



## Introduction to Safety Certified Capacitors



## Introduction

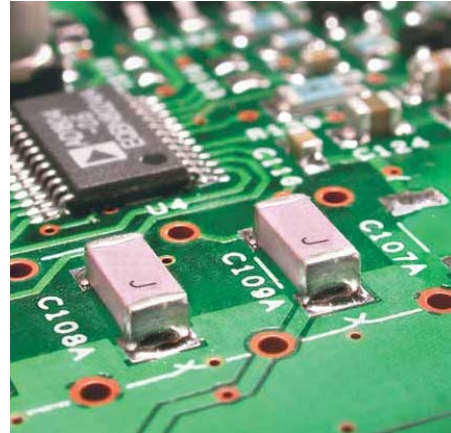
- Purpose:
  - Provide an introduction to Safety Certified Capacitor requirements and applications
- Objectives:
  - Provide an overview of the testing requirements the capacitors must meet for certification
  - Describe the applications and circuits where the capacitors are used
- Content
  - 10 pages

This training module is designed to offer a quick overview of the Safety Certified Capacitors offered by Johanson Dielectrics. This will include definitions, testing requirements, and application information.



## Introduction

- Safety Certified Capacitors are high voltage capacitors designed for:
  - AC voltage conditions (commonly 250 VAC).
  - High voltage impulses, transients, or surges.
- These capacitors shunt the energy to ground, protecting the circuit and the user from any high voltage surge.
- Johanson offers capacitors certified to IEC 60384-14, IEC 60950, and UL 60950



Safety Certified Capacitors are application specific high voltage capacitors that are designed to withstand AC voltage conditions and high voltage impulses. These capacitors shunt the energy from an impulse to ground, providing protection for the circuit as well as the end user. The capacitors offered by Johanson Dielectrics are rated 250VAC, and are certified to IEC 60384-14, IEC 60950, and UL 60950.



## Safety Capacitor Definitions

Safety Capacitors are classified according to their use in the circuit:

- X Capacitor: for use in line to line applications. In this application failure would not lead to danger of electric shock
- Y Capacitor: for use in line to ground applications. In this application failure could lead to danger of electric shock

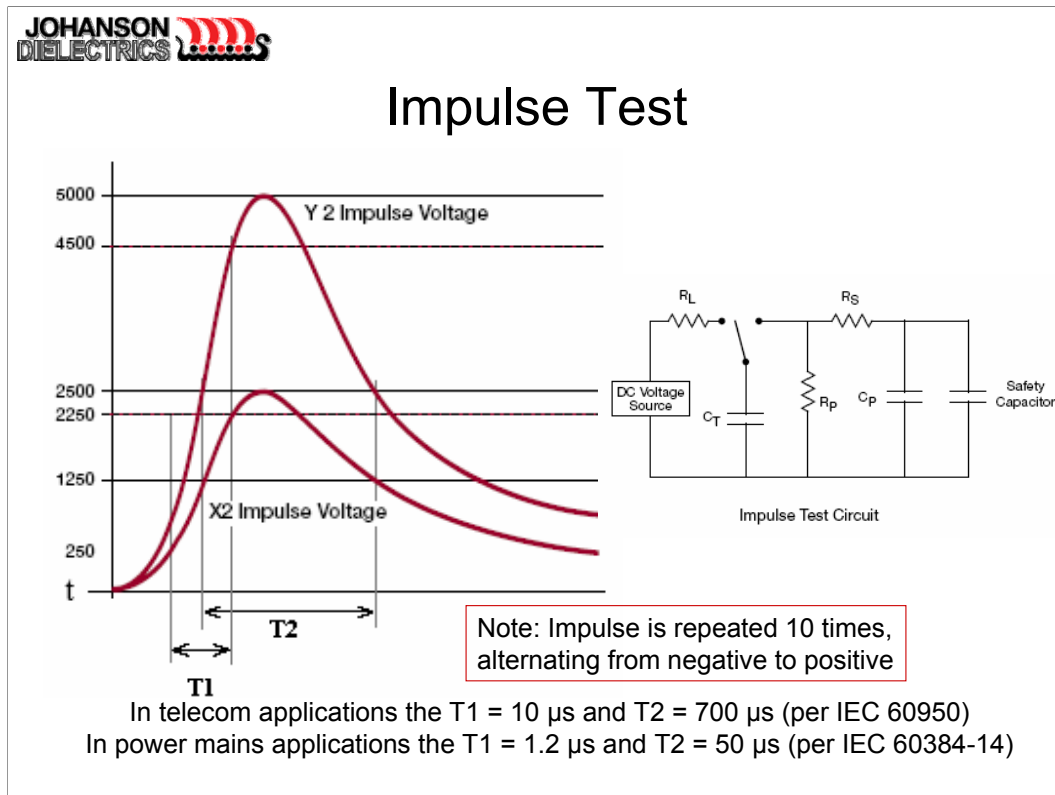
Rating	Rated Voltage AC	Dielectric Withstanding Voltage	Impulse Voltage
Y2	250VAC	1500VAC at 60Hz	5000V
Y3	250VAC	1500VAC at 60Hz	None
X1	250VAC	1500VAC at 60Hz	4000V
X2	250VAC	1500VAC at 60Hz	2500V

