{RMS})	DIAMETER (D) x THICKNESS (T) (mm)	PART NUMBER
R_{25} (OHMS)	R_{DYN} (OHMS)				
5	4	200	10	16 x 2.5	307C1674*
5.5	4.2	180	12	16 x 2.5	307C1670
6.8	5	200	10	16 x 2.5	307C1700*
8	5.8	150	10	16 x 2.5	307C1280
10	7.2	200	10	16 x 2.5	307C1711*
10	7.2	200	10	16 x 2.5	307C1713
20	13.5	250	7.5	16 x 2.5	307C1490
47	30	300	6.5	16 x 2.5	307C1136
68	42	300	5.5	16 x 2.5	307C1043
4	3.2	180	15	17.5 x 2.5	307C1614
5	4	180	12	17.5 x 2.5	307C1668
6.8	5	200	10	17.5 x 2.5	307C1644
10	7.2	200	10	17.5 x 2.5	307C1651
15	10.5	265	6	17.5 x 2.5	307C1190
20	13	320	8	17.5 x 2.5	307C1720
25	17	300	7.5	17.5 x 2.5	307C1066
33	22	300	6.5	17.5 x 2.5	307C1040
47	30	350	4	17.5 x 2.5	307C1284
68	42	400	4	17.5 x 2.5	307C1283
3.3	2.6	160	12	20 x 2.5	307C1411
4.7	3.5	180	12	20 x 2.5	307C1484
5.6	4.1	180	12	20 x 2.5	307C1544
6.8	5	200	10	20 x 2.5	307C1399
10	7.2	230	9	20 x 2.5	307C1489
12	8.5	250	8.5	20 x 2.5	307C1476
15	10.5	300	8	20 x 2.5	307C1530
22	15	400	8	20 x 2.5	307C1531
33	22	355	6	20 x 2.5	307C1282
47	30	400	5	20 x 2.5	307C1533
68	42	430	4	20 x 2.5	307C1292
3.9	3 (@ 50V)	175	16	20 x 3.2	307C1487
12	10.3 (@ 100V)	350	8	20 x 3.2	307C1529
14	12 (@ 100V)	350	8	20 x 3.2	307C1545
30	15.9 (@ 240V)	380	12	20 x 3.2	307C1640
25	18 (@ 240V)	400	9	20 x 5.0	307C1518
38	25 (@ 240V)	400	9	20 x 5.0	307C1024
50	35 (@ 240V)	400	7.5	20 x 5.0	307C1409
75	50 (@ 240V)	400	5.5	20 x 5.0	307C1410

R_{25} = zero power resistance ± 30% at 25°C; other tolerances available.
R_{DYN} = nominal dynamic (effective) resistance, 120V applied unless otherwise noted.
*High performance ceramic formulation, lower transition temperature provides reduced power consumption for energy concious applications.
Note: All motor start pellets receive 100% resistance and 100% voltage pulse burn-in simulating actual motor start-up.
Note: Selected pellets carry UL recognition per File E107611.
Note: Usage requires packaging materials appropriate for maximum pellet surface temperature of 180°C.

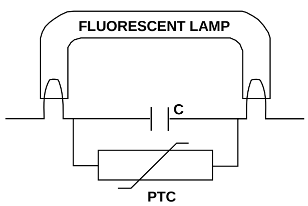
PTC Thermistors For Electronic Fluorescent Ballasts

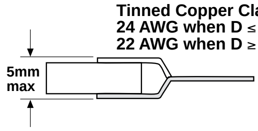
FEATURES

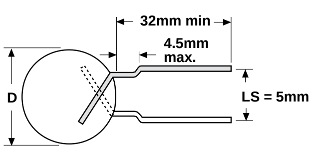
- Electrode preheat thermistors for use in compact fluorescent lamps (CFL) and electronic ballasts.
- Current limiting, time-delayed start-up extends lamp life.
- Quiet, flicker-free operation.
- Developed in cooperation with leading ballast designers.
- Both standard and custom parts are available.
- Economical, reliable and proven in millions of lamps throughout the world.

APPLICATION CONSIDERATIONS

- Ignition time can be optimized to increase life of lamp.
- PTC resistance (R_{25}) is chosen, along with filament resistance and application voltage, to control desired electrode preheat current.
- Lamp preheat time is determined by time required for thermistor to switch from low to high resistance state. Preheat currents shown result in switch times of approximately 1 second at 25°C. Lower currents result in longer switch times.







Options:
- High Temperature Coating
- Short Clipped Leads
- Other Wire Forms and Lead Spacings

PTC THERMISTORS FOR ELECTRONIC FLUORESCENT BALLASTS

RESISTANCE R_{25} (OHMS) [1]	INSTANTANEOUS VOLTAGE (V_{RMS}) [2]	CONTINUOUS VOLTAGE (V_{RMS}) [3]	PREHEAT CURRENT (mA) [4]	D MAX. (mm) [5]	PART NUMBER [6]
150	265	80	215	4.5	307C1407
150	280	200	200	4.5	307C1414
50	175	50	430	5.5	307C1230
70	265	150	350	5.5	307C1654
100	260	95	370	5.5	307C1364
125	230	80	280	5.5	307C1259
150	235	90	260	5.5	307C1253
200	320	145	300	5.5	307C1223
240	350	150	260	5.5	307C1171
300	400	165	225	5.5	307C1225
380	410	170	205	5.5	307C1390
600	420	120	185	5.5	307C1252
600	460	200	170	5.5	307C1224
850	450	340	140	5.5	307C1622
100	340	265	390	7	307C1403
150	340	150	400	7	307C1306
180	350	165	380	7	307C1569
200	355	265	300	7	307C1375
300	370	75	270	7	307C1242
300	420	320	230	7	307C1360
500	480	400	190	7	307C1361
800	530	450	155	7	307C1362
850	520	175	190	7	307C1260
70	210	50	750	8.5	307C1367
70	300	140	725	8.5	307C1366
85	210	50	670	8.5	307C1363
150	400	100	550	8.5	307C1287
85	280	60	820	10	307C1258
100	310	90	750	10	307C1365
400	430	120	420	10	307C1422

Note 1: R_{25} - Nominal zero power resistance ± 25% at 25°C. For given diameter, higher resistance thermistors offer higher maximum voltages.
Note 2: Instantaneous Voltage - Maximum rms voltage permitted across thermistor during fluorescent lamp start-up cycle.
Note 3: Continuous Voltage - Maximum rms voltage continuously applied across thermistor during normal lamp operation.
Note 4: Preheat Current - rms current (60Hz) which switches thermistor to high resistance in approximately 1 second at 25°C ambient.
Note 5: Size (mass) of PTC influences rate of I^2R temperature increase. For given resistance, larger thermistors have longer switch times. Optional coating slightly increases switch time.
Note 6: P/N suffix (not shown) describes wire lead forms and other options.

PTCR Overcurrent Protection

FEATURES:

Sizes For Your Application - Hold currents from 5 mA to 1.5 A are available in sizes from 4 to 22mm.

Better Protection, Maintenance Free - PTCRs reset after an overcurrent situation. Protection levels may be set lower than possible with fuses, without worrying about nuisance trips.

Resetting, Non Cycling - Functioning as a manual reset device, PTCR overcurrent protectors remain latched in the tripped state and automatically reset only after voltage has been removed. This prevents continuous cycling, and protects against reclosing into a fault condition.

Simplified Mounting - PTCRs may be mounted directly inside end use equipment. Unlike fuses, no bulky fuseholder or access for user replacement is required.

Ceramic Material Selection - Various curie materials are available to tailor hold and trip current operating points.

Repeatable, No Hysteresis - After resetting, ceramic PTCRs return to the initial resistance value, providing repeatable, consistent protection levels. Unlike polymer type PTCRs, Vishay Cera-Mite devices exhibit no resistance hysteresis application problems.

Telecom Line Balance - In telecom circuits matched pairs are used to maintain line balance. Unlike polymer PTCRs, ceramic devices maintain balance after resetting.

A NEW DIMENSION

The Positive Temperature Coefficient Resistor's (PTC thermistor) unique property of dramatically increasing its resistance above the curie temperature makes it an excellent candidate for overcurrent protection applications. Overcurrent situations in electronic devices occur due to voltage fluctuations, changes in load impedance, or problems with system wiring. PTC thermistors monitor current in series connected loads, trip in the event of excess current, and reset after the overload situation is removed, creating a new dimension of flexibility for designers.

APPLICATIONS:

- Telecommunication Products
- Electronic Power Supplies
- Automotive Motor Protection
- Industrial Control Systems

APPLICATION DATA

In a typical current limiter application, the PTC device is connected in series with a load impedance **(Fig P-1).** When current (I) flows, internal I^2R losses attempt to increase the PTCR's temperature. To maintain the low resistance "on" state, stabilization must occur below the switching temperature, where the heat generated (I^2R) is balanced by heat lost due to radiation and conduction.

Hold current (I_H) is the maximum continuous current at which a PTCR can be maintained in a low resistance "on" state while operating at rated ambient temperature (typ 25°C). To prevent nuisance tripping, choose the rated hold current to be greater than the normal current expected.

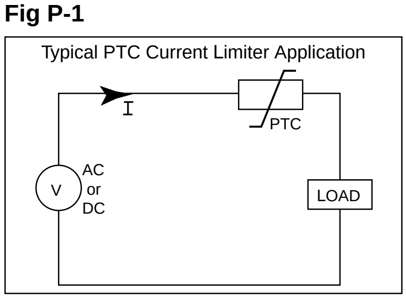
Since heat dissipated by the device is proportional to the ambient temperature, hold current must be derated for ambients higher than 25°C according to the following relationship:

$$\text{Hold Current } (I_H) = \sqrt{\frac{D(T_{SW} - T_A)}{R_{PTC}}}$$

Where:

- D = Dissipation Constant (varies based on disc size, wire type, & coating material)
- T_{SW} = Switching (Curie) Temperature of PTCR Material
- T_A = Ambient Temperature
- R_{PTC} = Resistance of PTCR at 25°C

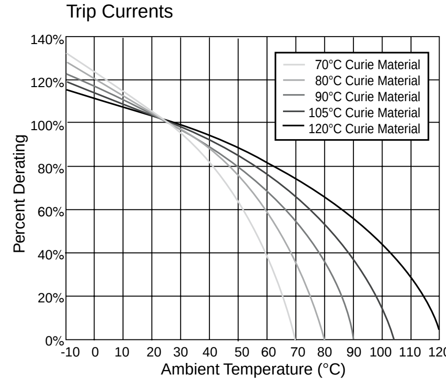
Fig P-1



This relationship is shown in **Fig P-2**, which provides hold current (I_H) derating estimates for ambient temperatures in excess of 25°C. Five curie materials illustrate the design flexibility offered by ceramic PTCR's.

Fig P-2

PTC Thermistor Overcurrent Protectors
Ambient Temperature Derating of Hold and Trip Currents



APPLICATION DATA
TRIPPING ACTION DUE TO OVERCURRENT

During normal operation, the PTCR remains in a low base resistance state **(Fig P-3, Region 1)**. However, if current in excess of hold current (I_H) is conducted, I^2R losses produce internal self heating. If the magnitude and time of the overcurrent event develops an energy input in excess of the device's ability to dissipate heat, the PTCR temperature will increase, thus reducing the current and protecting the circuit.

PTC current limiters are intended for service on telecom systems, automobiles, or the secondary of control transformers or in similar applications where energy available is limited by source impedance. They are not intended for application on AC line voltages where source energy may be high and source impedance low.

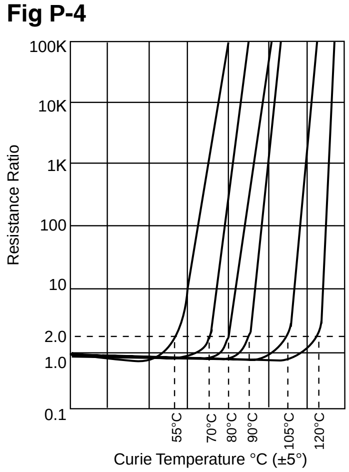
The current required to trip (I_T) is typically specified as two times the hold current (2 x I_H). I_T is defined as the minimum rms conduction current required to guarantee thermistor switching into a high resistance state **(Fig P-3, Region 2)** at a 25°C ambient temperature.

Ambient temperature influences the ability of the PTCR to transfer heat via surface radiation and thermal conduction at the wire leads. At high ambient temperatures, less energy input (via I^2R) is required to reach the trip temperature. Low ambients require greater energy input. Approximate derating effects are shown in Fig P-2.

CERAMIC MATERIALS

The temperature at which the PTCR changes from the base resistance to high resistance region is determined by the PTCR ceramic material. Switching temperature (T_{SW}) described by the boundary between regions 1 & 2 **(Fig P-3)**, is the temperature point at which the PTCR has increased to two times its base resistance at 25°C ambient (R_{SW} = 2 x R_{25}). Design flexibility is enhanced by Cera-Mite's wide selection of ceramic PTCR materials with different switching temperatures **(Fig P-4)**.

Fig P-4



Vishay Cera-Mite offers a wide selection of ceramic PTC materials providing flexibility for different ambient temperatures. Close protection levels are possible by designing resistance and physical size to meet specific hold current and trip current requirements.

SELF RESETTING - NON CYCLING - REPEATABLE

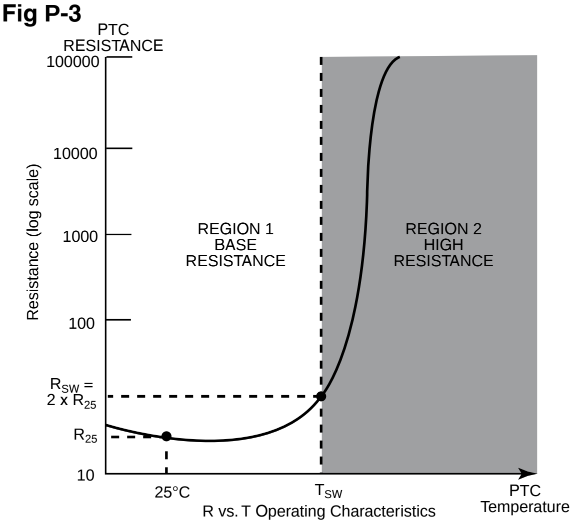
After tripping, the PTCR will remain latched in its high resistance state as long as voltage remains applied and sufficient trickle current is maintained to keep the device above the switching temperature. After voltage is removed, the PTCR resets (cools) back to its low resistance state and is again ready to provide protection.

Since the tripping operation is due to thermal change, there is a time-trip curve associated with each device. At relatively low magnitudes of overcurrent, it may take minutes for the device to trip. Higher current levels can result in millisecond response time. Trip time (t) can be calculated as follows

$$\text{Trip Time } (t) = \frac{kM(T_{SW} - T_A)}{I^2R - D(T_{SW} - T_A)}$$

Where: k = coefficient of heat absorption = 0.603 J/g/°C
M = mass of PTCR = volume x 5.27×10^{-3} g/mm^3
R = zero power resistance of PTCR at 25°C

Fig P-3



R vs. T Operating Characteristics

PHYSICAL DESIGN CONSIDERATIONS

Diameter (D) - Common diameters range from 4 to 22mm.

Thickness (T) - Typical thickness ranges from 1 to 5mm.

Curie (Switching) Temperature (T_{SW}) - **See Fig P-4.**

Resistivity (ρ) -

Determined during sintering process; combined with pellet geometry results in final resistance based on:

$$R_{25} = \text{zero power resistance at 25°C} = \frac{\rho T}{\text{Area}}$$

Table 2

How Various Physical Parameters Influence a PTCs:		
PARAMETER	**VOLTAGE & CURRENT CAPABILITY**	**HOLD CURRENT & TRIP TIME**
Disc Diameter (D)	Increased diameter will increase voltage and current ratings.	Increased diameter will increase hold current and lengthen trip time.
Disc Thickness (T)	Increased thickness will increase voltage rating; may or may not increase current rating.	Increased thickness will increase hold current and lengthen trip time.
Curie (Switch) (T_{SW}) Temperature	Typically, lower switch temperature materials have higher voltage/ current capability.	Higher switch temperature materials increase hold current and lengthen trip time.
Resistance (R_{25})	Higher resistance will increase voltage capability.	Lower resistance will increase hold current and lengthen trip times.
Thermal Loading (Heat Sink)	Increased thermal loading typically reduces the maximum interrupting current.	Increased thermal loading increases hold current and lengthens trip times.
Wire Leads	Wire leads added to a PTCR pellet act as a thermal load resulting in reduced maximum interrupting current.	Depends on thermal conductivity of wire used. Copper will increase hold current and trip time.
Coating Material	Applying coating to a leaded PTCR has minimal effect on voltage/current ratings.	Applying coating to a leaded PTCR increases hold current/trip time 10-20%.

Fig P-5

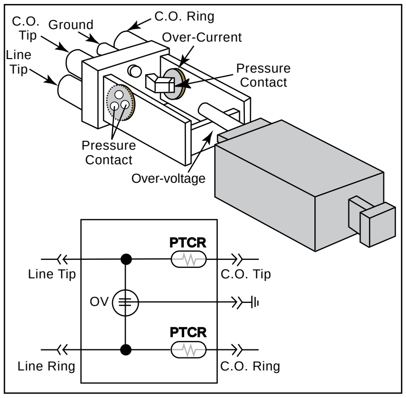
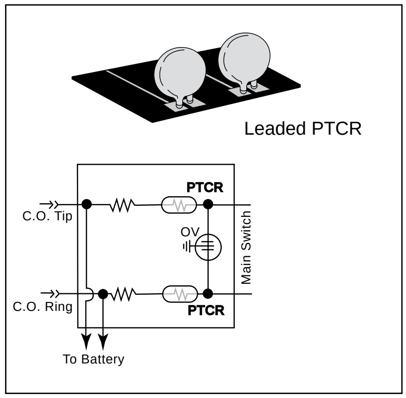


Fig P-6



PTC THERMISTORS FOR TELECOMMUNICATIONS

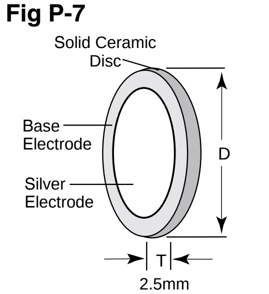
PTC Thermistors provide protection for large digital switches. Vishay Cera-Mite has pioneered this field with ceramic PTC thermistors working closely with major telephone equipment and telephone protection manufacturers. The requirements are dynamic, as switch makers continually strive to protect at lower levels. Vishay Cera-Mite participates with industry standard technical committees to establish common definitions and understanding of this new technology.

PTC THERMISTOR PELLETS FOR TELECOMMUNICATIONS

Table 2

HOLD (I_H) CURRENT mA	TRIP (I_T) CURRENT mA	RESISTANCE R_{25} Ohms	SWITCH TEMP. °C	SIZE (D) NOMINAL mm	VISHAY CERA-MITE PART NUMBER
110	220	30	105	6.5	307C1127
100	200	15	70	8	307C1128
100	200	20	80	8	307C1126
110	220	18	80	8	307C1268
120	240	15	80	8	307C1129
140	280	15	105	8	307C1435
110	220	15	70	9.5	307C1134
130	260	15	80	9.5	307C1130
140	280	9	70	9.5	307C1436
150	300	10	80	9.5	307C1437
Note 1		Note 2			Note 3

Fig P-7



Rated Voltage = 60 V_{DC}
Rated Current = 3A
Maximum Voltage = 220 Vrms

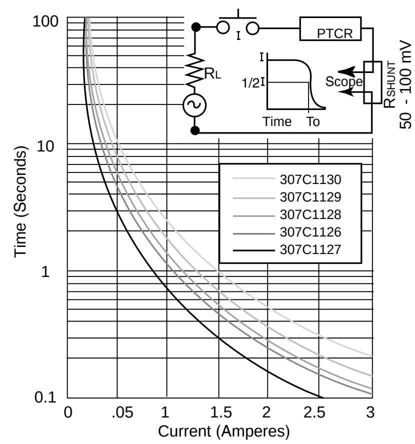
Note 1
Hold and trip currents are specified at 25°C ambient.

Note 2
R_{25} is nominal zero power resistance at 25°C with tolerance of ± 20%.

Note 3
All pellets have silver electrodes suitable for pressure contact mounting.

Fig P-8

Time-Trip Curves for Popular Telecom Pellets



Operating Time to 50% Current

INTERRUPTING CAPACITY ESTIMATES

Under unusual circumstances, telecommunication lines may be subjected to high surge currents as might occur from lightning effects or accidental crossing with power lines or transformer primaries.

