INTRODUCTION TO FILM CAPACITORS

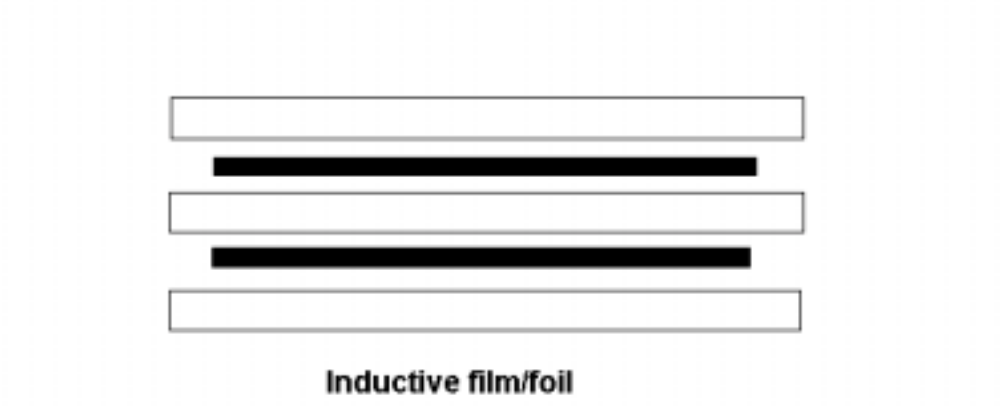
Film capacitors can be divided into three basic construction types: film/foil capacitors, metallized film capacitors, and mixed technology capacitors.

FILM/FOIL CAPACITORS

Film/foil capacitors consist of two metal foil electrodes made of aluminum foil separated by a piece of plastic film. The plastic film can be polyester, polypropylene or polycarbonate. There are other types of plastic films but these films are used in specialized applications.

The thickness of the plastic film typically ranges from 2 µm to 20 µm, while the aluminum foil thicknesses range from 5 µm to 9 µm.

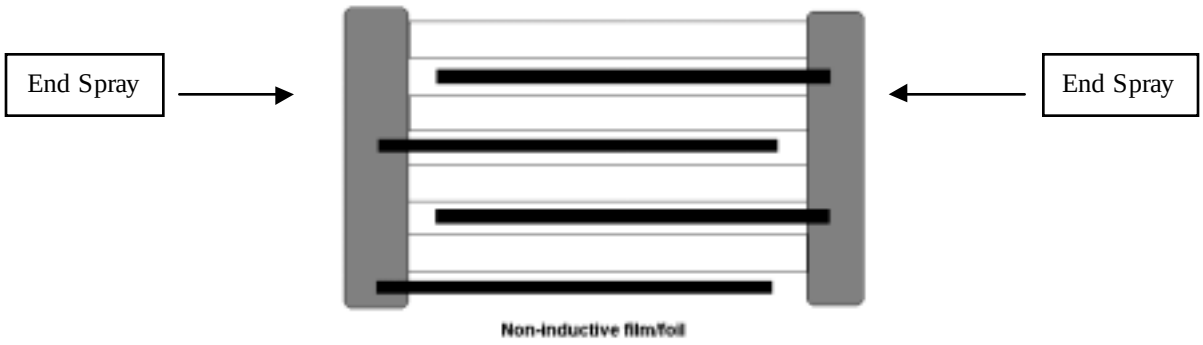
A film/foil capacitor is made by alternating two pieces of aluminum foil with two layers of plastic film. These interleaved layers are wound around a spindle in a manner that prevents the metal layers from touching. Film/foil capacitors can be wound in two different ways – inductive (insert tab) and non-inductive (extended foil).



Inductively wound capacitors have the aluminum foils centered between the layers of film. Connection to the foils is accomplished by inserting the wires against the foils during winding. The location of the lead wires on the foils determines the amount of inductance for the capacitor.