Table 1

Safety Certified Capacitors are classified either as X or Y capacitors. An X capacitor is for use in line to line applications. In this applications there is no danger of electric shock to humans. A Y capacitor is for use in line to ground applications. In this application failure could lead to danger of electric shock.

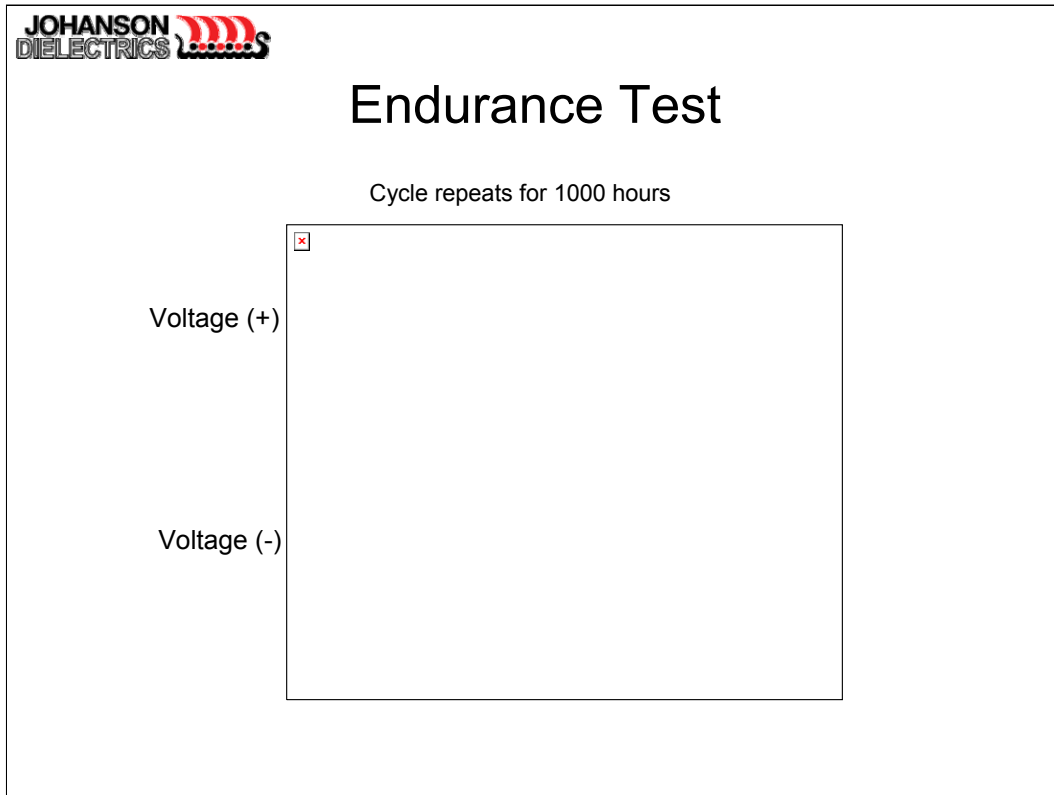
Beyond the X and Y rating, there is also a number that indicates the capability of the part. For example a Y2 rated capacitors are rated at 5000V impulse rating, and an X2 rated capacitors are rated at 2500V impulse.