Fig P-10 shows trip time curves for higher currents. Estimated interrupting capability data is also shown in Table 3 and is expressed as "I^2t Let Through" based on test data conducted in accordance with UL 497A and CSA 22.2 No. 0.7-M1985.

The data shown is for reference. Specific short circuit data or interrupting capability is partially determined by the mounting means and circuit application.

Fig P-9

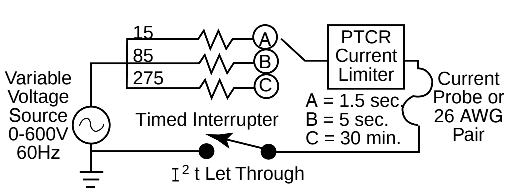
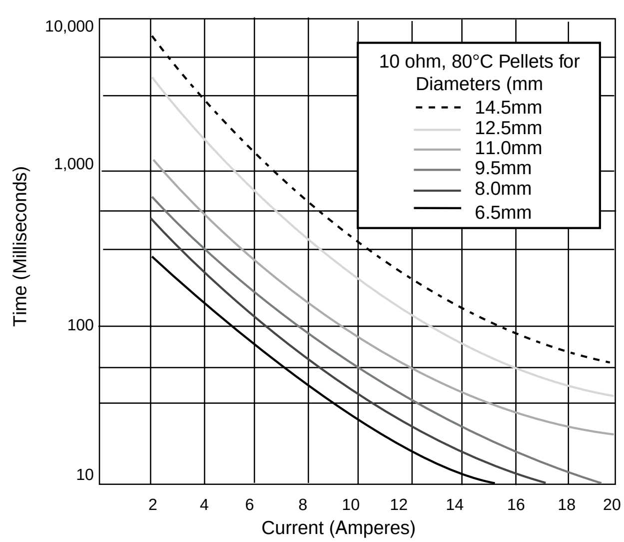


Fig P-10

Time VS. Current Curves for High Current Surges (25°C)



CUSTOM PTCR PELLET DESIGN CAPABILITY

- Vishay Cera-Mite will customize solid state overcurrent protector PTCRs to your exact requirements for telecommunication, power supply, or general electronic use. Providing great flexibility to establish specific voltage, hold current, time-trip characteristic, and ambient temperature values.
- Each device must be evaluated and ratings established per application. Mechanical packaging influences performance ratings.

Table 3

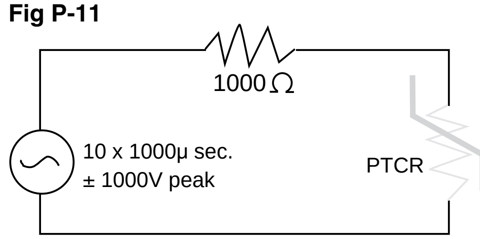
RATING CHART FOR CUSTOM PELLETS

DISC DIAMETER (2.5mm THICK)	6.5mm	8mm	9.5mm	11mm	12.5mm	14.5mm
Continuous Voltage Rating (rms) (proportional to resistance)	100 – 300	100 – 300	100 – 300	100 – 300	100 – 300	50 - 300
Resistance Range @ 25°C (ohms)	10 to 35	7 to 25	5 to 20	4 to 17	2 to 15	1 to 10
Continuous Carry Current (mA) Ambient 25° to 50°C (inversely proportional to resistance)	60 – 120	75 – 175	100 – 200	110 – 250	130 – 400	150 – 600
Approximate Minimum Power to Trip or Reset (watts)	0.4	0.5	0.6	0.7	0.8	0.9
Interrupting Capability						
A. Repetitive (25 to 300 V_{RMS}) Peak power in watts	600	700	800	900	1000	1100
B. Non-repetitive (for 10 ohm pellet) I^2t Let Through	2.5	4.0	7.5	15	20	30
Maximum Safe Interrupting Voltage (rms) (voltage rating is proportional to resistance)	300	350	400	450	500	600
Rating applies to pellets with silver electrodes and pressure connections.						

TRANSIENT VOLTAGE & CURRENT

Because of the thermal storage capacity of the ceramic PTCR, transient surges do not cause tripping. The PTCR is considered to be transparent to these low energy transients. **Fig P-11** shows a typical test circuit for such transients.

Fig P-11



Pass-Thru Pulse

WIRE LEADED PTC TELECOM THERMISTORS

Resettable current limiters featuring hold current and voltage ratings for telecommunication applications.

Fig P-12

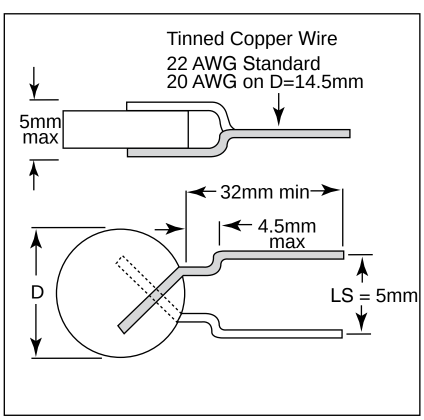


Table 4

TELECOM CURRENT LIMITERS

HOLD (I_H) CURRENT mA	TRIP (I_T) CURRENT mA	RESISTANCE R_{25} Ohms	TOL. %	SWITCH TEMP. °C	SIZE (D) NOMINAL mm	MAX. VOLTAGE V_{RMS}	VISHAY CERA-MITE PART NUMBER
70	140	100	25	120	6.5	265	307C1418
100	200	20	20	80	8	220	307C1305
100	200	30	20	105	8	220	307C1506
110	220	18	20	80	8	220	307C1354
110	220	25	20	105	8	220	307C1514
120	240	15	20	80	8	220	307C1129
120	240	20	20	105	8	220	307C1296
120	240	25	20	120	8	220	307C1470
130	260	13	20	80	8	120	307C1421
120	240	39	30	120	8.7	250	307C1505
120	240	25	25	105	8.7	250	307C1501
150	300	12	20	90	8.7	110	307C1439
120	240	15	25	80	9.5	220	307C1465
125	250	20	20	105	9.5	220	307C1507
135	270	10	25	80	9.5	220	307C1469
150	300	10	20	105	9.5	220	307C1233
170	340	10	20	105	11.2	220	307C1234
110	220	23	20	80	14.5	300	307C1262
125	250	18	25	80	14.5	265	307C1254
Note 1		Note 2					Note 3

Note 1
Hold and trip currents specified at 25°C ambient.

Note 2
R_{25} is nominal zero power resistance (± 25%) at 25°C.

Note 3
P/N suffix describes options including:
- Tape & Reel
- Wire Size
- Wire Style & Length
- Lead Spacing
- Coating Material

Rated Voltage = 60Vdc; Rated Current = 3A at rated voltage.

Table 5

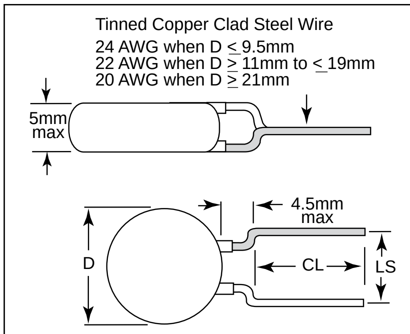
GENERAL PURPOSE PTC THERMISTORS OVERCURRENT PROTECTORS

RATED VOLTAGE VRMS	MAX. VOLTAGE VRMS	HOLD (I_H) CURRENT mA	TRIP (I_T) CURRENT mA	MAX. CURRENT A	RES R_{25} Ohms	SWITCH TEMP °C	D MAX. mm	VISHAY CERA-MITE PART NUMBER
12	15	130	260	1.1	13	120	5.5	307C1455
12	15	170	340	2.4	6	105	8	307C1308
12	15	600	1200	10	1.2	105	16	307C1311
24	30	130	260	2.3	10	105	8	307C1315
24	30	175	350	3.4	6	105	9.5	307C1429
24	30	600	1200	11	1.3	105	17.5	307C1318
50	60	60	120	0.8	50	105	6.5	307C1321
50	60	120	240	2	12	105	8	307C1323
50	60	150	300	2.6	10	105	9.5	307C1548
50	60	325	650	10	3.5	105	14.5	307C1325
50	60	475	950	12	2	105	17.5	307C1326
120	140	60	120	0.6	50	105	6.5	307C1329
120	140	85	170	0.8	30	105	8	307C1330
120	140	95	190	1.5	39	105	11	307C1302
120	140	115	230	2	27	105	12.5	307C1303
120	140	105	210	1	20	105	9.5	307C1331
120	140	350	700	5	4.5	105	19	307C1333
240	375	20	40	0.2	600	105	6.5	307C1335
240	340	28	56	0.3	300	105	6.5	307C1336
240	310	31	62	0.33	240	105	6.5	307C1337
240	265	34	68	0.34	200	105	6.5	307C1338
240	265	40	80	0.45	125	105	6.5	307C1340
240	320	45	90	0.4	150	105	9.5	307C1339
240	320	55	110	0.5	100	105	11	307C1341
240	265	65	130	0.6	70	105	9.5	307C1342
240	265	90	180	1	45	105	11	307C1343
		Note 1			Note 2			Note 3

GENERAL PURPOSE PTC CURRENT LIMITERS

- Designed as resettable current limiters, PTC thermistors offer an alternative to conventional over-current protection devices such as fuses or circuit breakers.
- A wide variety of sizes and current ranges are available for many electronic, industrial and automotive applications. Both standard parts and custom designs are offered.

Fig P-13



CL - Cut Leads are Standard 4.75± 0.5mm
LS - Standard Lead Spacings:
5mm when D ≤11mm
7.5mm when D = 12.5 to 17.5mm
10mm when D ≥19mm

CUSTOM CURRENT LIMITER GUIDELINES

Table 6

RANGE CHART FOR CUSTOM WIRE LEADED DESIGN

MAX. D (mm) COATED	DESIGN LIMITS (APPROX.) V_{RMS}	I_{HOLD}	OHMS
5.5	600	5 mA	2000
	15	150 mA	13
6.5	600	7 mA	1200
	15	200 mA	8
8	600	10 mA	850
	15	275 mA	6
9.5	600	13 mA	500
	15	350 mA	4
11	600	20 mA	350
	15	450 mA	2.5
12.5	600	22 mA	250
	15	500 mA	2.0
14.5	600	30 mA	200
	15	650 mA	1.5
16	600	35 mA	150
	15	800 mA	1.2

MAX. D (mm) COATED	DESIGN LIMITS (APPROX.) V_{RMS}	I_{HOLD}	OHMS
17.5	600	40 mA	125
	15	950 mA	0.8
19	600	45 mA	100
	15	1.1 A	0.7
21	600	55 mA	80
	15	1.2 A	0.6
22.5	600	60 mA	70
	15	1.3 A	0.5
23.5	600	70 mA	60
	15	1.4 A	0.45
25	600	80 mA	50
	15	1.5 A	0.4

Resistance is proportional to voltage and inversely proportional to hold current (I_H)

Conformal coating adds 1.5mm

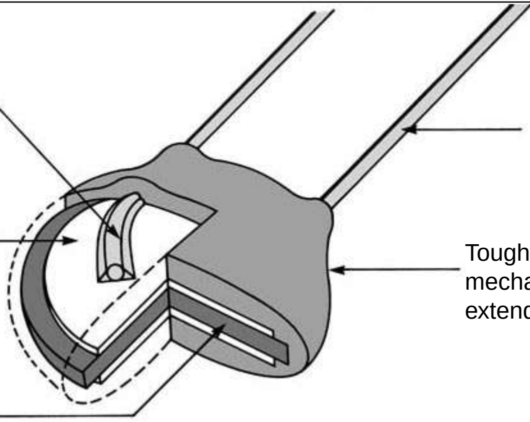
APPLICATION CONSIDERATIONS:

- PTC current limiters are intended for service on telecom systems, automobiles, or the secondary of control transformers or in similar applications where energy available is limited by source impedance. They are not intended for application on AC line voltages where source energy may be high and source impedance low.
- Fuses and circuit breakers result in total circuit isolation after tripping. PTC thermistors provide a current limiting function by switching to a high resistance mode. Safety consideration must be given to the potential shock hazard caused by the steady state leakage current and voltage potential remaining in the circuit.
- Wire leaded PTC current limiting thermistors are intended for applications which expect a limited number of tripping operations. Actual life is a function of operating parameters. For high duty cycle applications, ceramic PTC pellets mounted in spring contact mechanical housings are preferred.
- Wire size, wire type and coating material can be used to precisely tailor required operating characteristics.
- Options Include: Tape & Reel; Wire Forms; Lead Spacings.

VISHAY

Application Data, Ceramic Disc Capacitors
1.0 Picofarad to 0.1 Microfarad

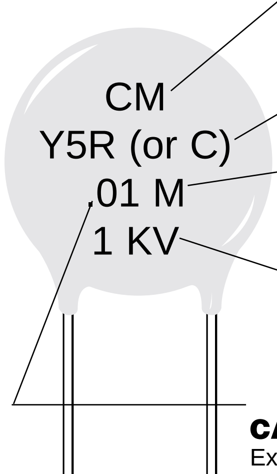
RELIABLE SOLUTIONS IN EMI/RFI, DECOUPLING, DV/DT & DI/DT, SNUBBERS, BY-PASS, ESR & ESL. EXCELLENT FOR HIGH VOLTAGE & SWITCHING POWER SUPPLIES.



MARKING INFORMATION

Wire leaded DC rated, disc capacitors are marked with a code identifying the manufacturer, capacitance, tolerance, voltage, and type of ceramic.

Specialty types such as AC rated are marked as described in those sections.



MANUFACTURER IDENTIFICATION
"Cera-Mite®" or the identification "CM."

TEMPERATURE COEFFICIENT
(See chart at right)

CAPACITANCE TOLERANCE

C = ± .25pF	M = ± 20%
D = ± .5pF	P = +100 – 0%
J = ± 5%	Y = –20 + 50%
K = ± 10%	Z = –20 + 80%

VOLTAGE
Rating normally DC volts. AC voltage rating marked AC or ~ ;. If no voltage is marked, part is 500VDC.

CAPACITANCE
Expressed in picofarads or microfarads.
Examples: 680 = 680 picofarads.
0047 = .0047 microfarads.

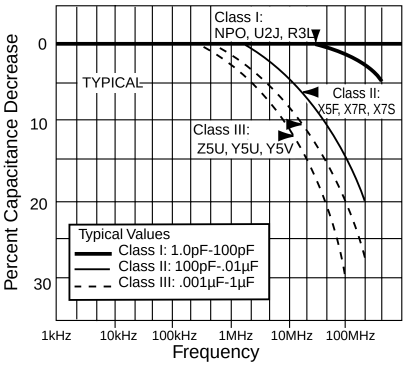
OPTIONAL MARKINGS
Lot Date Code and/or Customer Part Number are available options which may also be imprinted on the capacitor

TYPE OF CERAMIC (Temperature Coefficient)

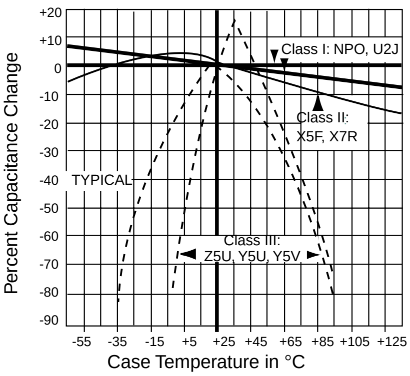
CAPACITANCE CHANGE OVER TEMP. RANGE PPM PER DEGREE C	MARKING CODE FOR TEMP. RANGE –55° TO +125°C				ALTERNATE MARKING CODE	DIELECTRIC CLASS
0 ± 30 (NPO)	C0G				A	I
–750 ± 120 (N750)	U2J				U	I
–1000 ± 250 (N1000)	M3K				V	I
–1500 ± 250 (N1500)	P3K				W	I
–2200 ± 500 (N2200)	R3L				X	I
–3300 ± 500 (N3300)	S3L				Y	I
–4700 ± 1000 (N4700)	T3M				Z	I & II*
MAX. % CHANGE	**+ 10° + 85°C**	**– 30° + 85°C**	**– 55° + 85°C**	**– 55° + 125°C**	–	–
± 4.7%	Z5E	Y5E	X5E	X7E	B	II
± 7.5%	Z5F	Y5F	X5F	X7F	B	II
± 10%	Z5P	Y5P	X5P	X7P	C	II
± 15%	Z5R	Y5R	X5R	X7R	C	II or IV**
± 22%	Z5S	Y5S	X5S	X7S	C	II or IV
+22 – 56%	Z5U	Y5U	X5U	X7U	E	III
+22 – 82%	Z5V	Y5V	X5V	X7V	F	III

* N4700 is a transition material between Class I and II, and has characteristics of both. It is used for larger cap values: capacitance and DF measured at 1 kHz.
** Class IV uses same material as Class II, but is processed differently.

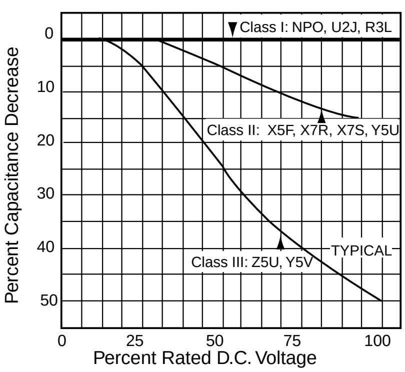
Capacitance Change vs. Frequency



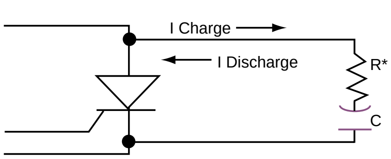
Capacitance Change vs. Temperature



Capacitance Decrease vs. D-C Voltage Bias



Ceramic Disc Capacitors as Snubbers



*Select R to limit dv/dt and di/dt to capacitor and semiconductor ratings. "Lossless" low dissipation factor discs are especially well suited for snubber service due to low self heating. See types 10TCU, 1DF0, 2DF0, and 3DF0.

CERAMIC DISC CAPACITOR APPLICATION NOTES

- **HIGH K:** For small size and higher values of capacitance, EIA 198D Class III, Z5U, Y5U, Y5V. This type is usually broad tolerance: ± 20% or + 80 – 20%.
- **MODERATELY HIGH K:** Materials are formulated to provide better capacitance stability against change in temperature and voltage, but may be larger in size than the HIGH K types, especially in the higher capacitance values, EIA 198D Class II, X5F, X7R, X7S. Usually tighter tolerance. ±10%at 25˚C. Higher dv/dt rating.
- **LOW K FORMULATIONS FOR PRECISION CAPACITORS:** Ultra stable capacitance over broadest temperature, frequency and voltage variation, EIA Class I, NP0, U2J, R3L and S3L. Usually ±5% tolerance. Highest dv/dt rating.
- **HYPERCON** construction gives highest capacitance density. Made by forming a thin dielectric barrier layer at each electrode surface. They exhibit very high capacitance and good temperature stability. Improvements have extended range to 100 VDC. EIA 198D Class IV.
- **CAPACITANCE MEASUREMENTS:** Class IV dielectric are conducted at 50 to 100 millivolts, 1000Hz. All others are measured at 1.0 volts, Class II & III at 1 kHz. Class I at 1 MHz.

FREQUENCY:

- Operating frequency range is determined primarily by capacitor value and self resonance due to lead inductance. This typically occurs at 500 MHz for 100 pF, decreasing to 50 MHz at .01 µF and 10 MHz at 0.1 µF.
- Class III and IV, typical applications are power and logic bus coupling and decoupling, and broad-band bypass filtering. Class I and II are chosen for frequency discriminating filters, d-c blocking, reference circuits, and similar circuits requiring close tolerance and stability.

TEMPERATURE:

- Capacitors are designed for service temperatures of –55˚C to +105˚C or greater. The limiting factor is the life of the polymer coating. Ceramic discs are not injured by short time exposure up to 125˚C.
- In applications where there is continuous heat dissipation in the capacitor, such as in snubber networks for power semiconductors, the case temperature rise should be limited to 30˚C. Class I, II and III may be used for snubber service. Low Dissipation Factor capacitors are especially well suited.

VOLTAGE:

- The extensive range of d-c voltage ratings available allows selection of the appropriate device to minimize d-c voltage effects in the circuit.
- A-C voltage ratings for capacitors up to 1000 volts applies to applications where energy and current are limited by circuit impedance. 1000 ohms impedance at the maximum a-c voltage rating is adequate.
- Ratings apply to 50 kHz. Above 50 kHz derate a-c voltage by $(\text{freq.}/50\text{kHz})^2$.

