



Introduction



- Purpose
 - Provide a general introduction to KEMET 900 series safety certified disc capacitors, including certification requirements and typical applications.
- Objectives
 - What are “X” and “Y” class devices?
 - Basic purpose and application.
 - Define sub-classes.
 - Define “combination” designations
 - Preformed lead configurations
 - Construction
 - Certification, marking and conformity
 - Testing requirements capacitors must meet for certification.
- Content
 - 12 pages
- Learning Time
 - 20 minutes

Welcome to KEMET Electronics Corporation’s introduction to ceramic Safety Certified Disc Capacitors training module. This training module is designed to provide a basic overview of Safety Certified Disc Capacitors as well as those offered by KEMET. This module will also provide a general overview of capacitor class definitions, testing requirements, and general application information

What are Safety Certified Capacitors?

Electronic Components
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- AC voltage rated
- Designed to suppress line interference
 - Impulses
 - Transients
 - Surges
 - Dips
- Provide protection
 - Prevent risk of shock
 - Prevent risk of fire

 **SAFETY CAP**
CIRCUIT PROTECTION

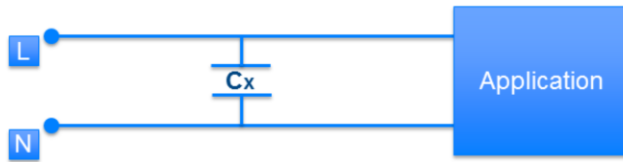


Safety Certified Capacitors are generally designed and used for AC line filtering in many electronic devices and appliances. These capacitors are also known as EMI/RFI suppression capacitors or AC Line filter safety capacitors. They prevent equipment and machinery from sending and receiving electromagnetic and radio frequency interference. Because of their direct connections to AC lines, capacitor failure can sometimes result from exposure to over-voltages and transients. Failure of an capacitor in an across-the-line connection would not cause electrical shock, but it could open safety fuses or circuit breakers and cause fire. In line-to-ground, a failure can lead to a potentially fatal electric shock because of the loss of the ground connection. Various safety agencies closely monitor the performance of safety capacitors by subjecting them to impulse voltage tests, endurance tests and active flammability tests in order to ensure the performance and reliability of these devices.

Safety Capacitor Classifications

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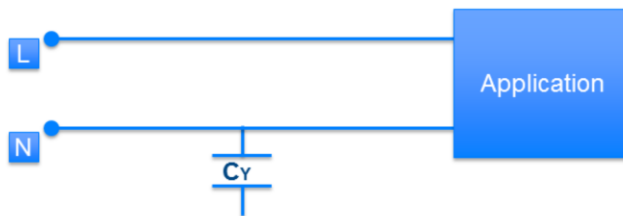
Class X Capacitor (Line-to-Line)



Failure could result in fire



Class Y Capacitor (Line-to-Ground)



Failure could result in electric shock



Safety Certified Capacitors are classified as either X and/or Y according to their rated voltage and the peak impulse voltage they can safely withstand. Class X capacitors are primarily used in line-to-line (across-the-line) applications. In this application, there is no danger of electric shock to humans should the capacitor fail, but could result in a risk of fire. The Class Y capacitor is primarily used in line-to-ground (line by-pass) applications. In this application, failure of the capacitor could lead to danger of electric shock.

Safety Capacitor Sub-Classifications



Class X Capacitor Subclass

Sub-Class	X1
Impulse Test Voltage (Peak Test Voltage)	4.0kV
Peak service voltage V_p	$2.5kV < V_p \leq 4.0kV$
Applications	Permanent connections to fixed installations High pulse applications

Safety capacitors are grouped into a number of different sub-classes. For X Type capacitors there are sub-classes X1, X2 and X3. For Y Type capacitors there are sub-classes Y1, Y2, Y3 and Y4.

For X Type capacitors, KEMET offers sub-class X1 devices. Application voltages range from 400 to 760 VAC (nominal). Sub-class X1 capacitors are typically used in permanent connections to fixed installations. This also includes both three-phase distribution and single-phase commercial lighting. To meet safety standard requirements, sub-class X1 capacitors must be impulse tested to 4.0 kV.

Safety Capacitor Sub-Classifications



Class Y Capacitor Subclasses

Sub-Classes	Y1	Y2
Rated Voltage	250, 400, 500 VAC	250 or 300 VAC
Type of Bridged Insulation	Double or reinforced	Basic or supplemental
Impulse Test Voltage	8.0kV	5.0kV

For Y Type capacitors there are sub-classes Y1, Y2, Y3 and Y4.