Johanson Dielectrics offers either X2/Y3 or X1/Y2 rated capacitors. For example, if a capacitor is rated X1/Y2 it is suitable for use as a Y2 capacitor in line to ground applications, or as an X1 capacitor in line to line applications.




As mentioned in the previous slide, Safety Certified Capacitors are rated according to their impulse capability. Impulses are usually identified by their rise times ( $T1$ ) and their time to half value ( $T2$ ), and they are described as  $T1/T2$  impulses (for example 1.2/50us impulse). The rise time is the time it takes the pulse to go from 10% to 90% of the peak voltage.  $T2$  is the half value time and is the time it takes the voltage to go from 50% of the peak back to that same level.

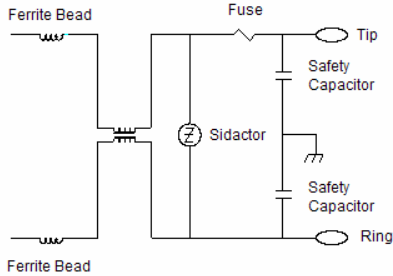
Different applications have different impulse requirements. Johanson Dielectrics Safety Certified Capacitors are suitable for applications requiring 10/700us impulse for telecom applications per IEC 60950 and UL 60950 as well as 1.2/50us impulse per IEC 60384-14 for AC line applications.



During the certification process, the capacitors are subjected to ten impulses of alternating polarity. After that an endurance test is performed. This test is to confirm that the capacitors can withstand multiple impulses and still perform reliably under AC voltage conditions. The endurance test is an AC life test at 425VAC / 60Hz, and every hour a 1000VAC voltage is applied for 0.1 seconds. The length of this test is 1000 hours.

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## RJ11 Application: EMI Filtering



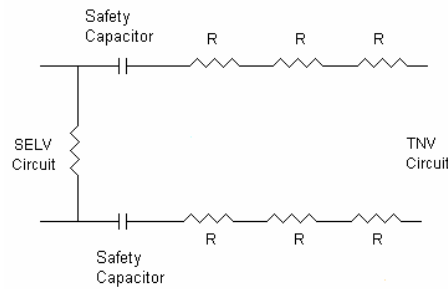
- Applications: DSL and dial up modems, VoIP phones, set top boxes, point of sales terminals and fax machines.
- Capacitors are used for filtering EMI from Tip and Ring lines to ground to meet EN 55024 requirements
- Capacitors bridge the isolation barrier and must withstand high impulse voltages in case of a power surge.

Safety Certified Capacitors are used in large quantities in telecom applications utilizing RJ11 (standard phone line) connections. These applications include DSL and dial up modems, set top boxes, VoIP phones, point of sales terminals and fax machines.

In this kind of application Safety Certified Capacitors are used in two circuits. The first one is for filtering EMI from the Tip and Ring lines to ground. A telephone line carries a lot of noise and must be filtered to meet EN 55024 requirements. The capacitors are used as EMI filters in this case, but since they bridge the isolation barrier between line and ground they must be able to withstand any high impulse voltages that may come down the line. The capacitance values used in this circuit are usually between 100pF and 1000pF