CURRENT:

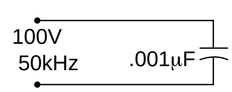
- **For sinusoidal applied voltages:** $I_{RMS} = 7VfC$ where V = rms Voltage; f =frequency; C = farads. Power dissipation may be approximated by Watts = $(I_{RMS})^2$ x Effective Series Resistance (ESR).

Approximate ESR values:

Class I, ESR = $\frac{100}{C(pF)\ f(MHz)}$ Ex.: 10pF ESR = 10 ohms at 1 MHz

Class II or III, ESR = $\frac{1}{C(\mu F)\ f(kHz)}$ Ex.: .001 µF ESR = 100 ohms at 10kHz

Ex.:



$I_{RMS} = 7 \times 100 \times (50 \times 10^3) \times (.001 \times 10^{-6}) = 35$ mA
Power Dissipation = $(35 \times 10^{-3})^2 \times 20 = .024$ watts

- **For nonsinusoidal applied voltage** (repetitive transient pulses) limit on peak current is: $Ip = \frac{dv}{dt} \times C$ where V = volts; T = seconds; C = farads; approximate $\frac{dv}{dt}$ limits:

≤ 100pF = 10,000V/µs, Class I	100pF - 1,000pF =2,000V/µs, Class II & III
>100pF = 5,000V/µs, Class I	1000pF - 10,000pF = 1,000V/µs, Class II & III
<100pF = 5,000V/µs, Class II	>10,000pF = 500V/µs, Class II & III
	>10,000pF = 100V/µs, Class IV

Example: .001 µF, Class II; Ip = $\frac{1000}{10^{-6}} \times (.001 \times 10^{-6}) = 1$ ampere peak

Note: Above calculations are typical. Actual circuit conditions may allow more or less current and voltage. Actual circuit test is recommended.

Lower Voltage Disc Capacitors

12V TO 1KV

Lower Voltage Capacitors are stocked in distribution. See “Packaging Options” section for other electrical and mechanical options, including Tape & Reel.

Fig 1

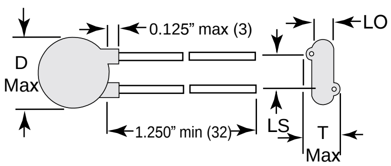


Fig 2

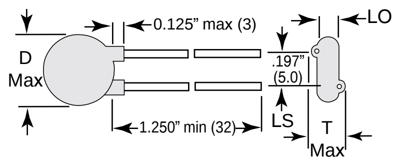
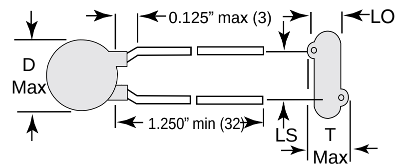


Fig 3



STANDARD WIRE SIZE:

- C and E Sizes - 24 gauge (.020") Tinned Copper Clad Steel Wire.
- F through Q Sizes - 22 gauge (.025") Tinned Copper Wire.

TAPE & REEL OPTIONS:

- Tape & Reel available on diameter sizes .250" to .680".
- To specify T & R, add two letter suffix to catalog number for example: TGS10 QA-suffix describes alternate wire lead forms & lead spacing options - see complete description in “Packaging Options” section.
- 10,000 piece minimum shipment for T & R.

SIZE CODE	DIAMETER “D” MAX		THICKNESS “T” MAX		LEAD SPACING “LS” FIG 1 & 3	
	in	mm	in	mm	in	mm
C	.250	6.4	.156	4.0	.250	6.4
E	.290	7.4	.156	4.0	.250	6.4
E_7	.330	8.4	.156	4.0	.250	6.4
F	.370	9.4	.156	4.0	.250	6.4
F_7	.400	10.2	.156	4.0	.250	6.4
G	.440	11.2	.156	4.0	.250	6.4
G_7	.460	11.7	.156	4.0	.250	6.4
H	.490	12.4	.156	4.0	.250	6.4
H_3	.490	12.4	.156	4.0	.375	9.5
H_7	.530	13.5	.156	4.0	.375	9.5
J	.560	14.2	.156	4.0	.375	9.5

SIZE CODE	DIAMETER “D” MAX		THICKNESS “T” MAX		LEAD SPACING “LS” FIG 1 & 3	
	in	mm	in	mm	in	mm
K	.630	16.0	.156	4.0	.375	9.5
L	.680	17.3	.156	4.0	.375	9.5
M	.760	19.3	.156	4.0	.375	9.5
P	.890	22.6	.156	4.0	.375	9.5
R	.510	13.0	.200	5.1	.375	9.5
T	.580	14.7	.200	5.1	.375	9.5
U	.640	16.3	.200	5.1	.375	9.5
W	.700	17.8	.200	5.1	.375	9.5
X	.770	19.6	.200	5.1	.375	9.5
Y	.900	22.9	.200	5.1	.375	9.5
Q	.950	24.1	.200	5.1	.375	9.5

VOLTAGE CLASS	LEAD OFFSET “LO” (nom)	
	in	mm
100	.040	1.0
500	.040	1.0
1000	.050	1.3

12/25/50/100V HYPERCON CONSTRUCTION HIGH-CAPACITANCE DISCS

- Application:
  Low Voltage Bulk Filter

563C Series
Class IV Dielectirc

12 VDC, Y5R, 2.5ΩF, 5% DF				
VALUE		CATALOG NUMBER	SIZE	
µF	TOL.		FIGURE	CODE
.05	Y	HY105	3	E
.10	M	HY110	1	G
.22	M	HY122	1	J
.47	M	HY147	1	P

25 VDC, Y5R, 5ΩF, 5% DF				
VALUE		CATALOG NUMBER	SIZE	
µF	TOL.		FIGURE	CODE
.01	M	HY820	3	C
.022	M	HY825	3	E
.033	M	HY530	3	E
.047	M	HY835	3	F
.10	M	HY850	1	G

50 VDC, Y5R, 25ΩF, 4% DF				
VALUE		CATALOG NUMBER	SIZE	
µF	TOL.		FIGURE	CODE
.01	M	HY920	3	C
.022	M	HY925	3	E
.047	M	HY935	1	G
.10	M	HY950	1	H

100 VDC, Y5S, 100ΩF, 3% DF				
VALUE		CATALOG NUMBER	SIZE	
µF	TOL.		FIGURE	CODE
.0022	M	HMMD22	2	C
.0047	M	HMMD47	2	C
.01	M	HMMS10	3	E
.10	M	HMMP10	1	L

100 VOLT GENERAL PURPOSE

562C Series

- Application Range:
  Up to 250 VDC, 75 VAC RMS**
- Insulation Resistance: 10,000 MΩ minimum, 500ΩF
- Dissipation Factor: 3.0% maximum
- Dielectric Strength:
  750 VDC, 250 VAC RMS

VALUE		CATALOG NUMBER	SIZE		TEMP. COEF.
pF	TOL.		FIGURE	CODE	
10	D	TSQ10	2	C	NP0
22	J	TSQ22	2	C	NP0
33	K	TSQ33	2	C	U2J
47	K	TSQ47	2	C	U2J
100	K	TST10	2	C	X7R
220	K	TST22	2	C	X7R
330	K	TST33	2	C	X7R

VALUE		CATALOG NUMBER	SIZE		TEMP. COEF.
pF	TOL.		FIGURE	CODE	
470	K	TST47	2	C	X7R
1000	K	TSD10	2	C	X7R
2200	K	TSD22	2	F	X7R
3300	K	TSD33	2	F	X7R
4700	K	TSD47	2	G	X7S
6800	K	TSD68	2	H	X7S
0.01µF	K	TSS10	2	J	X7S

VALUE		CATALOG NUMBER	SIZE		TEMP. COEF.
µF	TOL.		FIGURE	CODE	
.005	M	TGD50	1	E	Z5U
.01	M	TGS10	1	F	Z5U
.02	M	TGS20	1	G	Z5U
.022	M	TSS22	1	T	X7S
.047	M	TGS47	1	R	Z5U
.050	M	TGS50	1	R	Z5U
.10	M	TGP10	1	W	Z5U

** See “Application Data” section for limits on AC voltage.

500 VOLT GENERAL PURPOSE

562C Series

- Application Range: Up to 600 VDC, 100 VAC RMS**
- Insulation Resistance: 15,000 MΩ minimum, 750ΩF
- Dissipation Factor: 3.0% maximum
- Dielectric Strength: 1500 VDC, 300 VAC RMS

VALUE pF	TOL.	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
1000	K	5TSD10	3	E	X7R
1000	M	5TSSD10	3	C	Y5U
1500	K	5TSD15	3	F	X7R
2200	K	5TSD22	3	F	X7R
3300	K	5TSD33	1	G	X7R
4700	K	5TSD47	1	H	X7R
5000	Z	5TSD50	1	F	Z5U

VALUE µF	TOL.	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
.0068	K	5TSD68	1	H	X7S
.01	K	5TSS10	1	J	X7S
.01	M	5GASS10	1	G	Z5U
.01	Z	5HKSS10	1	G	Z5U
.02	M	5GASS20	1	J	Z5U
.022	M	5TSS22	1	L	X7S
.033	M	5TSS33	1	X	X7S

VALUE µF	TOL.	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
.05	M	5GAS50	1	P	Z5U
.05	Z	5HKS50	1	T	Z5U
.10	M	5GAP10	1	X	Z5U
.10	Y	5HKSP10	1	Q	Y5V
.10	Z	5HKP10	1	X	Z5U
.15	Y	5GAP15	1	Y	Z5U
.20	M	5GAP20	1	Q	Z5U

1000 VOLT GENERAL PURPOSE

562C Series

- Application Range: Up to 1000 VDC, 150 VAC RMS**
- Insulation Resistance: 20,000 MΩ minimum, 1000ΩF
- Dissipation Factor: 2.5% maximum
- Dielectric Strength: 2500 VDC, 500 VAC RMS

VALUE pF	TOL.	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
10	M	5GAQ10	3	C	NP0
20	M	5GAQ20	3	C	NP0
33	M	5GAQ33	3	E	U2J
47	M	5GAQ47	3	E	U2J
100	M	5GAT10	3	C	X5F
150	M	5GAT15	3	C	X5F
200	M	5GAT20	3	C	X5F
220	M	5GAT22	3	C	X5F
330	M	5GAT33	3	C	X5F
470	M	5GAT47	3	C	X5F
500	M	5GAT50	3	C	X5F

VALUE pF	TOL.	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
1000	M	5GAD10	3	E	X7R
1000	P	5HKD10	3	E	Y5U
1200	M	5GAD12	3	E	Z5U
1500	M	5GAD15	3	E	Z5U
2000	M	5GAD20	3	E	Z5U
2200	M	5GAD22	3	E	Z5U
2500	M	5GAD25	3	E	Z5U
2700	M	5GAD27	3	E	Z5U
3000	M	5GAD30	3	E	Z5U
3300	M	5GAD33	3	E	Z5U
4700	M	5GAD47	1	F	Z5U

VALUE pF	TOL.	CATALOG NUMBER	SIZE FIGURE	SIZE CODE	TEMP. COEF.
5000	M	5GAD50	1	F	Z5U
6800	M	5GAD68	1	G	Z5U
8200	M	5GAD82	1	G	Z5U
0.01µF	M	5GAS10	1	H_3	Z5U
.01	M	5HKMS10	1	H	Z5U
.01	P	5HKS10	1	H_3	Z5U
.015	M	5GAS15	1	J	Z5U
.020	M	5GAS20	1	L	Z5U
.050	M	10HKS50	1	X	Z5U
.10	M	10GAP10	1	Q	Z5U
.15	M	10GAP15	1	Q	Y5V

1KV TEMP. & VOLTAGE STABILIZED, 10% TOL.

562C Series

- Application Range: Up to 1250 VDC, 200 VAC RMS**
- Insulation Resistance: 50,000 MΩ minimum, 1000ΩF
- Dissipation Factor: 2.0% maximum
- Dielectric Strength: 2500 VDC, 750 VAC RMS

VALUE pF	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
10	10TSQ10	3	C	NP0
25	10TSQ25	3	E	NP0
27	10TSQ27	3	C	U2J
30	10TSQ30	3	C	U2J
33	10TSQ33	3	E	U2J
39	10TSQ39	3	E	U2J
47	10TSQ47	3	E	U2J
50	10TSQ50	3	E	U2J
56	10TSQ56	3	C	X5F
68	10TSQ68	3	C	X5F

VALUE pF	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
75	10TSQ75	3	C	X5F
82	10TSQ82	3	C	X5F
100	10TST10	3	C	X5F
120	10TST12	3	C	X5F
150	10TST15	3	C	X5F
180	10TST18	3	C	X5F
200	10TST20	3	C	X5F
220	10TST22	3	C	X5F
250	10TST25	3	C	X5F

VALUE pF	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
270	10TST27	3	C	X5F
300	10TST30	3	C	X5F
330	10TST33	3	C	X5F
390	10TST39	3	C	X5F
470	10TST47	3	C	X5F
500	10TST50	3	C	X5F
560	10TST56	3	E	X5F
680	10TST68	3	E	X5F
750	10TST75	3	E	X5F

VALUE pF	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
820	10TST82	3	E	X5F
1000	10TSD10	3	E	X5F
1500	10TSD15	1	G	X5F
2000	10TSD20	1	H_3	X5F
2200	10TSD22	1	H_3	X5F
2700	10TSD27	1	J	X5F
3300	10TSD33	1	J	X5F
4700	10TSD47	1	L	X5F
.01µF	10TSS10	1	L	X5S

1KV NPO/N750 PRECISION DISC CAPACITORS, 5% TOL

561C Series

Temperature/Frequency/Voltage Stable

- Application Range: Up to 1500 VDC, 300 VAC RMS**
- dv/dt up to 10,000 V/usec
- Insulation Resistance: 100,000 MΩ minimum, 1000ΩF
- Dielectric Strength: 2500 VDC, 750 VAC RMS
- High Q: 1000, Dissipation Factor: 0.1% max
- Application: NP0 capacitors are used when the ultimate in stability is required
- N750/S3L are smaller & ideal for "lossless snubbers".

VALUE pF*	CATALOG NUMBER	SIZE FIG.	SIZE CODE
1.0	10TCCV10	3	C
2.2	10TCCV22	3	C
2.7	10TCCV27	3	C
3.0	10TCCV30	3	C
3.3	10TCCV33	3	C
3.9	10TCCV39	3	C
4.7	10TCCV47	3	C
5.0	10TCCV50	3	C
5.6	10TCCV56	3	C
6.8	10TCCV68	3	C
8.2	10TCCV82	3	C

VALUE pF	CATALOG NUMBER	SIZE FIG.	SIZE CODE
10	10TCCQ10	3	C
12	10TCCQ12	3	C
15	10TCCQ15	3	C
18	10TCCQ18	3	E
20	10TCCQ20	3	E
22	10TCCQ22	3	E
25	10TCCQ25	3	E
27	10TCCQ27	3	F
30	10TCCQ30	3	F
33	10TCCQ33	3	F
39	10TCCQ39	3	F

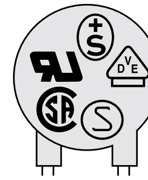
VALUE pF	CATALOG NUMBER	SIZE FIG.	SIZE CODE
47	10TCCQ47	1	G
50	10TCCQ50	1	G
56	10TCCQ56	1	G
68	10TCCQ68	1	H
82	10TCCQ82	1	H_3
100	10TCCT10	1	J
120	10TCCT12	1	J
150	10TCCT15	1	K
180	10TCCT18	1	L
220	10TCCT22	1	M
270	10TCCT27	1	P

VALUE pF	CATALOG NUMBER	SIZE FIG.	SIZE CODE	TEMP. COEF.
N750/S3L Disc Capacitors				
33	10TCUQ33	3	E	U
47	10TCUQ47	3	E	U
68	10TCUQ68	3	F	U
100	10TCUT10	3	F	U
220	10TCUT22	1	G	V
330	10TCUT33	1	H	V
470	10TCUT47	1	J	V
560	10TCUT56	1	J	V
680	10TCUT68	1	K	Y
1000	10TCUD10	1	L	Y

*1.0 to 10pF are D tolerance

**See "Application Data" section for limits on AC voltage.

AC Line Rated Disc Capacitors



X & Y EMI/RFI FILTER TYPES: ACROSS-THE-LINE, LINE-BY-PASS, ANTENNA COUPLING

Vishay Cera-Mite AC Line Rated Discs are rugged, high voltage capacitors specifically designed and tested for use on 125 Volt through 600 Volt AC power sources. Certified to meet demanding X & Y type worldwide safety agency requirements, they are applied in across-the-line, line-to-ground, and line-by-pass filtering applications. Vishay Cera-Mite offers the most complete selection in the industry—six product families—exactly tailored to your needs.

- Worldwide Safety Agency Recognition
  - Underwriters Laboratories - UL1414 & UL1283
  - Canadian Standards Association - CSA 22.2 No. 1 & No. 8
  - European EN132400 to IEC 384-14 Second Edition
- Required In AC Power Supply and Filter Applications
- Six Families Tailored To Specific Industry Requirements
- Complete Range of Capacitance Values

AC LINE RATED CERAMIC CAPACITOR SPECIFICATIONS

PERFORMANCE DATA / SERIES:	440L	30LV	30LVS	25Y	125L	20VL
Application Voltage Range (Vrms 50/60 Hz) (Note 1)	250/500	300/400	250/400	250/400	250	250
Dielectric Strength (Vrms 50/60 Hz for 1 minute)	4000	2500	2500	2500	2000	1250
Dissipation Factor (Maximum)	2%					
Insulation Resistance (Minimum)	1000 ΩF					
Mechanical Data	Service Temperature 125°C Maximum; Coating Material per UL94V0					
Temperature Characteristics	Y5U	Y5U	Y5U	Y5S	Y5V	Y5V
	See Part Number Detail for Temperature Characteristics					

SAFETY AGENCY RECOGNITION AND EMI/RFI FILTERING SUBCLASS

Series / Recognition / Voltage	440L	30LV	30LVS	25Y	125L	20VL
Underwriters Laboratories Inc.: (Note 2)						
UL 1414 Across-The-Line	Across-The-Line	Across-The-Line	—	—	—	—
UL 1414 Antenna Coupling	Antenna-Coupling	Antenna-Coupling	—	—	—	—
UL 1414 Line-By-Pass	Line-By-Pass	Line-By-Pass	Line-By-Pass	Line-By-Pass	Line-By-Pass	—
UL 1414 Rated Voltage	250 VAC	250 VAC	250 VAC	250 VAC	250 VAC	—
Electromagnetic Interference Filters	EMI Filters	EMI Filters	EMI Filters	EMI Filters	—	EMI Filters
UL1283 Rated Voltage	600 VAC	250 VAC	250 VAC	250 VAC	—	250 VAC
Canadian Standards Association:						
CSA 22.2 No.1 Across-The-Line	Across-The-Line	Across-The-Line	—	—	—	—
CSA 22.2 No.1 Isolation	Isolation	Isolation	Isolation	Isolation	Isolation	—
CSA 22.2 No. 1 Rated Voltage	250 VAC	250 VAC	250 VAC	250 VAC	125/250 VAC	—
CSA 22.2 No. 8 Line-to-Ground Capacitors	—	Line-To-Ground	Line-To-Ground	Line-To-Ground	—	Line-To-Ground
For Use in Certified EMI Filters	—	Certified EMI Filters	Certified EMI Filters	Certified EMI Filters	—	Certified EMI Filters
CSA 22.2 No. 8 Rated Voltage	—	400 VAC	400 VAC	400 VAC	—	250 VAC
European CENELEC Electronic Components Committee (CECC) EN 132 400 to Publication IEC 384-14 Table II, Edition 2:						
IEC 384 -14 Second Edition Subclass Y: (Note 3)	**Y1**	**Y2**	**Y2**	**Y2**	**Y4**	—
Subclass Y Voltage (Vrms 50-60 Hz)	500 VAC	300 VAC	250 VAC	250 VAC	125 VAC	
Type of Insulation Bridged	Double or Reinforced	Basic or Supplementary	Basic or Supplementary	Basic or Supplementary	Basic or Supplementary	—
Peak Impulse Voltage Before Endurance Test	8 kV	5 kV	5 kV	5 kV	2.5 kV	—
IEC 384-14 Second Edition Subclass X: (Note 4)	**X1**	**X1**	**X1**	**X1**	**X1**	**X2**
Subclass X Voltage (Vrms 50-60 Hz)	400 VAC	400 VAC	400 VAC	400 VAC	400 VAC	400 VAC
Peak Impulse Voltage in Service	2.5 to 4.0 kV	2.5 to 4.0 kV	2.5 to 4.0 kV	2.5 to 4.0 kV	2.5 to 4.0 kV	To 2.5 kV
Application	High Pulse	High Pulse	High Pulse	High Pulse	High Pulse	Gen. Purpose
Damp Heat, Steady State Recognition	Code HKF - 25°C/ + 125°C/21 days					

Note 1
Voltage Ratings: All ratings are manufacturer's rating.
- Part markings are governed by agency rules and customer requirements.
- Parts are marked 250 VAC unless otherwise requested.

