

1. BASIC CONSTRUCTION OF ALUMINUM ELECTROLYTIC CAPACITOR

Basic construction of aluminum electrolytic capacitor is shown in Fig. 1.1.

Aluminum electrolytic capacitor consists of anode aluminum foil formed with aluminum oxide film on the surface as dielectric, cathode aluminum foil as collector, and liquid electrolyte as the real cathode, the electrolyte impregnated in spacer paper put between both foils.

Aluminum oxide film, which is formed through anodization (generally referred to as "forming") of aluminum foil in an appropriate electrolyte, is very thin and its thickness is in proportion to the voltage applied.

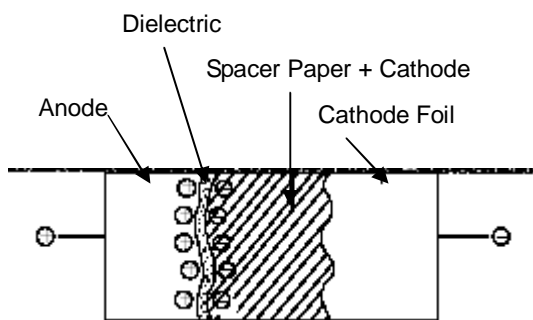


Fig. 1.1

- (1) Anode: Substrate of anode aluminum foil
- (2) Cathode: Liquid electrolyte
- (3) Dielectric: Aluminum oxide film formed on the surface of anode foil
- (4) Cathode Foil: Electrically connects electrolyte to external terminal. Cathode foil is not required forming process to form oxide film, but it is covered with natural oxide film on the surface due to reaction of aluminum with oxygen in the air after etching. It is said that this natural oxide film has the withstanding voltage of 1 to 2 volts.
- (5) Spacer Paper: Preventing physical contact between anode and cathode foil and holding necessary amount of electrolyte.

Oxide film on anode foil withstands DC voltage only when the capacitor is charged as positive polarity to aluminum substrate and negative to electrolyte. If the capacitor is charged with reversed polarity, it will lose withstanding voltage property in a few seconds. These phenomena are called "Valve Effect", which is the reason why aluminum electrolytic capacitor has polarity.

If both electrode aluminum foil have formed oxide film, the capacitor will be a non-polarized capacitor.

Various papers report mechanism for valve effect of aluminum, in which the predominant "Hydrogen Ion

Theory" is explained hereunder. When the system including aluminum foil with anodic oxide film and an electrolyte is charged so that the electrolyte is at the positive side and the metal at the negative side, hydrogen ions gathered on the surface of the oxide film pass through the film to reach the boundary between the metal and the film and convert into hydrogen gas through discharge. Bubbles of hydrogen gas peel the oxide film off the aluminum substrate with expanding force, so that electric current flows after penetration of electrolyte. On the contrary when the system is charged with reversed polarity, anions with much larger diameter gather on the surface of the film. However the film maintains voltage because such anions are unable to pass through the film due to their larger diameter.