Of these sub-classes, KEMET offers Y1 and Y2. Y1 application voltages range from 250 to 500 VAC (nominal), while Y2 application voltages range from 250 to 300 VAC (nominal). There are many equipment standards which define the grade of insulation required to protect an end user from electrical shock. Insulation grades include “basic,” “supplementary,” “reinforced” and “double.” These categories are used for all types of insulating materials which separate exposed conductive elements from dangerous voltages. This includes Y capacitors which are allowed to bridge the insulation. Sub-class Y1 capacitors are typically used to bridge “reinforced” or “double” insulation grades. Sub-Class Y2 capacitors are typically used to bridge “basic” and “supplementary” insulation grades.

To meet safety standard requirements, sub-class Y1 and Y2 capacitors must be impulse tested to 8 kV and 5 kV respectively.

Safety Disc Capacitors

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900 Series Safety Standard Disc Capacitor

X1 400 VAC / Y1 250 VAC
X1 400 VAC / Y1 400 VAC
X1 760 VAC / Y1 500 VAC
X1 400 VAC / Y2 250 VAC
X1 440 VAC / Y2 300 VAC

Dielectrics	SL, Y5P, Y5U, Y5V
Cap Range	10 pF – 10 nF
Lead Spacing	5.0 mm, 7.5 mm, 10mm



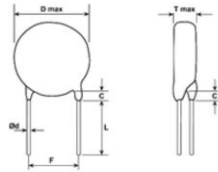
KEMET 900 Series Safety Disc Capacitors are offered with a combination designation such as X1/Y1. This simply indicates that the capacitor can be used as an X1 capacitor in a line-to-line application, or as a Y1 capacitor in a line-to-ground application. KEMET offers both X1/Y1 and X1/Y2 class combinations.

As the dielectric constant of specific dielectric material limits available capacitance values, KEMET 900 Series devices are available in a wide range of dielectric materials to accommodate capacitance offerings ranging from 10 pF up to 10 nF (0.01 microfarads). Lead spacing options include 5.0 mm, 7.5 mm and 10 mm.

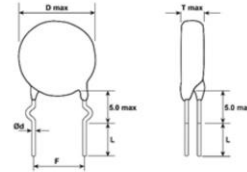
Preformed Lead Configurations



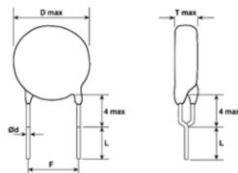
Straight



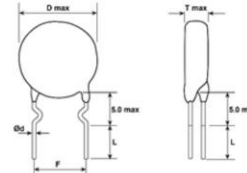
Outside Kink



Vertical Kink

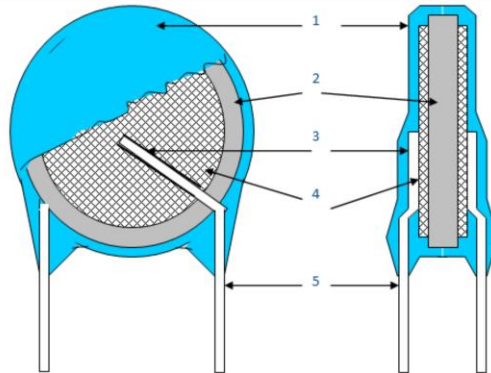


Inside Kink



KEMET 900 Series devices are also available in a variety of preformed lead configurations. Most combination designations (X/Y) are available in “Straight,” “Vertical Kink” and “Outside-Kink” configurations. We also offer an “Inside Kink” configuration on the X1/Y2 class designation devices. However, due to a high risk of arcing, the “Inside Kink” lead configuration option cannot be combined with 5 mm lead spacing. The “Inside Kink” option is only available on devices with lead spacing of 7.5 mm or 10 mm.

Construction



	Description	Material	Component
1	Insulation coating	Epoxy polymer	Epoxy resin (Blue / UL 94 V-0)
2	Dielectric element	Ceramic	BaTiO ₃
3	Solder	Tin-silver	Sn96.5-Ag3-Cu0.5
4	Electrodes	Ag	Silver glass frit
5	Lead wire	Tinned copper clad steel wire	Substrate metal: Fe & Cu Surface plating: 100% Sn

KEMET 900 Series devices are manufactured using single layer disc construction. Each capacitor is encapsulated in an epoxy resin that meets the flame test requirements outlined in UL Standard 94V-0. All devices are manufactured using halogen-free and RoHS compliant materials meeting all the requirements set forth by both EU and China RoHS directives.