Note 2
UL1414 Across-The-Line, Antenna Coupling, and Line-By-Pass Capacitors:
- Across-The-Line—A capacitor connected either across a supply circuit or between one side of a supply circuit and a conductive part that may be connected to earth ground.
- Antenna-Coupling—A capacitor connected from an antenna terminal to circuits within an appliance.
- Line-By-Pass—A capacitor connected between one side of a supply circuit and an accessible conductive part.

Note 3
IEC 384-14 Subclass Y Capacitors:
- A capacitor of a type suitable for use in situations where failure of the capacitor could lead to danger of electric shock.
- Class Y capacitors are divided into sub- classes based on type of insulation bridged and voltage ranges.
- For definitions of basic, supplementary, double and reinforced insulation, see IEC Publication 536.
- Subclass Y capacitors may be used in applications which require a Subclass X rating.

Note 4
IEC 384-14 Subclass X Capacitors:
- A capacitor of a type suitable for use in situations where failure of the capacitor would not lead to danger of electric shock.
- Class X capacitors are divided into subclasses according to the peak impulse test voltage superimposed on the main voltage

Note 5
AC Leakage Current:
- For all Series (except 125L) - AC Leakage Current (mA) specified at 250 Vrms, 60 Hz.
- For 125L Series - AC Leakage Current (mA) specified at 125 Vrms, 60Hz.

Note 6
Alternate Lead Spacings of 7.5mm and 10mm are available bulk or tape & reel.
- European Required Minimum Lead Clearance (Prevents Use of Inside Crimp) .315" (8mm) on 440L Series; 0.118" (3mm) on all other series.

INTERNATIONAL AGENCY APPROVALS

UL | VDE | CSA | SEV | SEMKO | NEMKO | DEMKO | FIMKO

Fig 5 TYPICAL FILTER SHOWING X & Y TYPES

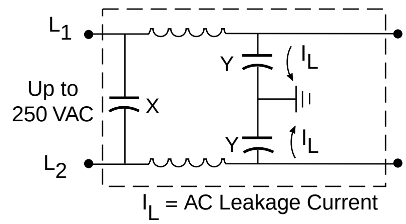
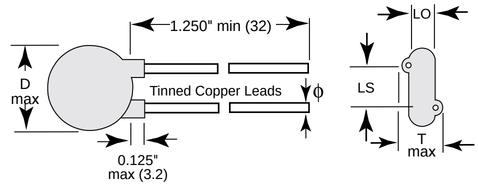


Fig 6



WIRE LEAD OFFSET

Series	"LO" typ. in	mm
440L	.158"	(4.0)
30LV	.132"	(3.4)
30LVS	.125"	(3.2)
25Y	.060"	(1.5)
125L	.110"	(2.8)
20VL	.077"	(2.0)

440L SERIES
AC RATED CERAMIC DISC CAPACITORS

Rugged, High Dielectric Strength, Full UL Recognition, X1 & Y1 Applications

UL 1414	UL 1283	CSA 22.2	IEC 384-14 2nd Edition
Across-The-Line	EMI Filters	No. 1 - Across-The-Line	Y1 - 500 VAC
Antenna Coupling		No. 1 - Isolation	X1 - 400 VAC
Line-By-Pass			

VALUE pF	TOL	VISHAY CERA-MITE NUMBER	AC LEAKAGE I_L mA	TEMP CHAR.	D DIAMETER (in/mm)	T THICKNESS (in/mm)	LS LEAD SPACE (in/mm)	Φ WIRE SIZE (AWG/in/mm)
10	K	440LQ10	1.3 uA	COG	.330 (8.4)	.195 (5.0)	.375 (9.5)	20 .032 (.81)
15	K	440LQ15	2.0 uA	U2J	.330 (8.4)	.210 (5.3)	.375 (9.5)	20 .032 (.81)
22	K	440LQ22	3.0 uA	P3K	.330 (8.4)	.190 (4.8)	.375 (9.5)	20 .032 (.81)
33	K	440LQ33	4.4 uA	R3L	.330 (8.4)	.200 (5.1)	.375 (9.5)	20 .032 (.81)
47	K	440LQ47	6.3 uA	R3L	.330 (8.4)	.180 (4.6)	.375 (9.5)	20 .032 (.81)
68	K	440LQ68	0.01	X7R	.330 (8.4)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
100	K	440LT10	0.02	X7R	.330 (8.4)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
150	K	440LT15	0.03	X7R	.330 (8.4)	.235 (6.0)	.375 (9.5)	20 .032 (.81)
220	K	440LT22	0.04	X7R	.330 (8.4)	.235 (6.0)	.375 (9.5)	20 .032 (.81)
330	K	440LT33	0.05	X7R	.330 (8.4)	.225 (5.7)	.375 (9.5)	20 .032 (.81)
470	M	440LT47	0.07	Y5U	.330 (8.4)	.230 (5.8)	.375 (9.5)	20 .032 (.81)
560	M	440LT56	0.08	Y5U	.330 (8.4)	.230 (5.8)	.375 (9.5)	20 .032 (.81)
680	M	440LT68	0.10	Y5U	.330 (8.4)	.235 (6.0)	.375 (9.5)	20 .032 (.81)
1000	M	440LD10	0.15	Y5U	.365 (9.3)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
1500	M	440LD15	0.23	Y5U	.365 (9.3)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
2000	M	440LD20	0.30	Y5U	.400 (10.2)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
2200	M	440LD22	0.34	Y5U	.430 (10.9)	.225 (5.7)	.375 (9.5)	20 .032 (.81)
2700	M	440LD27	0.41	Y5U	.460 (11.7)	.225 (5.7)	.375 (9.5)	20 .032 (.81)
2800	M	440LD28	0.43	Y5U	.460 (11.7)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
3000	M	440LD30	0.46	Y5U	.490 (12.4)	.225 (5.7)	.375 (9.5)	20 .032 (.81)
3200	M	440LD32	0.49	Y5U	.490 (12.4)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
3300	M	440LD33	0.50	Y5U	.490 (12.4)	.215 (5.5)	.375 (9.5)	20 .032 (.81)
3900	M	440LD39	0.59	Y5U	.530 (13.5)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
4000	M	440LD40	0.61	Y5U	.530 (13.5)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
4700	M	440LD47	0.71	Y5U	.620 (15.7)	.230 (5.8)	.375 (9.5)	20 .032 (.81)
5000	M	440LD50	0.76	Y5U	.620 (15.7)	.225 (5.7)	.375 (9.5)	20 .032 (.81)
5500	M	440LD55	0.84	Y5U	.680 (17.3)	.230 (5.8)	.375 (9.5)	20 .032 (.81)
5600	M	440LD56	0.85	Y5U	.680 (17.3)	.230 (5.8)	.375 (9.5)	20 .032 (.81)
6800	M	440LD68	1.04	Y5U	.720 (18.3)	.235 (6.0)	.375 (9.5)	20 .032 (.81)
8000	M	440LD80	1.22	Y5U	.720 (18.3)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
9000	M	440LD90	1.37	Y5U	.790 (20.1)	.225 (5.7)	.375 (9.5)	20 .032 (.81)
.01µF	M	440LS10	1.52	Y5U	.850 (21.6)	.230 (5.8)	.375 (9.5)	20 .032 (.81)
			Note 5				Note 6	

30LV SERIES
AC RATED CERAMIC DISC CAPACITORS

Full UL 1414 Recognition, X1 & Y2 Applications

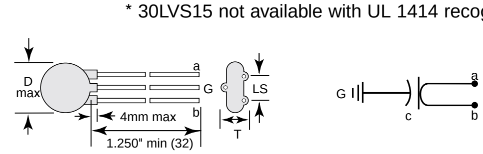
UL 1414	UL 1283	CSA 22.2	IEC 384-14 2nd Edition
Across-The-Line	EMI Filters	No. 1 - Across-The-Line	Y2 - 300 VAC
Antenna Coupling		No. 1 - Isolation	X1 - 400 VAC
Line-By-Pass		No. 8 - EMI Filters	

VALUE pF	TOL.	VISHAY CERA-MITE NUMBER	AC LEAKAGE I_L mA	TEMP CHAR.	D DIAMETER (in/mm)	T THICKNESS (in/mm)	LS LEAD SPACE (in/mm)	F WIRE SIZE (AWG/in/mm)
10	K	30LVQ10	1.3 uA	COG	.330 (8.4)	.185 (4.7)	.250 (6.4)	22 .025 (.64)
15	K	30LVQ15	2.0 uA	U2J	.330 (8.4)	.200 (5.1)	.250 (6.4)	22 .025 (.64)
22	K	30LVQ22	3.0 uA	P3K	.330 (8.4)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
33	K	30LVQ33	4.4 uA	R3L	.330 (8.4)	.190 (4.8)	.250 (6.4)	22 .025 (.64)
47	K	30LVQ47	6.3 uA	R3L	.330 (8.4)	.170 (4.3)	.250 (6.4)	22 .025 (.64)
68	K	30LVQ68	0.01	S3L	.330 (8.4)	.175 (4.4)	.250 (6.4)	22 .025 (.64)
100	K	30LVT10	0.02	X7R	.330 (8.4)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
150	K	30LVT15	0.03	X7R	.330 (8.4)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
220	K	30LVT22	0.04	X7R	.330 (8.4)	.195 (5.0)	.250 (6.4)	22 .025 (.64)
330	K	30LVT33	0.05	X7R	.330 (8.4)	.195 (5.0)	.250 (6.4)	22 .025 (.64)
470	K	30LVT47	0.08	X7R	.330 (8.4)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
560	K	30LVT56	0.09	X7R	.330 (8.4)	.200 (5.1)	.250 (6.4)	22 .025 (.64)
680	K	30LVTT68	0.11	X7R	.330 (8.4)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
680	M	30LVT68	0.10	Y5U	.330 (8.4)	.220 (5.6)	.250 (6.4)	22 .025 (.64)
1000	K	30LVTD10	0.16	X7R	.365 (9.3)	.185 (4.7)	.250 (6.4)	22 .025 (.64)
1000	M	30LVD10	0.15	Y5U	.330 (8.4)	.215 (5.5)	.250 (6.4)	22 .025 (.64)
1500	K	30LVTD15	0.24	X7R	.460 (11.7)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
1500	M	30LVD15	0.23	Y5U	.330 (8.4)	.195 (5.0)	.250 (6.4)	22 .025 (.64)
2000	M	30LVD20	0.31	Y5U	.400 (10.2)	.210 (5.3)	.250 (6.4)	22 .025 (.64)
2200	M	30LVD22	0.34	Y5U	.400 (10.2)	.200 (5.1)	.250 (6.4)	22 .025 (.64)
2700	M	30LVD27	0.41	Y5U	.430 (10.9)	.200 (5.1)	.250 (6.4)	22 .025 (.64)
2800	M	30LVD28	0.43	Y5U	.430 (10.9)	.200 (5.1)	.250 (6.4)	22 .025 (.64)
3000	M	30LVD30	0.46	Y5U	.460 (11.7)	.205 (5.2)	.250 (6.4)	22 .025 (.64)
3200	M	30LVD32	0.49	Y5U	.460 (11.7)	.200 (5.1)	.250 (6.4)	22 .025 (.64)
3300	M	30LVD33	0.50	Y5U	.460 (11.7)	.195 (5.0)	.250 (6.4)	22 .025 (.64)
3900	M	30LVD39	0.59	Y5U	.490 (12.4)	.200 (5.1)	.250 (6.4)	22 .025 (.64)
4000	M	30LVD40	0.61	Y5U	.530 (13.5)	.210 (5.3)	.250 (6.4)	22 .025 (.64)
4700	M	30LVD47	0.72	Y5U	.620 (15.7)	.220 (5.6)	.375 (9.5)	20 .032 (.81)
5000	M	30LVD50	0.76	Y5U	.620 (15.7)	.215 (5.5)	.375 (9.5)	20 .032 (.81)
5500	M	30LVD55	0.84	Y5U	.560 (14.2)	.195 (5.0)	.375 (9.5)	20 .032 (.81)
5600	M	30LVD56	0.85	Y5U	.560 (14.2)	.195 (5.0)	.375 (9.5)	20 .032 (.81)
6800	M	30LVD68	1.04	Y5U	.680 (17.3)	.205 (5.2)	.375 (9.5)	20 .032 (.81)
8000	M	30LVD80	1.22	Y5U	.680 (17.3)	.195 (5.0)	.375 (9.5)	20 .032 (.81)
9000	M	30LVD90	1.37	Y5U	.720 (18.3)	.200 (5.1)	.375 (9.5)	20 .032 (.81)
.01µF	M	30LVS10	1.52	Y5U	.790 (20.1)	.190 (4.8)	.375 (9.5)	20 .032 (.81)
.015µF	M	30LVS15*	2.28	Y5U	.900 (22.9)	.200 (5.1)	.375 (9.5)	20 .032 (.81)
			Note 5				Note 6	

* 30LVS15 not available with UL 1414 recognition.

Fig 7 Optional 3-Leaded Style

An optional 3-leaded construction is available. It consists of a single capacitor with the two outside leads attached to one electrode, and the center lead attached to the other electrode. Used in feed-thru or line-to-ground applications, it allows a short ground lead for enhanced high frequency performance.



INTERNATIONAL SAFETY AGENCY APPROVALS

Agency Files/ Licenses	440L	30LV	30LVS	25Y	125L	20VL
Underwriters Laboratories Inc.						
UL 1414 Antenna-Coupling Components	E99264	E99264	—	—	—	—
UL 1414 Line-By-Pass Components	—	—	E99264	E99264	E99264	—
UL 1283 Electromagnetic Interference Filters	E128046	E99264	E128046	E99264	—	E128046
Canadian Standards Association:						
CSA 22.2 No.1 Across-The-Line, Isolation	LR62016	LR62016	—	—	—	—
CSA 22.2 No.1 Isolation	—	—	LR62016	LR62016	LR62016	—
CSA 22.2 No. 8 EMI Filters	—	LR62016	LR62016	LR62016	—	LR62016
European CENELEC Electronic Components Committee (CECC)						
Country Certifications:	**Specification EN 132 400 to Publication IEC 384-14 Table 11, Edition 2 (1993)**					
VDE	14239 - 4670	14239 - 4670	14239 - 4670	14239 - 4670	14239 - 4670	14239 - 4670
SEV	95,771173	95,771173	95,771173	95,771173	95,771173	95,771173
SEMKO	954311001	961416201	961416301	954311601	954310601	9543108801
NEMKO	P95104257	P96101228	P96101227	P95104253	P95104252	P95104254
DEMKO	304885	304886	304887	304883	304882	304884
FIMKO	187550 - 01	190061 - 01	190059 - 01	187547 - 01	187548 - 01	187549 - 01

30LVS SERIES
AC RATED CERAMIC DISC CAPACITORS

Compact Size for EMI Filtering, X1 & Y2 Applications

UL 1414	UL 1283	CSA 22.2	IEC 384-1 2nd Edition
Line-By-Pass	EMI Filters	No. 1 - Isolation No. 8 - EMI Filters	Y2 - 250 VAC X1 - 400 VAC

VALUE pF	TOL.	VISHAY CERA-MITE NUMBER	AC LEAK. I_L mA	TEMP CHAR.	D DIAMETER (in/mm)	T THICK. (in/mm)	LS LEAD SPACE (in/mm)	F WIRE SIZE (AWG/in/mm)
1000	M	30LVSD10	0.15	Y5U	.330 (8.4)	.195 (5.0)	.250 (6.4)	22 .025 (.64)
1500	M	30LVSD15	0.23	Y5U	.330 (8.4)	.185 (4.7)	.250 (6.4)	22 .025 (.64)
2000	M	30LVSD20	0.31	Y5U	.330 (8.4)	.175 (4.4)	.250 (6.4)	22 .025 (.64)
2200	M	30LVSD22	0.34	Y5U	.330 (8.4)	.170 (4.3)	.250 (6.4)	22 .025 (.64)
2700	M	30LVSD27	0.41	Y5U	.365 (9.3)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
2800	M	30LVSD28	0.43	Y5U	.365 (9.3)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
3000	M	30LVSD30	0.46	Y5U	.400 (10.2)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
3200	M	30LVSD32	0.49	Y5U	.400 (10.2)	.175 (4.4)	.250 (6.4)	22 .025 (.64)
3300	M	30LVSD33	0.50	Y5U	.400 (10.2)	.175 (4.4)	.250 (6.4)	22 .025 (.64)
3900	M	30LVSD39	0.59	Y5U	.460 (11.7)	.185 (4.7)	.250 (6.4)	22 .025 (.64)
4000	M	30LVSD40	0.61	Y5U	.490 (12.4)	.185 (4.7)	.250 (6.4)	22 .025 (.64)
4700	M	30LVSD47	0.72	Y5U	.490 (12.4)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
4700	M	30LVSVD47	0.72	Y5V	.430 (10.9)	.185 (4.7)	.250 (6.4)	22 .025 (.64)
5000	M	30LVSD50	0.76	Y5U	.530 (13.5)	.180 (4.6)	.250 (6.4)	22 .025 (.64)
5500	M	30LVSD55	0.84	Y5U	.530 (13.5)	.185 (4.7)	.250 (6.4)	22 .025 (.64)
6800	M	30LVSD68	1.04	Y5U	.620 (15.7)	.200 (5.1)	.375 (9.5)	20 .032 (.81)
.010µF	M	30LVSS10	1.52	Y5U	.720 (18.3)	.200 (5.1)	.375 (9.5)	20 .032 (.81)
.010µF	M	30LVSVS10	1.52	Y5V	.620 (15.7)	.200 (5.1)	.375 (9.5)	20 .032 (.81)
			Note 5				Note 6	

125L SERIES
AC RATED CERAMIC DISC CAPACITORS

Economical, Line-by-Pass, X1 & Y4 Applications

UL 1414	CSA 22.2	IEC 384-14 2nd Edition
Line-By-Pass	No. 1 - Isolation	Y4 - 125 VAC X1 - 400 VAC

VALUE pF	TOL.	VISHAY CERA-MITE NUMBER	AC LEAK. I_L mA	TEMP CHAR.	D DIAMETER (in/mm)	T THICKNESS (in/mm)	LS LEAD SPACE (in/mm)	Φ WIRE SIZE (AWG/in/mm)
1000	M	125LD10	0.07	Y5V	.330 (8.4)	.195 (5.0)	.250 (6.4)	20 .032 (.81)
1500	M	125LD15	0.11	Y5V	.330 (8.4)	.195 (5.0)	.250 (6.4)	20 .032 (.81)
2000	M	125LD20	0.15	Y5V	.330 (8.4)	.185 (4.7)	.250 (6.4)	20 .032 (.81)
2200	M	125LD22	0.17	Y5V	.330 (8.4)	.180 (4.6)	.250 (6.4)	20 .032 (.81)
3300	M	125LD33	0.25	Y5V	.365 (9.3)	.195 (5.0)	.250 (6.4)	20 .032 (.81)
4700	M	125LD47	0.36	Y5V	400 (10.2)	.185 (4.7)	.250 (6.4)	20 .032 (.81)
5000	M	125LD50	0.38	Y5V	430 (10.9)	.195 (5.0)	.375 (9.5)	20 .032 (.81)
6800	M	125LD68	0.52	Y5V	490 (12.4)	.190 (4.8)	.375 (9.5)	20 .032 (.81)
8200	M	125LD82	0.63	Y5V	530 (13.5)	.190 (4.8)	.375 (9.5)	20 .032 (.81)
.010µF	M	125LS10	0.76	Y5V	560 (14.2)	.190 (4.8)	.375 (9.5)	20 .032 (.81)
.015µF	M	125LS15	1.14	Y5V	720 (18.3)	.205 (5.2)	.375 (9.5)	20 .032 (.81)
.018µF	M	125LS18	1.37	Y5V	790 (20.1)	.205 (5.2)	.375 (9.5)	20 .032 (.81)
.020µF	M	125LS20	1.52	Y5V	620 (15.7)	.240 (6.1)	.375 (9.5)	22 .025 (.64)
.022µF	M	125LS22	1.67	Y5V	900 (22.9)	.185 (4.7)	.375 (9.5)	20 .032 (.81)
.030µF	M	125LS30	2.28	Y5V	720 (17.3)	.240 (6.1)	.375 (9.5)	22 .025 (.64)
.050µF	M	125LS50	3.80	Y5V	900 (22.9)	.240 (6.1)	.375 (9.5)	22 .025 (.64)
			Note 5				Note 6	