Non-inductive capacitors are wound in a similar manner to inductive capacitors except the foils are oriented so that one side of each foil extends beyond the film as illustrated below.

Connections to each electrode is accomplished by first connecting the foil extensions together with a metal end spray and then welding a lead wire to the metal spray. The inductance of the capacitor is determined by the width of the film.



Film/foil capacitors in general are characterized by high insulation resistance, good capacitance stability, low losses even at high frequencies, and high pulse handling capabilities.

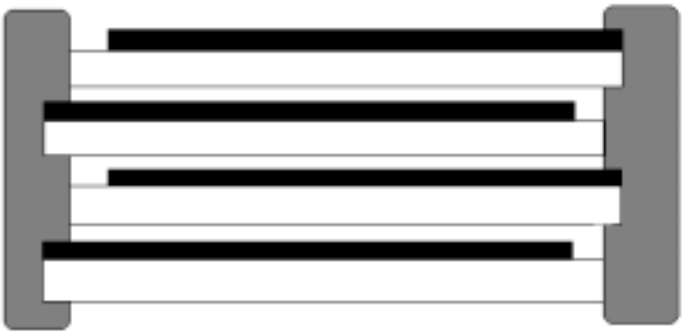
Inductive capacitors are characterized by low cost, small lead spacing, lower operating frequency range and lower operating temperature range.

Non-inductive capacitors are characterized by wide operating temperature range, high pulse current rating, and wide operating frequency range.

METALLIZED FILM CAPACITORS

Metallized film capacitors differ from film/foil capacitors in the sense that the aluminum foils are replaced by a layer of metal vacuum deposited onto the film itself. The metal layer is typically aluminum or zinc that is extremely thin in the range of .02 µm to .05µm. It is so thin that you could see thrugh when a single layer of metallized film is held up against a light.

The advantage of these capacitors is their reduced physical size and their self healing property. The capacitors are produced by winding the capacitor in the same manner a non-inductive capacitor is wound as shown below.



Extended Metallized Film

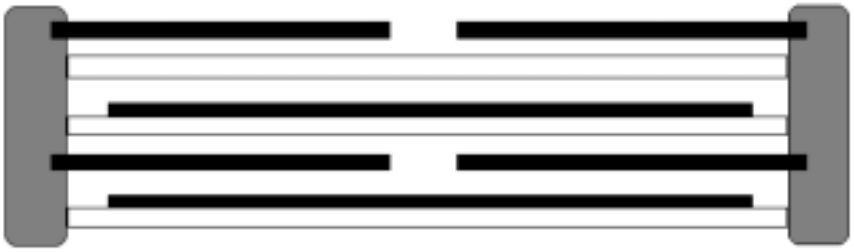
Metallized film capacitors are characterized by small size, wide operating frequency range, low losses, low to medium pulse handling capabilities and self-healing.

MIXED TECHNOLOGY

Mixed technology capacitors is a combination of either film/foil, and metallized film capacitor types. Normally these are high voltage capacitors with internal series connections, as illustrated below.

Mixed technology capacitors have the characteristics of both capacitor types, such as high pulse carrying capabilities and self-healing properties.

Double-sided metallized electrodes with internal series connections



Extended foil electrodes and metallized film with internal series connections

SELF HEALING

The self-healing property is exclusive to capacitors with metallized films and is their single biggest advantage over film/foil capacitors.

Self-healing is a phenomenon where in the event the electrodes are exposed to each other instead of the capacitor shorting, the capacitor repairs itself. This repairing of the capacitor is due to the thinness of the foils used.

In a film/foil capacitor when the foils are exposed to each other, the foils would touch and short together rendering the capacitor useless.

When a capacitor with metallized films has the foils exposed to each other, they also will touch each other, but here the combination of the foil's thinness and the high energy density at the fault area causes the foils to vaporize and the capacitor stays in operation.

During self-healing only a fraction of the energy stored in the capacitor is dissipated with the self-healing lasting less than 10 µs.

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