## RJ11 Application: Isolation

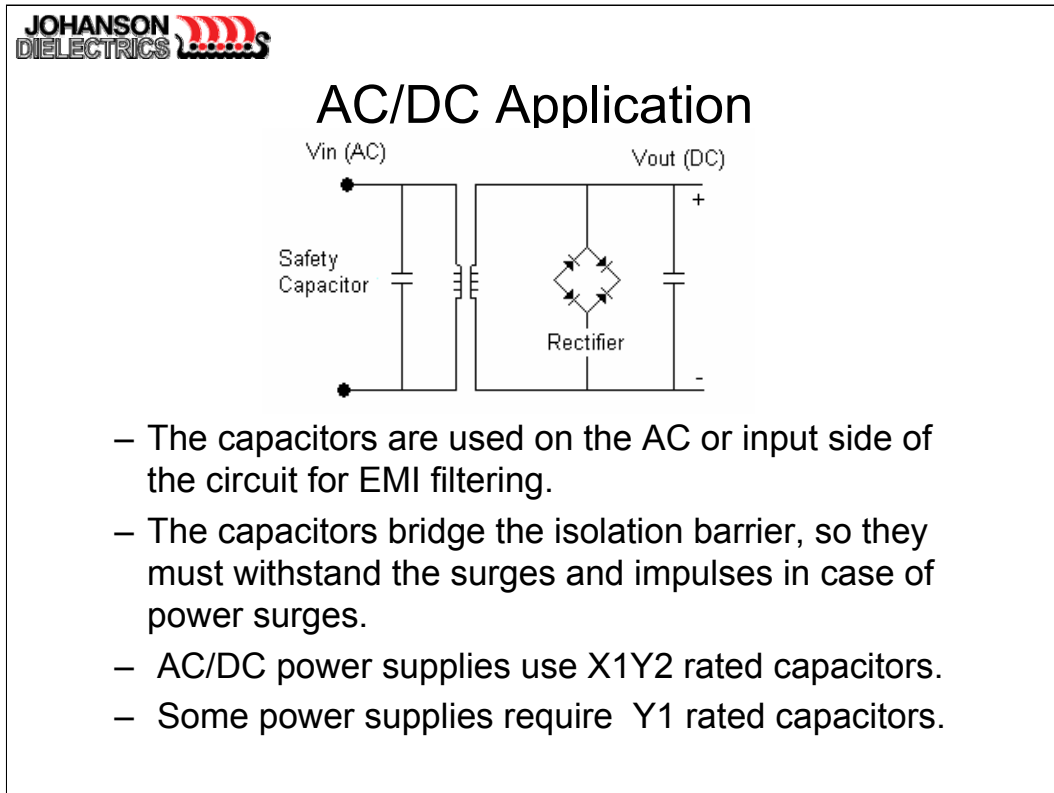


- The capacitors are used for isolation between Telecom Network Voltage (TNV) and protective earth (SELV).
- RJ11 applications use either X2Y3 or X1Y2 rated capacitors

The second circuit where Safety Certified Capacitors are used is the isolation circuit. The capacitors are used for isolation between the Telecom Network Voltage (sometimes called TNV) and protective earth (sometimes called SELV). The values used in this circuit are usually less than 100pF.

RJ11 applications use either X2/Y3 or X1/Y2 rated capacitors. The X1/Y2 capacitors offer higher surge immunity and can reduce the number of failures in the field due to surges on the line. That is why some companies use them as the higher part cost is justified by the reduction in field failures.





Another important application for Safety Certified Capacitors is in AC/DC power supplies. The capacitors are used on the AC or input side of the circuit for EMI filtering. Like phone lines, AC power lines carry a lot of noise as well as surges and transients. The capacitors bridge the isolation barrier, so they must withstand the surges and impulses in case of power surges.

AC/DC power supplies require the use of X1/Y2 rated capacitors. Some power supplies require Y1 rated capacitors, which are not available on the market in a surface mount package. The only surface mount solution available is to use two Y2 capacitor in series as in this case they are considered equivalent to a Y1 capacitor.



## Johanson Dielectrics Safety Certified Capacitors

- Johanson Dielectrics is recognized as a leader in Safety Certified Capacitors
- Safety Certified Capacitors are offered in the following ranges:
  - X2Y3:
    - 1808 case size: 1pF to 1500pF
    - 1812 case size: 330pF to 4700pF
  - X1Y2:
    - 1808 case size: 1pF to 1000pF
    - 2211 case size: 10pF to 2700pF
    - 2220 case size: 100pF to 4700pF

Johanson Dielectrics is recognized as a leader in SMT Safety Certified Capacitors and offers a wide range of ratings and sizes.



## Summary

- Safety Certified Capacitors are AC rated high voltage parts designed for surge and impulse protection
- The rating of the capacitors depends on their use in the circuit (X for line to line, Y for line to ground) as well as their impulse rating (X1, X2, Y2, Y3)
- Safety Certified Capacitors are used as EMI filters in telecom applications and AC/DC power supplies
- Safety Certified Capacitors are used for isolation in telecom applications