25Y SERIES
AC RATED CERAMIC DISC CAPACITORS

Temperature Stable Y5S (-30°C to +85°C ±22%), X1 & Y2 Applications

UL 1414	UL 1283	CSA 22.2	IEC 384-14 2nd Edition
Line-By-Pass	EMI Filters	No. 1 - Isolation No. 8 - EMI Filters	Y2 - 250 VAC X1 - 400 VAC

VALUE pF	TOL.	VISHAY CERA-MITE NUMBER	AC LEAK. I_L mA	TEMP CHAR.	D DIAMETER (in/mm)	T THICKNESS (in/mm)	LS LEAD SPACE (in/mm)	Φ WIRE SIZE (AWG/in/mm)
1000	M	25YD10	0.17	Y5S	.330 (8.4)	.170 (4.3)	.250 (6.4)	22 .025 (.64)
1500	M	25YD15	0.25	Y5S	.400 (10.2)	.175 (4.4)	.250 (6.4)	22 .025 (.64)
2000	M	25YD20	0.33	Y5S	.430 (10.9)	.170 (4.3)	.250 (6.4)	22 .025 (.64)
2200	M	25YD22	0.36	Y5S	.460 (11.7)	.170 (4.3)	.250 (6.4)	22 .025 (.64)
2700	M	25YD27	0.45	Y5S	.490 (12.4)	.170 (4.3)	.250 (6.4)	22 .025 (.64)
2800	M	25YD28	0.46	Y5S	.530 (13.5)	.175 (4.4)	.250 (6.4)	22 .025 (.64)
3000	M	25YD30	0.50	Y5S	.530 (13.5)	.175 (4.4)	.250 (6.4)	22 .025 (.64)
3200	M	25YD32	0.53	Y5S	.560 (14.2)	.185 (4.7)	.375 (9.5)	20 .032 (.81)
3300	M	25YD33	0.55	Y5S	.560 (14.2)	.185 (4.7)	.375 (9.5)	20 .032 (.81)
3900	M	25YD39	0.64	Y5S	.620 (15.7)	.185 (4.7)	.375 (9.5)	20 .032 (.81)
4000	M	25YD40	0.66	Y5S	.620 (15.7)	.185 (4.7)	.375 (9.5)	20 .032 (.81)
4700	M	25YD47	0.78	Y5S	.680 (17.3)	.185 (4.7)	.375 (9.5)	20 .032 (.81)
5000	M	25YD50	0.83	Y5S	.680 (17.3)	.185 (4.7)	.375 (9.5)	20 .032 (.81)
5500	M	25YD55	0.91	Y5S	.720 (18.3)	.190 (4.8)	.375 (9.5)	20 .032 (.81)
5600	M	25YD56	0.92	Y5S	.720 (18.3)	.190 (4.8)	.375 (9.5)	20 .032 (.81)
6800	M	25YD68	1.12	Y5S	.790 (20.1)	.185 (4.7)	.375 (9.5)	20 .032 (.81)
8000	M	25YD80	1.32	Y5S	.900 (22.9)	.200 (5.1)	.375 (9.5)	20 .032 (.81)
			Note 5				Note 6	

20VL SERIES
AC RATED CERAMIC DISC CAPACITORS

High Cap Valve, Compact Size, X2 Applications

UL 1283	CSA 22.2	IEC 384-14 2nd Edition
EMI Filters	No. 8 - EMI Filters	X2 - 400 VAC

VALUE µF	TOL.	VISHAY CERA-MITE NUMBER	TEMP CHAR.	D DIAMETER (in/mm)	T THICKNESS (in/mm)	LS LEAD SPACE (in/mm)	Φ WIRE SIZE (AWG/in/mm)
.009	M	20VLD90	Y5V	.530 (13.5)	.150 (3.8)	.375 (9.5)	22 .025 (.64)
.010	M	20VLS10	Y5V	.620 (15.7)	.150 (3.8)	.375 (9.5)	22 .025 (.64)
.010	Z	20VLSS10	Z5U	.530 (13.5)	.160 (4.1)	.250 (6.4)	22 .025 (.64)
.020	Z	20VLS20	Y5V	.720 (18.3)	.150 (3.8)	.375 (9.5)	22 .025 (.64)
.100	M	20VLP10 *	Y5V	.940 (23.9)	.240 (6.1)	.375 (9.5)	22 .025 (.64)
						Note 6	

* 20VLP10 not available with CSA 22.2 No. 8 recognition.

Low Dissipation Factor Disc Capacitors

FEATURES

- Ideal for High Voltage Switching to 100 kHz
- Low DF Minimizes Self Heating at High Frequencies.
- Application Voltages: 500, 1000 and 1500 Vac.
- Economical Alternative to Film Capacitors.

The 1DFO, 2DFO, and 3DFO Series are designed to operate up to 500, 1000, and 1500 V_{RMS}, respectively. Their low dissipation factor (DF) and stable temperature characteristics are well suited for operation at elevated frequency. Operating limits are governed by a suggested 30°C maximum case temperature rise as controlled by applied voltage and frequency dependent current. Power-rating charts covering the entire series provide operating guidelines for higher frequency applications.

APPLICATIONS:

- Fluorescent Ballasts
- Switching Power Supplies
- Industrial Electronic Systems
- Snubber Networks

GENERAL SPECIFICATIONS

Series:	1DFO	2DFO	3DFO
Application Voltage:	500 Vrms 1000 Vdc	1000 Vrms 2000 Vdc	1500 Vrms 3000 Vdc
Dielectric Strength:	1200 Vrms 2500 Vdc	2000 Vrms 4000 Vdc	3000 Vrms 6000 Vdc
Dissipation Factor:	0.1% Maximum at 1 kHz and 25°C		
Maximum Service Temperature:	125°C		
Power Rating:	(Note 1) Limit to 30°C Case Temperature Rise		
Insulation Resistance:	50,000 MΩ Minimum		

1DFO SERIES - LOW DISSIPATION FACTOR

561C Series

Application Range: 500 Vrms; 1000 Vdc

Value pF	Tol.	Catalog Number	Temp Char.	D Diameter (in / mm)	T Thickness (in / mm)	LS Lead Space (in / mm)
10	J	1DF0Q10	NP0	.250 (6.4)	.156 (4.0)	.250 (6.4)
12	J	1DF0Q12	NP0	.250 (6.4)	.156 (4.0)	.250 (6.4)
15	J	1DF0Q15	N1500	.250 (6.4)	.156 (4.0)	.250 (6.4)
18	J	1DF0Q18	N1500	.250 (6.4)	.156 (4.0)	.250 (6.4)
22	J	1DF0Q22	N1500	.250 (6.4)	.156 (4.0)	.250 (6.4)
27	J	1DF0Q27	N2200	.250 (6.4)	.156 (4.0)	.250 (6.4)
33	J	1DF0Q33	N2200	.250 (6.4)	.156 (4.0)	.250 (6.4)
39	J	1DF0Q39	N2200	.250 (6.4)	.156 (4.0)	.250 (6.4)
47	J	1DF0Q47	N1500	.250 (6.4)	.156 (4.0)	.250 (6.4)
56	J	1DF0Q56	N1500	.250 (6.4)	.156 (4.0)	.250 (6.4)
68	J	1DF0Q68	N1500	.250 (6.4)	.156 (4.0)	.250 (6.4)
82	J	1DF0Q82	N1500	.250 (6.4)	.156 (4.0)	.250 (6.4)
100	K	1DF0T10	N2000	.250 (6.4)	.156 (4.0)	.250 (6.4)
120	K	1DF0T12	N2000	.250 (6.4)	.156 (4.0)	.250 (6.4)
150	K	1DF0T15	N2000	.250 (6.4)	.156 (4.0)	.250 (6.4)
180	K	1DF0T18	N2000	.250 (6.4)	.156 (4.0)	.250 (6.4)
220	K	1DF0T22	N2500	.250 (6.4)	.156 (4.0)	.250 (6.4)
270	K	1DF0T27	N2500	.250 (6.4)	.156 (4.0)	.250 (6.4)
330	K	1DF0T33	N2800	.250 (6.4)	.156 (4.0)	.250 (6.4)
390	K	1DF0T39	N2800	.250 (6.4)	.156 (4.0)	.250 (6.4)
470	K	1DF0T47	N2800	.290 (7.4)	.156 (4.0)	.250 (6.4)
560	K	1DF0T56	N2800	.290 (7.4)	.156 (4.0)	.250 (6.4)
680	K	1DF0T68	N2800	.290 (7.4)	.156 (4.0)	.250 (6.4)
820	K	1DF0T82	N2800	.290 (7.4)	.156 (4.0)	.250 (6.4)
1000	K	1DF0D10	N2800	.370 (9.4)	.156 (4.0)	.250 (6.4)
1200	K	1DF0D12	N2800	.370 (9.4)	.156 (4.0)	.250 (6.4)
1500	K	1DF0D15	N2800	.405 (10.3)	.156 (4.0)	.250 (6.4)
1800	K	1DF0D18	N2800	.440 (11.2)	.156 (4.0)	.250 (6.4)
2200	K	1DF0D22	N2800	.460 (11.7)	.156 (4.0)	.250 (6.4)
2300	K	1DF0D23	N2800	.460 (11.7)	.156 (4.0)	.250 (6.4)
2400	K	1DF0D24	N2800	.460 (11.7)	.156 (4.0)	.250 (6.4)
2500	K	1DF0D25	N2800	.460 (11.7)	.156 (4.0)	.250 (6.4)
2700	K	1DF0D27	N2800	.490 (12.5)	.156 (4.0)	.250 (6.4)
3300	K	1DF0D33	N2800	.530 (13.5)	.156 (4.0)	.250 (6.4)
3900	K	1DF0D39	N2800	.560 (14.2)	.156 (4.0)	.375 (9.5)
4700	K	1DF0D47	N2800	.630 (16.0)	.156 (4.0)	.375 (9.5)
5600	K	1DF0D56	N2800	.680 (17.3)	.156 (4.0)	.375 (9.5)
6800	K	1DF0D68	N2800	.760 (19.3)	.156 (4.0)	.375 (9.5)

Note 3

Note 1

Power ratings are based on still air 60°C ambient with additional 30°C rise due to self heating. Thermal effects such as forced air cooling, component encapsulation or other heat-sinking techniques will alter ratings. Actual circuit test is recommended.

2DFO SERIES - LOW DISSIPATION FACTOR

564C Series

Application Range: 1000 Vrms; 2000 Vdc

Value pF	Tol.	Catalog Number	Temp Char.	D Diameter (in / mm)	T Thickness (in / mm)	LS Lead Space (in / mm)
10	J	2DF0Q10	NP0	.290 (7.4)	.160 (4.1)	.250 (6.4)
12	J	2DF0Q12	N1500	.290 (7.4)	.170 (4.3)	.250 (6.4)
15	J	2DF0Q15	N2200	.290 (7.4)	.185 (4.7)	.250 (6.4)
18	J	2DF0Q18	N2200	.290 (7.4)	.170 (4.3)	.250 (6.4)
22	J	2DF0Q22	N2200	.290 (7.4)	.170 (4.3)	.250 (6.4)
27	J	2DF0Q27	N1500	.290 (7.4)	.220 (5.6)	.250 (6.4)
33	J	2DF0Q33	N1500	.290 (7.4)	.195 (5.0)	.250 (6.4)
39	J	2DF0Q39	N1500	.290 (7.4)	.180 (4.6)	.250 (6.4)
47	J	2DF0Q47	N1500	.290 (7.4)	.170 (4.3)	.250 (6.4)
56	J	2DF0Q56	N2000	.290 (7.4)	.210 (5.3)	.250 (6.4)
68	J	2DF0Q68	N2000	.290 (7.4)	.190 (4.8)	.250 (6.4)
82	J	2DF0Q82	N2000	.290 (7.4)	.175 (4.5)	.250 (6.4)
100	K	2DF0T10	N2000	.290 (7.4)	.170 (4.3)	.250 (6.4)
120	K	2DF0T12	N2500	.290 (7.4)	.185 (4.7)	.250 (6.4)
150	K	2DF0T15	N2500	.290 (7.4)	.170 (4.3)	.250 (6.4)
180	K	2DF0T18	N2800	.290 (7.4)	.185 (4.7)	.250 (6.4)
220	K	2DF0T22	N2800	.290 (7.4)	.170 (4.3)	.250 (6.4)
270	K	2DF0T27	N2500	.330 (8.4)	.170 (4.3)	.250 (6.4)
330	K	2DF0T33	N2800	.330 (8.4)	.185 (4.7)	.250 (6.4)
390	K	2DF0T39	N2800	.330 (8.4)	.175 (4.5)	.250 (6.4)
470	K	2DF0T47	N2500	400 (10.2)	.170 (4.3)	.250 (6.4)
560	K	2DF0T56	N2800	400 (10.2)	.185 (4.7)	.250 (6.4)
680	K	2DF0T68	N2800	400 (10.2)	.170 (4.3)	.250 (6.4)
820	K	2DF0T82	N2800	430 (10.9)	.175 (4.5)	.250 (6.4)
1000	K	2DF0D10	N2800	460 (11.7)	.170 (4.3)	.250 (6.4)
1200	K	2DF0D12	N2800	490 (12.5)	.170 (4.3)	.250 (6.4)
1500	K	2DF0D15	N2800	530 (13.5)	.170 (4.3)	.250 (6.4)
1800	K	2DF0D18	N2800	560 (14.2)	.170 (4.3)	.375 (9.5)
2200	K	2DF0D22	N2800	680 (17.3)	.180 (4.6)	.375 (9.5)
2300	K	2DF0D23	N2800	680 (17.3)	.175 (4.5)	.375 (9.5)
2400	K	2DF0D24	N2800	680 (17.3)	.175 (4.5)	.375 (9.5)
2500	K	2DF0D25	N2800	680 (17.3)	.170 (4.3)	.375 (9.5)
2700	K	2DF0D27	N2800	680 (17.3)	.170 (4.3)	.375 (9.5)
3300	K	2DF0D33	N2800	720 (18.3)	.170 (4.3)	.375 (9.5)
3900	K	2DF0D39	N2800	790 (20.1)	.170 (4.3)	.375 (9.5)
4700	K	2DF0D47	N2800	900 (22.9)	.180 (4.6)	.375 (9.5)
5600	K	2DF0D56	N2800	900 (22.9)	.170 (4.3)	.375 (9.5)
6800	K	2DF0D68	N2800	950 (24.1)	.170 (4.3)	.375 (9.5)

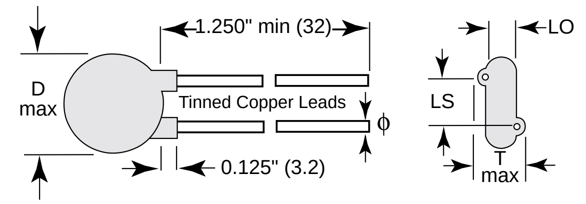
Note 3

Note 2

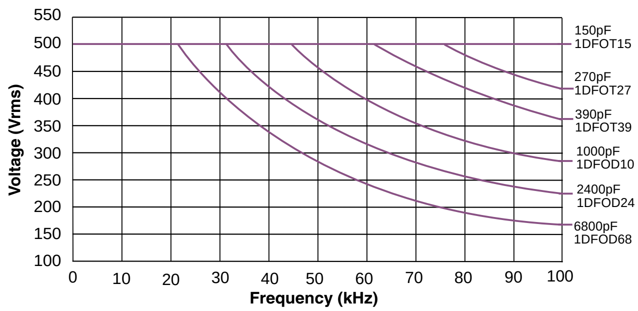
For convenience, power rating charts are shown to 100 kHz. Higher frequency operation is permissible with appropriate derating.

Consult factory for application suggestions.

Fig 8



Power Rating - 1DFO Series 500 Vrms Low DF - Note 1

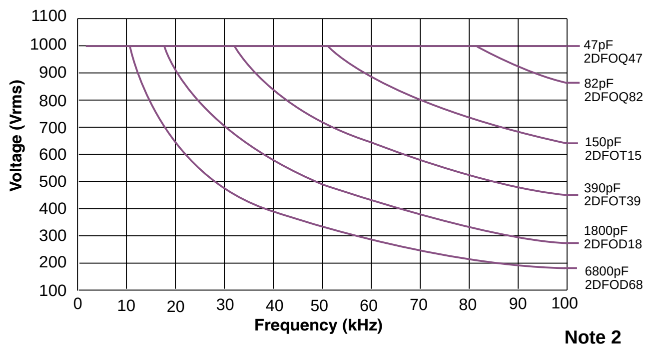


Note 2

WIRE LEAD INFORMATION

SERIES	Φ WIRE SIZE AWG / in / mm	"LO" TYP LEAD OFFSET in / mm
1DFO	22 .025 (.64)	.045 (1.2)
2DFO	20 .032 (.81)	.075 (1.8)
3DFO	20 .032 (.81)	.095 (2.4)