Safety Certification



- KEMET 900 Series Capacitors are VDE certified per standard IEC60384-14
- All 900 Series devices will bear the VDE/ENEC Mark
 - European Conformity
 - Certification by other bodies no longer required



- UL and CSA certification is not required
 - UL 1414 was replaced by UL 60384-14
 - UL adopted IEC standard with deviations on Dec 25, 2013

KEMET 900 Series devices have received certification through VDE per International Standard IEC60384-14. All product will bear both the ENEC 10 and VDE conformity markings. Aside from the well-known VDE mark, the ENEC mark is the European conformity mark. Certification bodies of other European states are obliged to treat products rightfully bearing the ENEC Mark in the same way as if they had granted the ENEC Mark themselves. Certification by another body is no longer required. Thus, the ENEC Mark serves the free movement of goods in the European Economic Area including Switzerland and increasingly also in the markets of Eastern Europe.

EN: European Norms

EC: Electrical Certification

10: Identification No. of the certification body VDE

KEMET 900 Series devices do not have UL or CSA certifications. It is not necessary to have these certification in order to sell and distribute products in the United States and Canada respectively. Canada (CSA) has recently adopted International Safety Standard 60384-14 (with deviations), and the United States (UL) replaced its current standard UL1414 with 60384-14 (with deviations) on December of 2013.

900 Series Ordering Information



Ceramic Series	Body Dia.	Lead Spacing	Spec.	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage	Dielectric/Temp. Char.	Design	Lead Configuration	Failure Rate
C9	3	1	U	101	J	V	S	D	A	A
C9 = Ceramic 900 Series	0 = 7.0mm 1 = 8.0mm 2 = 9.0mm 3 = 10.0mm 4 = 11.0mm 5 = 12.0mm 6 = 13.0mm 7 = 14.0mm 8 = 15.0mm	5 = 5.0mm 7 = 7.5mm 1 = 10.0 mm	U = Safety	2 significant digits + Number of zeroes	J = $\pm 5\%$ K = $\pm 10\%$ M = $\pm 10\%$	U = X1 400VAC/ Y1 250VAC V = X1 400VAC/ Y1 400VAC W = X1 760VAC/ Y1 500VAC Y = X1 400VAC, Y2 250VAC Z = X1 440VAC, Y2 300VAC	S = SL (-1000 \rightarrow +350ppm/°C) Y = Y5P ($\pm 10\%$) W = Y5U (+20% to -55%) V = Y5V (+30% to -80%)	D = Disc	A = Straight B = Vertical Kink C = Outside Kink D = Inside Kink	A = N/A

900 Series capacitors are available in a variety of dielectrics, body sizes, and popular lead spacing options. The ordering code (scheme) is similar to most KEMET through-hole ceramic capacitor products. The first two characters clearly identify the 900 product series. The fifth character position of the ordering code identifies safety certified product. Please reference product bulletins (catalogs) and datasheets to verify lead-spacing, lead-configuration and packaging option availability.

Summary

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Safety Standard Recognized

X and Y Classification

High Reliability

400 VAC – 760 VAC Rated (Class X)

250 VAC – 500 VAC Rated (Class Y)

SL, Y5P, Y5U and Y5V Dielectrics

5.0 mm, 7.5 mm and 10 mm Lead Spacing



KEMET 900 Series Safety Certified Capacitors are designed and used for AC line filtering in many electronic devices and appliances. Their main function is to suppress electrical noise and provide protection against electrical shock and fire. KEMET 900 Series capacitors are offered with a combination designation of both X1 /Y1 and X1/Y2 classes and are available in a wide range of dielectrics materials to accommodate capacitance offerings ranging from 10 pF up to 10nF (0.01 microfarads). Lead spacing options include 5.0 mm, 7.5 mm and 10 mm. KEMET 900 Series devices have received certification through VDE per International Standard IEC60384-14 and will bear both the ENEC 10 and VDE conformity markings.

www.kemet.com/safety/ceramic

For more information on KEMET's 900 Series safety certified capacitors, please visit our microsite @ www.kemet.com/safety/ceramic.