Power Rating - 2DFO Series 1000 Vrms Low DF - Note 1



Note 2

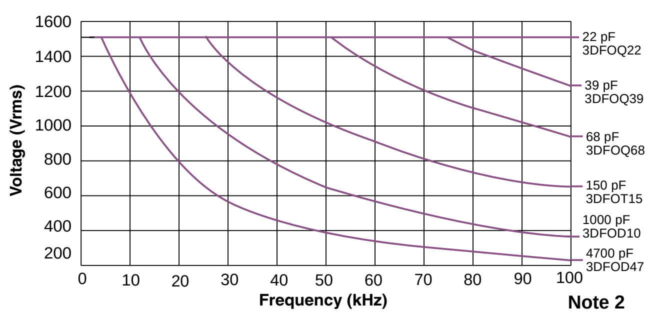
3DFO SERIES - LOW DISSIPATION FACTOR

564C Series

Application Range: 1500 Vrms, 3000 VDC

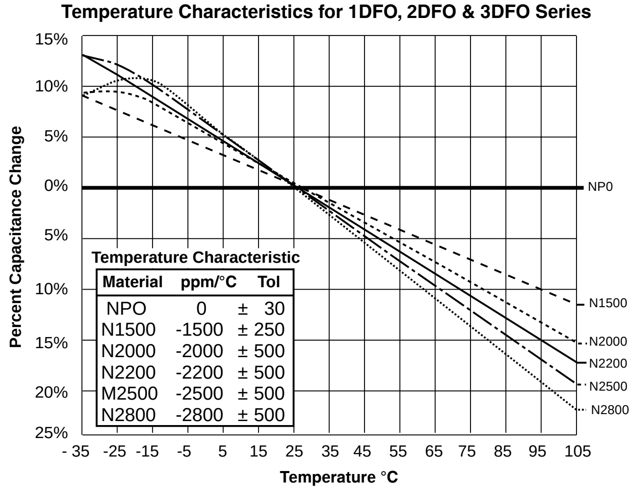
VALUE pF	TOL.	CATALOG NUMBER	TEMP CHAR.	D DIAMETER (in / mm)	T THICKNESS (in / mm)	LS LEAD SPACE (in / mm)
10	5%	3DF0Q10	N1500	.290 (7.4)	.185 (4.7)	.250 (6.4)
12	5%	3DF0Q12	N2200	.290 (7.4)	.210 (5.3)	.250 (6.4)
15	5%	3DF0Q15	N2200	.290 (7.4)	.185 (4.7)	.250 (6.4)
18	5%	3DF0Q18	N2200	.290 (7.4)	.185 (4.7)	.250 (6.4)
22	5%	3DF0Q22	N2200	.330 (8.4)	.210 (5.3)	.250 (6.4)
27	5%	3DF0Q27	N1500	.290 (7.4)	.220 (5.6)	.250 (6.4)
33	5%	3DF0Q33	N1500	.290 (7.4)	.195 (5.0)	.250 (6.4)
39	5%	3DF0Q39	N1500	.290 (7.4)	.190 (4.8)	.250 (6.4)
47	5%	3DF0Q47	N1500	.330 (8.4)	.225 (5.7)	.250 (6.4)
56	5%	3DF0Q56	N2000	.290 (7.4)	.210 (5.3)	.250 (6.4)
68	5%	3DF0Q68	N2000	.290 (7.4)	.190 (4.8)	.250 (6.4)
82	5%	3DF0Q82	N2000	.290 (7.4)	.185 (4.7)	.250 (6.4)
100	10%	3DF0T10	N2500	.290 (7.4)	.205 (5.2)	.250 (6.4)
120	10%	3DF0T12	N2500	.290 (7.4)	.190 (4.8)	.250 (6.4)
150	10%	3DF0T15	N2800	.290 (7.4)	.200 (5.1)	.250 (6.4)
180	10%	3DF0T18	N2800	.290 (7.4)	.190 (4.8)	.250 (6.4)
220	10%	3DF0T22	N2500	.330 (8.4)	.190 (4.8)	.250 (6.4)
270	10%	3DF0T27	N2800	.330 (8.4)	.205 (5.2)	.250 (6.4)
330	10%	3DF0T33	N2800	.330 (8.4)	.190 (4.8)	.250 (6.4)
390	10%	3DF0T39	N2800	.400 (10.2)	.215 (5.5)	.250 (6.4)
470	10%	3DF0T47	N2800	.400 (10.2)	.195 (5.0)	.250 (6.4)
560	10%	3DF0T56	N2800	.430 (10.9)	.200 (5.1)	.250 (6.4)
680	10%	3DF0T68	N2800	.460 (11.7)	.195 (5.0)	.250 (6.4)
820	10%	3DF0T82	N2800	.490 (12.5)	.195 (5.0)	.250 (6.4)
1000	10%	3DF0D10	N2800	.530 (13.5)	.190 (4.8)	.250 (6.4)
1200	10%	3DF0D12	N2800	.560 (14.2)	.190 (4.8)	.375 (9.5)
1500	10%	3DF0D15	N2800	.620 (15.8)	.190 (4.8)	.375 (9.5)
1800	10%	3DF0D18	N2800	.680 (17.3)	.190 (4.8)	.375 (9.5)
2200	10%	3DF0D22	N2800	.720 (18.3)	.190 (4.8)	.375 (9.5)
2300	10%	3DF0D23	N2800	.720 (18.3)	.190 (4.8)	.375 (9.5)
2400	10%	3DF0D24	N2800	.790 (20.1)	.195 (5.0)	.375 (9.5)
2500	10%	3DF0D25	N2800	.790 (20.1)	.195 (5.0)	.375 (9.5)
2700	10%	3DF0D27	N2800	.790 (20.1)	.190 (4.8)	.375 (9.5)
3300	10%	3DF0D33	N2800	.900 (22.9)	.200 (5.1)	.375 (9.5)
3900	10%	3DF0D39	N2800	.900 (22.9)	.190 (4.8)	.375 (9.5)
4700	10%	3DF0D47	N2800	.950 (24.1)	.185 (4.7)	.375 (9.5)
						Note 3

Power Rating - 3DFO Series 1500 Vrms Low DF - Note 1



Note 2

Temperature Characteristics for 1DFO, 2DFO & 3DFO Series

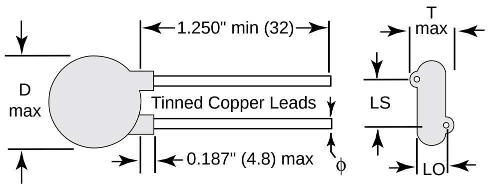


Note 3

Alternate lead spacing of 5mm, 7.5mm, and 10mm are available bulk or tape & reel.

High Voltage Disc Capacitors

Radial Lead Style - 2000 to 15,000 VDC
Axial Lead Style - 10,000 to 30,000 VDC



ϕ - 20 AWG .032" (.81) except per Note 1.
LO ~ (Thk - .100") except per Note 1.

Note 1
#22 AWG .025" (.64) wire leads used on:
20GAP10 (LO = .07")
30GASS20 (LO = .08")
30GASS33 (LO = .10")

Vishay Cera-Mite High Voltage Capacitors are the choice of discriminating designers throughout the world. Our reputation for product quality and reliability is a result of continuous research in fine electrical ceramics, high temperature coatings, process controls and rigorous production testing.

The 2 and 3 kV parts are widely used in demanding applications such as snubbers, EMI/RFI filters, and switching power supplies. High voltage capacitors are also specified in lower voltage applications to withstand transient voltage and energy surges in accordance with FCC and IEEE standards.

APPLICATIONS:

- Lighting Ballasts
- Telecommunications
- Power Supplies

2000 VOLT, 10% AND 20% TOLERANCE

564C Series

- Application Range: Up to 2500 VDC, 600 VRMS
- Insulation Resistance: 10,000 MΩ minimum
- Dissipation Factor: 2.0% maximum
- Dielectric Strength: 3500 VDC, 1000 VRMS

VALUE pF	TOL.	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
100	K	20TST10	.330	.190	.250	X7R
220	K	20TST22	.330	.180	.250	X7R
330	K	20TST33	.330	.180	.250	X7R
470	K	20TST47	.330	.170	.250	X7R
560	K	20TST56	.330	.185	.250	X7R
680	K	20TST68	.330	.170	.250	X7R
1000	M	20GAD10	.330	.170	.250	Y5U
1000	M	20TSSD10	.330	.175	.250	Y5S
1000	K	20TSD10	.400	.175	.250	X7R
1500	M	20GAD15	.330	.170	.250	Y5U
1500	M	20TSSD15	.400	.170	.250	Y5S
1500	K	20TSD15	.430	.160	.250	X7R

VALUE pF	TOL.	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
1800	M	20GAD18	.360	.170	.250	Z5U
1800	M	20TSSD18	.430	.170	.250	Y5S
1800	K	20TSD18	.460	.170	.250	X7R
2200	M	20GAD22	.400	.175	.250	Z5U
2200	M	20TSSD22	.460	.170	.250	Y5S
2200	K	20TSD22	.460	.170	.250	X7R
2700	M	20GAD27	.430	.175	.250	Z5U
2700	M	20TSSD27	.530	.175	.250	Y5S
2700	K	20TSD27	.530	.170	.250	X7R
3300	M	20GAD33	.430	.175	.250	Z5U
3300	M	20TSSD33	.530	.175	.250	Y5S
3300	K	20TSD33	.530	.160	.250	X7R

VALUE pF	TOL.	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
3900	M	20GAD39	.490	.175	.250	Z5U
3900	M	20TSSD39	.620	.175	.250	Y5S
3900	K	20TSD39	.680	.170	.250	X7R
4700	M	20GAD47	.490	.170	.250	Z5U
4700	M	20TSSD47	.680	.175	.375	Y5S
4700	K	20TSD47	.680	.170	.375	X7R
5600	M	20TSSD56	.680	.170	.375	Y5S
6800	M	20GAD68	.560	.170	.375	Z5U
6800	M	20TSSD68	.720	.170	.375	Y5S
.01uF	M	20GAS10	.680	.170	.375	Z5U
.01uF	M	20GASS10	.620	.170	.375	Y5V
.10uF	M	20GAP10	.950	.240	.375	Y5V

3000 VOLT, 10% AND 20% TOLERANCE

564C Series

- Application Range: Up to 4000 VDC, 1000 VRMS
- Insulation Resistance: 50,000 MΩ minimum
- Dissipation Factor: 2.0% maximum
- Dielectric Strength: 5250 VDC, 1500 VRMS

VALUE pF	TOL.	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
10	M	30GAQ10	.330	.210	.250	U2J
12	M	30GAQ12	.330	.205	.250	U2J
15	M	30GAQ15	.330	.180	.250	U2J
22	M	30GAQ22	.330	.200	.250	R3L
27	M	30GAQ27	.330	.190	.250	R3L
33	M	30GAQ33	.330	.170	.250	R3L
47	M	30GAQ47	.330	.230	.250	X7R
56	M	30GAQ56	.330	.190	.250	X7R
68	M	30GAQ68	.330	.200	.250	X7R
100	M	30GAT10	.330	.180	.250	X7R
150	M	30GAT15	.330	.190	.250	X7R
220	M	30GAT22	.330	.175	.250	X7R
270	M	30GAT27	.330	.180	.250	X7R
330	M	30GAT33	.330	.175	.250	X7R
390	M	30GAT39	.330	.175	.250	X7R
470	M	30GAT47	.330	.175	.250	X7R
680	M	30GAT68	.330	.175	.250	Y5U

VALUE pF	TOL.	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
680	K	30TST68	.330	.180	.250	X7R
1000	M	30GAD10	.330	.195	.250	Z5U
1000	M	30TSSD10	.400	.190	.250	Y5S
1000	K	30TSD10	.400	.175	.250	X7R
1500	M	30GAD15	.360	.190	.250	Z5U
1500	M	30TSSD15	.460	.190	.250	Y5S
1500	K	30TSD15	.490	.185	.250	X7R
1800	M	30GAD18	.400	.190	.250	Z5U
1800	M	30TSSD18	.490	.190	.250	Y5S
1800	K	30TSD18	.530	.185	.250	X7R
2200	M	30GAD22	.430	.190	.250	Z5U
2200	M	30TSSD22	.530	.190	.250	Y5S
2200	K	30TSD22	.530	.180	.250	X7R
2700	M	30GAD27	.460	.200	.250	Z5U
2700	M	30TSSD27	.560	.185	.250	Y5S
2700	K	30TSD27	.620	.185	.250	X7R
3300	M	30GAD33	.490	.185	.250	Z5U

VALUE pF	TOL.	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
3300	M	30TSSD33	.620	.185	.375	Y5S
3300	K	30TSD33	.620	.170	.375	X7R
3900	M	30GAD39	.530	.185	.375	Z5U
3900	M	30TSSD39	.680	.185	.375	Y5S
3900	K	30TSD39	.720	.185	.375	X7R
4700	M	30GAD47	.620	.195	.375	Z5U
4700	M	30TSSD47	.680	.185	.375	Y5S
4700	K	30TSD47	.720	.175	.375	X7R
5600	M	30TSSD56	.790	.190	.375	Y5S
6800	M	30GAD68	.680	.185	.375	Z5U
6800	M	30TSSD68	.900	.205	.375	Y5S
6800	K	30TSD68	.900	.185	.375	X7R
8200	M	30GAD82	.680	.185	.375	Z5U
.01uF	M	30GAS10	.790	.185	.375	Z5U
.01uF	M	30GASS10	.720	.185	.375	Y5V
.02uF	M	30GASS20	.720	.240	.375	Z5U
.033uF	M	30GASS33	.900	.240	.375	Z5U

6000 VOLT, 20% TOLERANCE

564C Series

- Application Range: Up to 6000 VDC, 1500 VRMS
- Insulation Resistance: 75,000 MΩ minimum
- Dissipation Factor: 2.0% maximum
- Dielectric Strength: 10,500 VDC, 3000 VRMS

VALUE pF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
10	60GAQ10	.400	.220	.375	NP0
22	60GAQ22	.460	.240	.375	U2J
33	60GAQ33	.400	.230	.375	R3L
47	60GAQ47	.460	.205	.375	R3L
100	60GAT10	.400	.240	.375	X5F

VALUE pF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
220	60GAT22	.400	.265	.375	X5F
330	60GAT33	.400	.260	.375	X5S
470	60GAT47	.400	.265	.375	Y5U
560	60GAT56	.400	.240	.375	Y5U
1000	60GAD10	.400	.270	.375	Z5U

VALUE pF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
1500	60GAD15	.460	.280	.375	Z5U
2200	60GAD22	.530	.240	.375	Z5U
3300	60GAD33	.620	.260	.375	Z5U
4700	60GAD47	.790	.260	.375	Z5U
.01uF	60GAS10	.950	.250	.375	Z5U

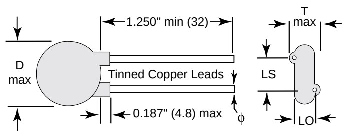
VISHAY

High Voltage Disc Capacitors

Radial Lead Style - 2000 to 15,000 VDC
Axial Lead Style -10,000 to 30,000 VDC

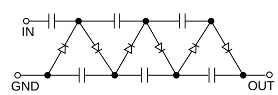
HIGH VOLTAGE APPLICATIONS:

- Televisions, Monitors and Oscilloscopes
- High Voltage Power Supplies and Lasers
- Electronic Air Cleaners
- X-Ray Equipment



LO ≈ (Thk - .100") ϕ - 20 AWG .032" (.81)

TRIPLER



7500 VDC, 2000 VRMS, 60 HZ

564C Series

VALUE pF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
100	75GAT10	.530	.310	.500	X5F
470	75GAT47	.620	.270	.500	X5F
1000	75GAD10	.620	.320	.500	Y5U
2500	75GAD25	.620	.280	.500	Z5U

10,000 VDC, 3000 VRMS, 60 HZ

VALUE pF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
100	100GAT10	.680	.370	.500	X5F
100	100GAST10	.490	.330	.375	Y5R
250	100GAT25	.680	.300	.500	X5F
250	100GATT25	.490	.290	.375	N4700
250	100GAST25	.490	.340	.375	Y5R
500	100GAT50	.680	.345	.500	X5F
500	100GATT50	.680	.320	.500	N4700
500	100GAST50	.490	.310	.375	Y5R

615C Series

VALUE pF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
680	100GATT68	.750	.300	.500	N4700
820	100GATT82	.810	.300	.500	N4700
1000	100GAD10	.750	.320	.500	Y5R
1000	100GATD10	.980	.320	.500	N4700
1000	100GASD10	.680	.330	.500	Y5U
2500	100GAD25	.750	.350	.500	Z5U
2500	100GATD25	.980	.330	.500	Y5R
3000	100GAD33	.980	.390	.500	Z5U

15,000 VDC, 4500 VRMS, 60 HZ

VALUE pF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
100	150GAST10	.490	.490	.500	Y5R
100	150GAT10	.670	.430	.750	X5F
100	150GATT10	.490	.470	.500	N4700
250	150GAST25	.490	.480	.500	Y5R
250	150GAT25	.670	.455	.750	X5F

VALUE PF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
250	150GATT25	.670	.430	.750	N4700
390	150GATT39	.750	.425	.750	N4700
500	150GAST50	.490	.375	.500	Y5U
500	150GAT50	.670	.430	.750	Y5R
500	150GATT50	.810	.410	.750	N4700

615C Series

VALUE pF	CATALOG NUMBER	MECHANICAL (in) DIA.	THK.	L.S.	TEMP. CHAR.
750	150GATT75	.980	.350	.750	N4700
1000	150GAD10	.670	.420	.750	Y5U
1000	150GATD10	.980	.460	.750	Y5R
2200	150GAD22	.980	.510	.750	Z5U
2500	150GAD25	1.150	.450	.750	Z5U

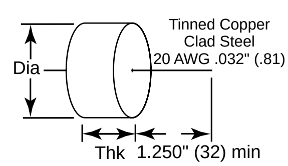
PERFORMANCE DATA - 7500 TO 15KV SERIES

- **Operating Temperature:** -25° to +105°C
- **Capacitance Tolerance:** ± 20% (X5F, Y5R, N4700); + 80/- 20% (Y5U, Z5U).
- **Dissipation Factor:** 0.2%, (N4700); 1.5 & 2.0% (X5F, Y5U, Y5R, Z5U).
- **Dielectric Strength:** 150% of VDC (dielectric fluid), charging current limit to 50 mA max.
- **Insulation Resistance:** 200,000 MΩ minimum @ 180 VDC, 1000 ΩF.
- **Corona:** 100 picocoulombs at rated AC voltage.
- **Power Dissipation:** Limit to 25°C case rise above ambient, 105°C max.
- **Peak Current:** dv/dt limit approx. 2000 V/µs. Application to be tested and confirmed by user.

Axial Leaded High Voltage Capacitors, Molded Case, High Temperature, Epoxy Construction

FEATURES

- Greater lead-to-lead arcing distance, without costly encapsulation.
- Longer life at elevated temperatures (up to 125°C); extended thermal cycling.
- Low corona (10 picocoulombs) at rated AC voltage.



660C Series

SIZE CODES-AXIAL LEADED

DIA	in / mm	THK	in / mm
A	0.83 (21)	1	0.50 (13)
C	1.18 (30)	2	0.60 (15)
D	1.45 (37)	3	0.80 (20)
		4	0.95 (24)

10,000 VDC/3,000 V_{rms}

VALUE pF	TOL.	CATALOG NUMBER	SIZE CODE	TEMP. COEF.
470	M	10AZT47	A1	N4700
1000	M	10AZD10	C1	N4700
1500	Z	10AED15	A1	Z5U
2000	M	10AZD20	D1	N4700
2200	Z	10AED22	A1	Z5U
3300	Z	10AED33	C1	Z5U
3300	M	10ACD33	C2	X7R
4700	Z	10AED47	C1	Z5U
4700	M	10ACD47	D2	X7R
6800	Z	10AED68	C1	Z5U
10000	Z	10AES10	D1	Z5U

15,000 VDC/5,000 V_{rms}

VALUE pF	TOL.	CATALOG NUMBER	SIZE CODE	TEMP. COEF.
390	M	15AZT39	A1	N4700
820	M	15AZT82	C1	N4700
1000	Z	15AED10	A1	Z5U
1500	Z	15AED15	A1	Z5U
1500	M	15ACD15	C2	X7R
1500	M	15AZD15	D1	N4700
2200	Z	15AED22	C1	Z5U
2200	M	15ACD22	C1	X7R
3300	Z	15AED33	C1	Z5U
3300	M	15ACD33	D2	X7R
3900	M	15ACD39	D2	X7R
4700	Z	15AED47	C1	Z5U
6800	Z	15AED68	D1	Z5U

20,000 VDC/6,000 V_{rms}

VALUE pF	TOL.	CATALOG NUMBER	SIZE CODE	TEMP. COEF.
220	M	20AZT22	A2	N4700
680	Z	20AET68	A2	Z5U
680	M	20AZT68	C2	N4700
1000	Z	20AED10	A2	Z5U
1000	M	20ACD10	C3	X7R
1000	M	20AZD10	D2	N4700
1500	Z	20AED15	A2	Z5U
1500	M	20ACD15	C3	X7R
2200	Z	20AED22	C2	Z5U
2200	M	20ACD22	D3	X7R
2500	M	20ACD25	D3	X7R
2700	M	20ACD27	D3	X7R
3300	Z	20AED33	C2	Z5U
4700	Z	20AED47	D2	Z5U
5000	Z	20AED50	D2	Z5U

30,000 VDC/10,000 V_{RMS}

VALUE pF	TOL.	CATALOG NUMBER	SIZE CODE	TEMP. COEF.
180	M	30AZT18	A3	N4700
330	M	30ACT33	A4	X7R
470	M	30AZT47	C3	N4700
470	Z	30AET47	A3	Z5U
680	M	30AZT68	D3	N4700
680	Z	30AET68	A3	Z5U
820	Z	30AET82	A3	Z5U
1000	M	30ACD10	C4	X7R
1000	Z	30AED10	C3	Z5U
1200	Z	30AED12	C3	Z5U
1500	M	30ACD15	D4	X7R
1500	Z	30AED15	C3	Z5U
1800	Z	30AED18	D3	Z5U
2000	Z	30AED20	D3	Z5U
2200	Z	30AED22	D3	Z5U
2500	Z	30AED25	D3	Z5U
3000	Z	30AED30	D3	Z5U
3300	Z	30AED33	D3	Z5U

SPECIFICATIONS:

- **Application Range:** Up to 30,000 VDC,10,000Vrms
- **Dielectric Strength:** 150% of rated voltage (in dielectric fluid) charging current limited to 50mA.
- **Temperature Characteristcs:** N4700 (T3M), X7R, Z5U
- **Insulation Resistance:** 200,000 MΩ, minimum @ 180 VDC,1000 ΩF.
- **Dissipation Factor:** 0.2% (N4700); 2% max (X7R, Z5U).

561 AND 564 CLASS I SERIES ELECTRICAL OPTIONS (Precision and over 50 kHz)

CERAMIC TYPE	RANGE OF CAPACITANCE VALUES (PICOFARADS)				
	500 VOLT .250" TO .680" (6.4 TO 17mm)	1000 VOLT .250" TO .760" (6.4 TO 19mm)	2000 VOLT .330" TO .900" (8.4 TO 23mm)	3000 VOLT .330" TO .900" (8.4 TO 23mm)	TOLERANCE CODES
NP0	10 - 390	1 - 330	1 - 270	1 -180	C, D, J, K
N750	47 - 680	22 - 470	10 - 330	10 - 270	J, K
N1000	56 - 820	33 - 560	15 - 390	10 - 330	J, K
N2200	68 - 750	56 - 680	33 - 560	22 - 470	J, K
N3300	100 -1000	75 - 820	47 - 750	33 - 560	J, K
N4700	n/A	330-5600	220-4700	100-3300	K, M

Note: Vishay Cera-Mite also offers capacitors in N030, N080, N150, N220, N330, and N470 characteristics to serve special applications requiring TC matching. Values are available in the same range as NP0.

CUSTOM DISCS

Vishay Cera-Mite's most popular 12 Volt to 6,000 Volt values and constructions are shown as standard part numbers in this catalog. Many other values and lead styles are available. Complete capacitance ranges for various Class I, II and III ceramic materials are shown in the tables below. Various wire lead forms and packaging options are detailed on the next pages. Part numbers for custom capacitors consist of an 18-character designator assigned by our application engineering group. Vishay Cera-Mite will provide a certified outline drawing and complete part number covering custom options specified. Customer approval of the outline is usually requested to guarantee satisfaction.

All performance characteristics shown in this catalog apply to the options unless otherwise stated on the outline drawing.

562 AND 564 CLASS II & III SERIES ELECTRICAL OPTIONS

(General Purpose)

CERAMIC TYPE	RANGE OF CAPACITANCE VALUES (PICOFARADS)							
	500 Volt .250" to .950" (6.4 to 24mm)	1000 Volt .250" to .950" (6.4 to 24mm)	2000 Volt .330" to .950" (8.4 to 24mm)	3000 Volt .330" to .950" (8.4 to 24mm)	6000 Volt .400" to .900" (10.2 to 23mm)	TOLERANCE CODES 500 V	1000 V	2 to 6 KV
X5F	200 - 22,000	100 - 20,000	68 - 12,000	47 - 8,200	47 - 2200	K, M	K, M	K, M
X5S	400 - 22,000	300 - 25,000	470 - 22,000	390 -15,000	220 - 3900	M	K, M	K, M
X7R	500 - 22,000	390 - 28,000	390 - 22,000	290 - 15,000	560 - 3900	K, M	K, M	K, M
Y5U	1000 - 50,000	750 - 50,000	560 - 33,000	390 - 33,000	470 - 6800	M	M	M, Y
Z5U	1500 - 100,000	1000 -100,000	1000 - 47,000	680 - 33,000	820 - 8200	M, Z	M, Z	M, Z
Y5V	2000 - 200,000	1500 -150,000	1500 -100,000	1000 - 50,000	N/A	Y, Z	M, Z	M, Z

Note: 100 Volt ratings are available in same ranges as 500 Volt.

CUSTOM PART NUMBER DESIGNATOR

General Method Used To Describe Radial Leaded Custom Disc Capacitors

562C X5F BA 102 E C 151 K

- **K — CAPACITANCE TOLERANCE** - See Application Data (Marking Information) for code letters.
- **151 — CAPACITANCE (pF)** - First two digits are significant numbers. Last digit specifies number of zeros (151 = 150 pF). Values below 10 pF, use letter R for decimal point (2R2 = 2.2 pF).
- **C — BODY SIZE** - Disc diameter code letter as specified by Cera-Mite Engineering.
- **E — COATING MATERIAL** - E = Epoxy, A = Phenolic.
- **102 — WORKING VOLTAGE** - First two digits are significant numbers. Last digit specifies number of zeros (102 = 1000 Volts).
- **BA — WIRE LEAD STYLE & PACKAGING** - See two-letter Option Code tables on following pages.
- **X5F — TEMPERATURE CHARACTERISTIC** - See Application Data (Temp Coefficient table) for code letters.
- **562C — VISHAY CERA-MITE PRODUCT CODE** -
  - 561C: Precision Capacitors
  - 562C: General Application Discs - Diameter .250" thru .900"
  - 565C: 100 thru 1000 Volt Dual Parallel Discs - Diameter .510" thru .950"
  - 563C: Low Voltage (12 thru 100 Volt) Hypercon High Cap Density Discs
  - 564C: High Voltage Disc Capacitors (2000 thru 7500 Volt)
  - 615C: High Voltage Disc Capacitors (10,000 Volt and 15,000 Volt)

Packaging Options

BULK PACKAGING

Inner cardboard boxes will be either 6 x 6 x 2 inches (15 x 15 x 5cm); or 6 x 6 x 3.5 inches (15 x 15 x 9cm) and are labeled as shown. In certain circumstances, sealed plastic bags may be used as an alternate.

CUSTOMER	VISHAY CERA-MITE
• Name • Purchaser Order Number • Part Number & Rev. • Item Number	• Part No. & Descriptor Code • Order Number • Lot Number • Quantity & Date Code
Vishay Cera-Mite Corporation • Grafton, WI 53024 • USA	

Outer corrugated cardboard shipping cartons range in size from 6.5 x 7 x 8 inches (17 x 18 x 20cm) to 12.5 x 15 x 7 inches (32 x 38 x 18cm) and are labeled as follows:

Vishay Cera-Mite Corporation 1327 6th Avenue Grafton, WI 53024	OR	Vishay Cera-Mite Corporation 6150 Van Hecke Avenue Oconto, WI 54153	
Customer PO#	Customer Part #	Quantity	Box __ of __
Customer Name		Customer Address	

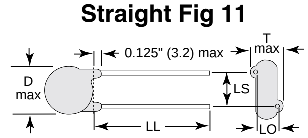
WIRE LEAD OPTIONS

- Radial leaded capacitors may be ordered with various wire lead options by adding appropriate suffix code to the catalog part number.

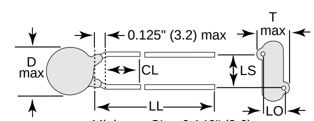
Example: 30GAD22 GJ (Suffix Code) specifies:

#20 AWG wire; LS = .375"; Inside Crimp; Short Cut Lead Length.

Straight Fig 11

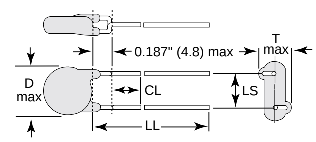


Steeple Fig 12



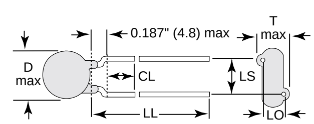
Minimum CL = 0.140" (3.6)

Inline High Voltage Fig 13



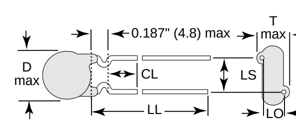
Minimum CL = 0.120" (3) Inline Wire, LO = 0

Step Low Voltage Fig 14



Minimum CL = 0.140" (3.6)

Inside Crimp Fig 15



Minimum CL = 0.120" (3)

12 VOLT - 1000 VOLT CAPACITORS			SUFFIX CODES FOR VARIOUS LEAD SPACING (LS) AND WIRE SIZE (AWG)						
			.200" (5)		.250" (6.3)		.300" (7.5)	.375" (9.5)	.400" (10)
WIRE FORM DESCRIPTION	WIRE	LEAD LENGTH	#22 AWG	#24 AWG	#22 AWG	#24 AWG	#22 AWG	#22 AWG	#22 AWG
Straight Wire	Fig 11	Long "LL"	MA	PA	UB	UA	BK	BJ	BL
Steeple Wire	Fig 12	Long "LL" Cut "CL"	CL NB	PT PK	CJ NK	CH NG	CA NC	CK ND	CB NE
Step Wire	Fig 14	Long "LL" Cut "CL"	VD PG	VK PU	VB PR	PQ PL	VF PH	VG PS	VH PJ
Inside Crimp	Fig 15	Long "LL" Cut "CL"	JQ JA	JT JD	JC JK	JF JY	JL JR	JS JJ	JP JB

2000 AND 3000 VOLT CAPACITORS			SUFFIX CODES FOR VARIOUS LEAD SPACING (LS) AND WIRE SIZE (AWG)										
			.250" (6.3)		.300" (7.5)		.375" (9.5)		.400" (10)		.500" (12.7)		.750" (19)
WIRE FORM DESCRIPTION	WIRE	LEAD LENGTH	#20 AWG	#22 AWG	#20 AWG	#22 AWG	#20 AWG	#22 AWG	#20 AWG	#22 AWG	#20 AWG	#22 AWG	#20 AWG
Straight Wire	Fig 11	Long "LL"	AA	UB	AE	BK	AJ	BJ	AD	BL	AM	BM	AB
Inline Wire	Fig 13	Long "LL" Cut "CL"	XW XX	XY XZ	UC UD	UE UF	UG UH	UJ UK	UL UN	UM UP	UQ UR	US UT	— —
Inside Crimp	Fig 15	Long "LL" Cut "CL"	GB GE	JC JK	GC JH	JL JR	GN GJ	JS JJ	GD JG	JP JB	GF GM	JN JM	— —

NOTE: Popular wire lead form options are described above; consult factory for other available forms.

NOTE: Practical consideration may limit wire options depending on capacitor size - verify special requirements with factory.

Wire Information : #20 AWG .032" (.81) Copper Wire
#22 AWG .025" (.64) Copper Wire
#24 AWG .020" (.51) Copper Clad Steel Wire

PACKAGING OPTIONS:

- Parts will be BULK packaged in cartons or plastic bags unless optional packing is specified.
- Can be optionally TAPE & REELED per EIA-468B or Reverse Reeled. (Fig 16)
- Consult factory for other packaging options, such as Ammo Pack cartons.
- Bar coding is available.

LEAD LENGTH INFORMATION:

- Standard Long Lead "LL" Length = 1.250" (32mm) minimum.
- Cut Lead "CL" Length may be user specified; if unspecified Vishay Cera-Mite supplies 0.187" (4.8mm) EIA standard.
- Cut Lead Lengths are measured from bottom of wire seating plane (wire support point on circuit board).
- Minimum Cut Lead Lengths "CL min" are contained in wire figures 12 thru 15.
- Cut Lead Length Tolerance: +.031"/-.015" (0.8/-0.4mm).

TAPE & REEL OPTIONS

- Radial leaded parts may be ordered with Tape & Reel packaging by adding appropriate suffix code to part number.
  Example: TGS10 QR (Suffix Code) defines: #22 AWG wire; Straight Lead Form; LS = 5mm; Tape & Reel per EIA 468B.

TAPE & REEL PACKAGING- PART NUMBER SUFFIX CODES					TAPE & REEL SUFFIX CODES FOR VARIOUS WIRE FORMS & SIZES											
					FIG. 11 STRAIGHT WIRE			FIG. 12 STEEPLE WIRE		FIG. 13 INLINE WIRE		FIG. 14 STEP WIRE		FIG. 15 INSIDE CRIMP WIRE		
TAPE & REEL FIGURE	LEAD SPACING "LS"	MAX. CAP DIAMETER in.	MAX. CAP DIAMETER mm	TAPE & REEL (NOTE 1)	#20 AWG	#22 AWG	#24 AWG	#22 AWG	#24 AWG	#20 AWG	#22 AWG	#22 AWG	#24 AWG	#20 AWG	#22 AWG	#24 AWG
A	5mm	.490	12.4	C-M	QG	QA	QB	TK	WK	XA	ZA	VC	VQ	RA	RE	RB
				EIA	QH	QR	QD	TR	TX	XB	XN	VZ	VE	RC	RR	LA
B	7.5mm	.530	13.5	C-M	QP	QK	—	—	—	XG	ZC	—	—	RP	RK	—
				EIA	QS	QF	—	—	—	XH	XR	—	—	RX	RL	—
C	10mm	.708	18.0	C-M	QQ	QM	—	—	—	XJ	XS	—	—	RQ	RM	—
				EIA	AP	QX	—	—	—	XK	XT	—	—	RJ	RU	—
D	7.5mm	.708	18.0	C-M	QW	QN	—	—	—	XL	XU	—	—	RW	RN	—
				EIA	AQ	QE	—	—	—	XM	XV	—	—	RV	RD	—

Wire Information : #20 AWG .032" (.81) Tinned Copper Wire
#22 AWG .025" (.64) Tinned Copper Wire
#24 AWG .020" (.51) Tinned Copper Clad Steel Wire

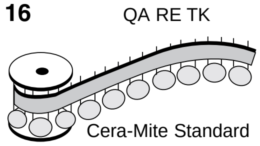
TAPE & REEL (EIA - 468-B)

ITEM (DIMENSIONS IN MM)	CODE	Tape & Reel Packaging FIG A LS=5mm P=12.7mm	FIG B LS=7.5mm P=15mm	FIG C LS=10mm P=25.4mm	FIG D LS=7.5mm P=30mm
Pitch of component	P	12.7	15.0	25.4	30.0
Pitch of sprocket hole	P_0	12.7 ± 0.3	15.0 ± 0.3	12.7 ± 0.3	15.0 ± 0.3
Lead spacing	F	$5.0 {}^{+0.8}_{-0.2}$	7.5 ±1.0	10.0 ± 1.0	7.5 ± 1.0
Length from hole center to component center	P_2	6.35 ± 1.3	7.5 ± 1.5	—	7.5 ± 1.5
Length from hole center to lead	P_1	3.85 ± 0.7	3.75 ± 1.0	7.7 ± 1.5	3.75 ± 1.0
Body diameter	D	See individual product specification			
Deviation along tape, left/right	ΔS	0 ± 1.3	0 ± 2.0		
Carrier tape width	W	18.0 ± 0.5			
Position of sprocket hole	W_1	9.0 ± 0.5			
Height (Fig 11) straight wire	H	$20 {}^{+1.5}_{-1.0}$	$20 {}^{+1.5}_{-1.0}$	$18 {}^{+2.0}_{-1.0}$	$20 {}^{+1.5}_{-1.0}$
Height (Fig 12-15) seating plane	H	16 ± 0.5	16 ± 0.5	16 ± 0.5	16 ± 0.5
Protrusion length	P_3	3.0 Max.			
Dia. of sprocket hole	D_0	4.0 ± 0.2			
Total tape thickness	t_1	0.6 ± 0.3			
Total thickness, tape and lead wire	t_2	1.5 Maximum			
Portion to cut in case of defect	L	11 Maximum			
Hold down tape width	W_0	11.5 Minimum			
Hold down tape position	W_2	1.5 ± 1.5			

EIA lead spacings for tape and reel are based on multiples of .100" (2.5mm) to coordinate with automatic insertion machinery and boards using .100" grid convention.

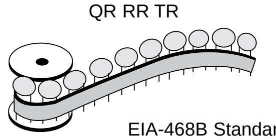
Fig 16

QA RE TK



Cera-Mite Standard

QR RR TR

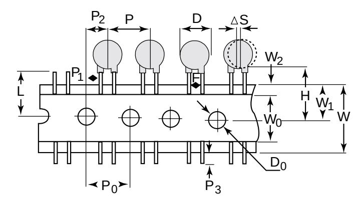


EIA-468B Standard

Note 1 Vishay Cera-Mite standard is a reverse reeled version of EIA 468B.

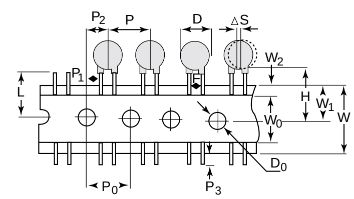
LEAD SPACE	PITCH	CAP DIA.	CAP FAMILY
5mm	12.7mm (0.5")	≤ 12.4mm	≤ 3KVDC

Fig A



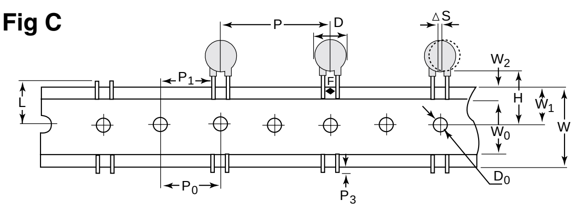
LEAD SPACE	PITCH	CAP DIA.	CAP FAMILY
7.5mm	15mm	≤ 13.5mm	≤ 3KVDC & AC Rated

Fig B



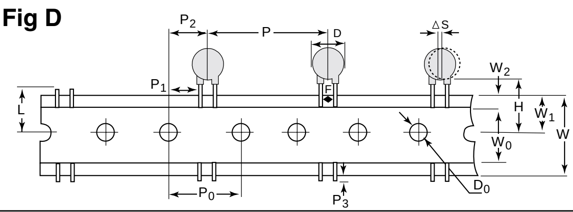
LEAD SPACE	PITCH	CAP DIA.	CAP FAMILY
10mm	25.4mm (1.0")	≤ 18mm	≤ 6KVDC & AC Rated

Fig C



LEAD SPACE	PITCH	CAP DIA.	CAP FAMILY
7.5mm	30mm	≤ 18mm	≤ 6KVDC & AC Rated

Fig D



Heavy Duty High Voltage Capacitors

10 TO 40KV MOLDED EPOXY CASE

DK GENERAL PURPOSE TYPE, EIA CLASS III

APPLICATIONS:

- High Voltage Power Supplies, CRTs, Lasers.
- Smallest Size Available.

KT SPECIAL PURPOSE TYPE, EIA CLASS I

APPLICATIONS:

- High Voltage Power Supplies, CRTs, Lasers.
- Greater Capacitance Stability.
- Features Low DF and Low Heating, Low DC & AC Voltage Coefficient.
- Tighter Tolerance On Capacitance.
- Highest AC Voltage Ratings.

PERFORMANCE CHARACTERISTICS:

Operating Temperature Range: -30°C to +85°C

Storage Temperature Range: -40°C to +100°C

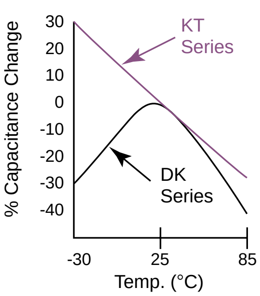
Dielectric Strength: 150% of rated voltage, charging current limited to 50mA.

Insulation Resistance: 200,000 megohms or 1000ΩF minimum at 25°C.

Corona Limit: 50 picocoulombs at rated AC voltage.

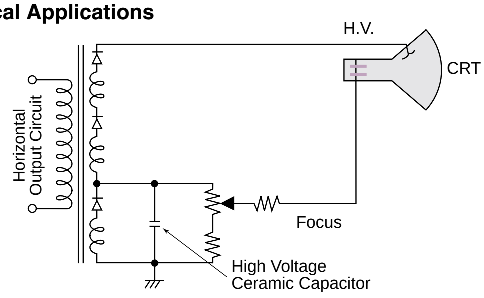
Self Resonant Frequency: Ranges from 50 MHz for small diameters to 10 MHz for large diameters.

Power Dissipation: Limit to 25°C rise above ambient, measured on case.



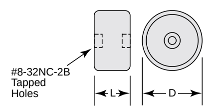
KT Series ceramic material is specially designed to handle AC current, due to low dissipation factor.

Typical Applications



Applications where high dv/dt is present will operate at high peak currents (I_p = dv/dt x C). Capacitors should be evaluated in the actual circuit for dv/dt greater than 2000V/ microsecond. If repetitive, it may be necessary to use a series resistor or other impedance to limit peak currents to safe values.

Fig 17



NOTE: Screw torque limit: 12 inch pounds. Use #8-32, 3/16" long screw to prevent bottoming.

D SIZE CODE	DIAMETER MAX. in.	DIAMETER MAX. mm
A	.880	22.4
B	1.05	26.7
C	1.30	33.0
D	1.55	39.4
E	1.80	45.7
F	2.13	54.1
G	2.30	58.4
H	2.42	61.5

L SIZE CODE	LENGTH MAX. in.	LENGTH MAX. mm
J	.780	19.8
K	.900	22.9
L	1.00	25.4
M	1.18	30.0
N	1.36	34.5

715C Series

TYPE DK CAPACITOR

Class III Y5U Temp. Coefficient
Cap Tol. +80% - 20%
DF: 2% Max @ 1 kHz

15,000 VDC; 4,000 VRMS, 60HZ

CAP pF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
1500	15DKD15	B	K
2000	15DKD20	C	K
3300	15DKD33	D	K
4700	15DKD47	D	K
.01 uF	15DKS10	G	K

20,000 VDC; 5,000 VRMS, 60HZ

CAP pF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
500	20DKT50	A	L
1000	20DKD10	C	L
1300	20DKD13	C	L
2500	20DKD25	D	L
3300	20DKD33	E	L
4700	20DKD47	F	L
6800	20DKD68	H	L

30,000 VDC; 7,000 VRMS, 60HZ

CAP pF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
500	30DKT50	B	N
1000	30DKD10	C	M
2500	30DKD25	D	M
3300	30DKD33	F	M
4700	30DKD47	G	M

40,000 VDC; 9,000 VRMS, 60HZ

CAP pF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
300	40DKT30	A	N
500	40DKT50	B	N
780	40DKT78	C	N
1000	40DKD10	D	N
1600	40DKD16	E	N
2500	40DKD25	F	N
3300	40DKD33	G	N

TYPE KT CAPACITOR

Class I N4700 Temp. Coefficient
Cap Tol. ±20%
DF: 0.2% Max @ 1 kHz

10,000 VDC; 4,000 VRMS, 60HZ

CAP PF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
1000	10KTD10	C	J
2200	10KTD22	D	J
3900	10KTD39	F	J
4700	10KTD47	G	J

15,000 VDC; 6,000 VRMS, 60HZ

CAP pF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
820	15KTT82	C	K
1900	15KTD19	F	K
3300	15KTD33	G	K

20,000 VDC; 8,000 VRMS, 60HZ

CAP pF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
560	20KTT56	C	L
1000	20KTD10	D	L
1900	20KTD19	F	L
2700	20KTD27	H	L

30,000 VDC; 10,000 VRMS, 60HZ

CAP pF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
400	30KTT40	C	M
660	30KTT66	D	M
1200	30KTD12	F	M
1800	30KTD18	H	M

40,000 VDC; 13,000 VRMS, 60HZ

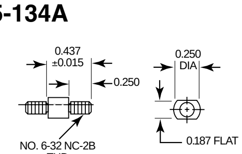
CAP pF	CATALOG NUMBER	SIZE D CODE	SIZE L CODE
300	40KTT30	C	N
640	40KTT64	E	N
1000	40KTD10	F	N
1300	40KTD13	H	N

TERMINAL ADAPTORS

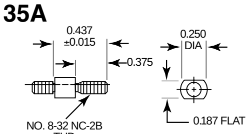
#8-32NC-2B Adapters.
Order separately as required.

All tolerances ±0.010 unless specified.

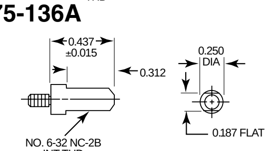
75-134A



75-135A



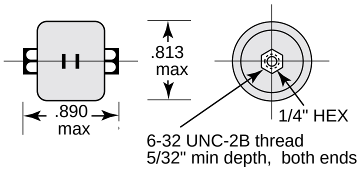
75-136A



Specialty High Voltage Items
RF Duty Capacitors

5 AND 7.5 KVDC - 1.5 TO 10 AMPERES

Body Style A

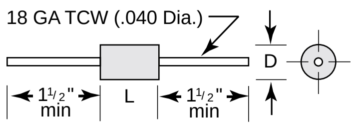


CAPACITANCE RANGE BY TEMPERATURE CHARACTERISTIC

Voltage	Value	T.C.
5 KVDC - 7.5 KVDC	5 - 65 pF	NP0
5 KVDC - 7.5 KVDC	50 - 150 pF	N750
5 KVDC	500 - 1,000 pF	X5U

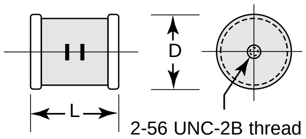
T.C.= Temperature Characteristic per EIA 198

Body Styles C, D and E



CAPACITANCE RANGE BY TEMPERATURE CHARACTERISTIC

Cera-Mite Body Style	Length ±.031	Dia. ±.031	KVDC	NP0	N750
C	.343	.250	5 KV	1-7 pF	8-10 pF
D	.375	.375	5 KV	5-10 pF	15-25 pF
E	.437	.500	5 KV	7-30 pF	34-45 pF



Body Styles F, G and H

2-56 UNC-2B thread 1/8" min. depth, both ends

CAPACITANCE RANGE BY TEMPERATURE CHARACTERISTIC

Cera-Mite Body Style	Length ±.031	Dia. ±.031	KVDC	NP0	N750
F	.390	.312	5 KV	1-7 pF	8-10 pF
G	.422	.437	5 KV	5-10 pF	15-25 pF
H	.484	.562	5 KV	7-30 pF	34-45 pF

Vishay Cera-Mite RF duty high voltage capacitors are designed to be used in circuits which operate at radio frequency. They are capable of handling high RF currents and voltages. Geometry minimizes inductance, optimizes voltage withstand and maximizes heat radiation. Applications include radio transmitters, antenna couplers, induction heaters and similar apparatus.

- **DIELECTRIC STRENGTH:** 150% of rated DC voltage.
- **INSULATION RESISTANCE:** 100,000 megohms
- **DISSIPATION FACTOR:** 0.1% to 0.2% for NP0 and N750. 0.5% for X5U.
- **ENVIRONMENTAL DESIGN CRITERIA:** EIA 198.

TYPICAL APPLICATION DATA FOR POPULAR CAPACITANCE VALUES

Value	T.C.	Std. Cap. Tolerance	Cera-Mite Part No.	Max. A.C. Volts (Peak KV)	Max. A.C. Current (RMS) Amps.	Max.VA (KVAR)*
25 pF	NP0	±10%	7FAA250K	7.5	5.5	7.0
50 pF	NP0	±10%	7FAA500K	7.5	8.0	8.0
50 pF	N750	±10%	7FAU500K	7.5	8.0	8.0
75 pF	N750	±10%	7FAU750K	7.5	9.0	8.0
100 pF	N750	±10%	7FAU101K	7.5	9.2	9.0
1,000 pF	X5U	±20%	5FAE102M	5.0	3.7	0.2

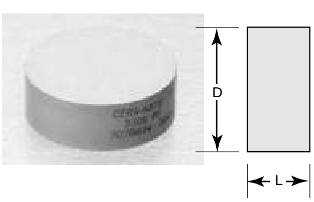
TYPICAL APPLICATION DATA FOR POPULAR CAPACITANCE VALUES

Value	T.C.	Std. Cap. Tolerance	Body Style	Cera-Mite Part No.	Max. A.C Volts (Peak KV)	Max. AC Current (RMS) Amps.	Max. VA (KVAR)*
3 pF	NP0	±10%	C	5FCA3R0K	5.0	1.5	2.3
5 pF	NP0	±10%	C	5FCA5R0K	5.0	1.6	3.8
10 pF	N750	±10%	C	5FCU100K	5.0	2.3	4.2
10 pF	NP0	±10%	D	5FDA100K	5.0	2.3	4.2
20 pF	N750	±10%	D	5FDU200K	5.0	3.4	7.6
20 pF	NP0	±10%	E	5FEA200K	5.0	3.4	7.6
40 pF	N750	±10%	E	5FEU400K	5.0	3.5	7.8
3 pF	NP0	±10%	F	5FFA3R0K	5.0	1.5	2.3
5 pF	NP0	±10%	F	5FFA5R0K	5.0	1.6	3.8
10 pF	N750	±10%	F	5FFU100K	5.0	2.3	4.2
10 pF	NP0	±10%	G	5FGA100K	5.0	2.3	4.2
20 pF	N750	±10%	G	5FGU200K	5.0	3.4	7.6
20 pF	NP0	±10%	H	5FHA200K	5.0	3.4	7.6
40 pF	N750	±10%	H	5FHU400K	5.0	3.5	7.8

*At rated voltage.
Data presented is based on a maximum case temperature rise of 30°C at 25°C ambient in free air.

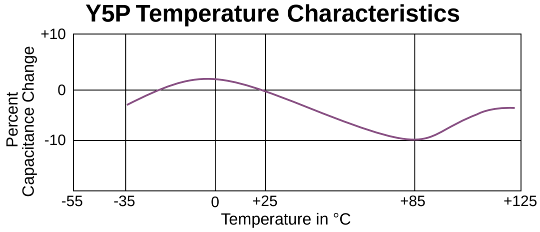
Unencapsulated, Temperature Stabilized
20 to 40 KVDC, 6 to 12 KVAC

722C SERIES



D: .980" (25mm) to 2.15" (54.6mm)
L: To suit application, typically .400" (10.0mm) to .800" (20.3mm)

Y5P Temperature Characteristics



Vishay Cera-Mite 722C type offers a temperature stabilized capacitor where capacitance stability over wider temperature ranges are needed.

This product is usually furnished unencapsulated for use in very high voltage capacitor assemblies utilizing capacitors in series, with very high BIL ratings. Typical applications are power circuit breakers, lightning arrestors, power transformers and metering, and medical laser technology.

The user must take all responsibility for mechanical and environmental protection against chipping, moisture and contamination. The capacitor must be enveloped in a suitable enclosure of oil, pressurized gas or equivalent.

- **DIELECTRIC STRENGTH:** 150% of rated voltage, charging current limited to 50mA
- **DISSIPATION FACTOR:** 2.0% max. at 1kHz
- **CAPACITANCE RANGE:** 20KVDC, 750 pF thru 3700pF
  30KVDC, 500 pF thru 2500pF
  40KVDC, 380 pF thru 1800pF

Fabmika® Capacitors

When applications extend beyond the capability of ceramic capacitors, consider Vishay Cera-Mite's Fabmika high voltage mica film technology. Offering high voltage and Hi-Rel packaging, it is applied in single or network designs.

Fabmika® capacitors are generally made over the range of .001μF to 1.0μF and 1500VDC to 30KVDC. Product is supplied either unencapsulated, polyester film wrapped and end potted, fiberglass epoxy housed or epoxy molded.

AEROSPACE & ELECTRICAL POWER APPLICATIONS:

- Military Aircraft Radar Transmitters
- Jet Engine Ignitors
- Missile Destruct Systems
- Pulse Forming Networks
- Power Generation Commutating Capacitors

APPLICATION CONSIDERATIONS

- **VOLTAGE & CURRENT STRESS ON DIELECTRICS:** The specified operating DC rating for the mica capacitor is that voltage which the capacitor can withstand continuously at rated temperature. The current is limited to a very small value equal to the leakage current, determined by the IR. In the case of an applied AC voltage, the capacitor dielectric must withstand both RMS voltages, peak voltage and peak-to-peak voltages. Each application must be considered carefully.

  In AC, there are both continuous currents and transient currents that can generate steady state heating and localized heating. The steady state heating would be the function of the continuous repetitive wave form or equivalent duty cycle. The transient currents are a function of the dv/dt and di/dt of the wave form or pulses.

  For any AC application, the user should define the wave forms and duty cycle at the time of request for quotation.

  An important factor governing a mica capacitor's ability to withstand current surges is the amount of electrical tab area. In high peak current applications, the tab area is increased to prevent erosion between the aluminum electrode foil and connecting tab.

- **THERMAL STRESS:** Even though mica capacitors have low losses relative to other types of capacitors, internal thermal heating is often the limiting factor in high-frequency applications. The capacitor temperature due to internal heating plus the ambient temperature should not exceed the maximum allowable operating temperature.

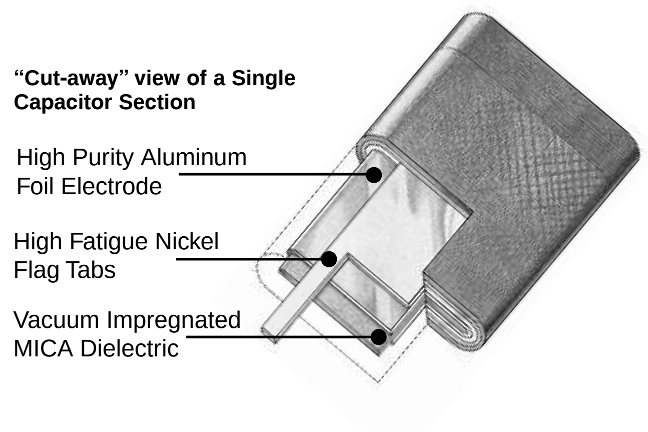
  $$\text{Power Dissipation} = (I_{RMS})^2 \times \text{ESR}$$

- **EQUIVALENT SERIES RESISTANCE:** ESR of the capacitor includes a frequency dependent factor which reflects the losses in the dielectric material and other internal losses.

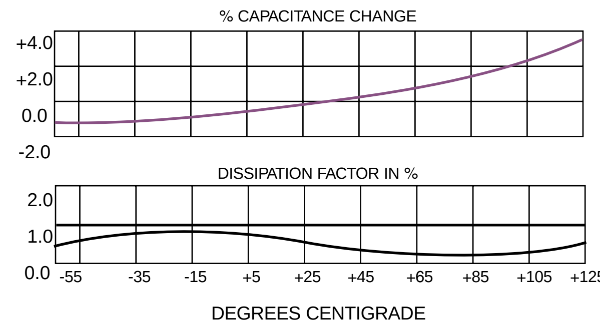
  $$\text{Approx. ESR} = \frac{\text{D.F.}}{2\pi fC}$$

  The design may have to be made larger to increase the power dissipation for high-frequency design.

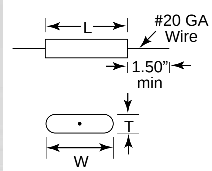
- **INDUCTANCE:** Fabmika capacitors have inductance (50 to 250 nano henrys), proportional to voltage and capacitance rating.



CAPACITANCE AND DISSIPATION FACTOR VS. TEMPERATURE



224M SERIES



This product consists of one section, available either unencapsulated or wrapped with polyester film tape and end potted with epoxy compound. The 224M offers the smallest volume part available. Wire leads or ribbon leads are terminations available.

Standard Ratings and Sizes:

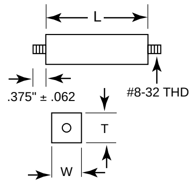
1500 Volts DC Working • Cap Range of 0.01μF to 1.0μF
1.50"L x 0.50"W x 0.105"T to 5.13"L x 2.00"W x 0.310"T

3000 Volts DC Working • Cap Range of 0.01μF to 1.0μF
1.50"L x 0.75"W x 0.155"T to 5.13"L x 3.50"W x 0.495"T

5000 Volts DC Working • Cap Range of 3300pF to 0.33μF
2.63"L x 0.75"W x 0.175"T to 5.13"L x 3.50"W x 0.600"T

7500 Volts DC Working • Cap Range of 1500pF to 0.15μF
2.63"L x 0.75"W x 0.190"T to 5.13"L x 3.50"W x 0.500"T

305M SERIES



This product is the bare impregnated section, available in a laminated epoxy fiberglass housing. The assembly is then potted with an epoxy compound. The 305M offers the greatest environmental protection available. Terminations can be wire leads or threaded studs.

Standard Ratings and Sizes:

5KV DC Working • Cap Range of 0.001µF to 0.1µF
1.56"L x 0.53"W x 0.53"T to 2.75"L x 1.03"W x 1.03"T

10KV DC Working • Cap Range of 500pF to 0.05µF
2.25"L x 0.63"W x 0.63"T to 4.25"L x 1.35"W x 1.35"T

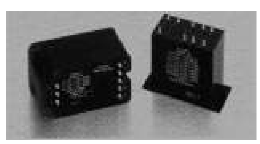
20KV DC Working • Cap Range of 500pF to 0.01µF
2.75"L x 0.63"W x 0.63"T to 4.25"L x 1.03"W x 1.03"T

30KV DC Working • Cap Range of 500pF to 0.01µF
4.00"L x 0.88"W x 0.88"T to 5.50"L x 1.35"W x 1.35"T

221M SERIES

Power Utilities
High BIL for measurements. Dual 0.3µF, 1400 VRMS commutating capacitors for brushless exciters.

High Energy Storage
For radar and guidance transmitters.



Network Capability
With multiple voltages and capacitance value

The rugged 221M Series offers a high voltage, high current capability multiple capacitor network in a single package. This single pretested device can internally house several capacitors of different values and voltage ratings or combine units in series-parallel combinations. Rugged electrical and mechanical packaging can be configured to allow curved surfaces, special mounting and irregular shapes, while offering superior strength and reliability. Such features lead to greater utilization of space and in many cases, lighter weight capacitor assemblies.

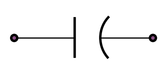
Either a single section or an assembly of sections may be epoxy encapsulated utilizing a metal or epoxy mold. Terminations can be wire leads, turret terminals, threaded studs or inserts, or high voltage connectors.

221M Series is available in voltages from 1500 VDC to 200 KVDC; and capacitance values of .001µF to 10µF.

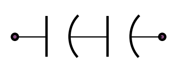
TYPICAL PERFORMANCE CHARACTERISTICS

Parameter	Specification	MIL-STD-202
Capacitance	At 25°C & 1kHz	Method 305
Dissipation Factor	0.5% max @ 25°C & 1kHz 0.8% max @ 125°C & 1kHz	Method 306
Insulation Resistance	5G ohms-uF minimum @ 25°C 20M ohms-uF minimum @ 125°C	Method 302 Test Condition B
Dielectric Withstanding Voltage	200% of rated DC voltage	Method 301
ACrms, 60Hz Voltage Rating	30% of rated DC voltage	Method 301
Temperature Range	-55°C to +125°C	—
Voltage Derating	No voltage derating required below +125°C	—
Capacitance Change	±4% max over the range of -55°C to +125°C (see curve)	—
Humidity Resistance (not applicable to bare sections)	Capacitance, DF and IR shall meet initial requirements	Method 103B
Moisture Resistance (not applicable to 224M style)	Capacitance, DF and IR shall meet initial requirements	Method 106F Test Condition B
Immersion (not applicable to 224M style)	Capacitance, DF and IR shall meet initial requirements	Method 104A Test Condition B
Temperature Cycling	Examine for physical damage	Method 107G Test Condition A
Vibration	No opens or shorts greater than 0.5 milliseconds	Method 201A and 204D
Shock	No opens or shorts greater than 0.5 milliseconds	Method 205E
Solderability	95% wetted by new solder	Method 208F
Terminal Strength	No evidence of breaking or loosening of the terminals	Method 211A

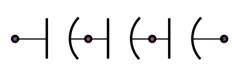
TYPICAL SECTION ARRANGEMENTS



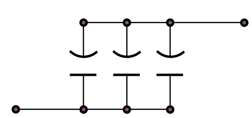
Single Section
CV Product (KV x µF) = .25 max
Max Voltage = 5KVDC
Corona Start Voltage = 500Vrms, 60 Hz



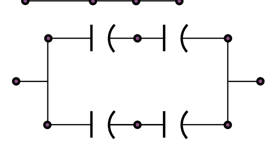
Split-Wound Section
CV Product (KV x µF) = .25 max
Max Voltage = 15KVDC
Corona Start Voltage = 1000Vrms, 60 Hz



Sections in Series
For voltages over 10KVDC



Sections in Parallel
For CV Product over .25µF•KV



Sections in Series/Parallel
For Applications Requiring High Voltage and Large Capacitance

WORLDWIDE SALES CONTACTS

DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS

THE AMERICAS	**VISHAY AMERICAS** ONE GREENWICH PLACE SHELTON, CT 06484 UNITED STATES PH: +1-402-563-6866 FAX: +1-402-563-6296
ASIA	**VISHAY INTERTECHNOLOGY ASIA PTE LTD.** 25 TAMPINES STREET 92 KEPPEL BUILDING #02-00 SINGAPORE 528877 PH: +65-6788-6668 FAX: +65-6788-0988
JAPAN	**VISHAY JAPAN CO., LTD.** SHIBUYA 3F, GE EDISON BUILDING 3-5-16 SHIBUYA SHIBUYA-KU TOKYO 150-0002 JAPAN PH: +81-3-5464-6411 FAX: +81-3-5464-6433
EUROPE	**VISHAY ELECTRONIC GmbH** GEHEIMRAT-ROSENTHAL-STR. 100 95100 SELB GERMANY PH: +49-9287-71-0 FAX: +49-9287-70435 **VISHAY S.A.** 4, RUE DE SALONIQUE 95101 ARGENTEUIL FRANCE PH: +33-1-39-98-22-00 FAX: +33-1-39-98-22-05 **VISHAY LTD.** PALLION INDUSTRIAL ESTATE SUNDERLAND, SR4 6SU GREAT BRITAIN PH: +44-191-514-4155 FAX: +44-191-567-8262

ONLINE INFORMATION

For product information and a current list of sales reps and distributors, visit our website:

www.vishay.com

MANUFACTURER OF THE WORLD'S BROADEST LINE OF DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS

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Malvern, PA 19355-2143

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