# Radial Crown SMD Aluminum Electrolytic Solution for DC-Link and EMC Applications for Automotive Power Systems

# 1. Introduction to Aluminum Electrolytic Capacitors

The development of the electrolytic capacitor (e-cap) has been one of the main factors in the successful miniaturization and increased performance of many modern-day electronics. The basic e-cap construction is shown in the figure below:

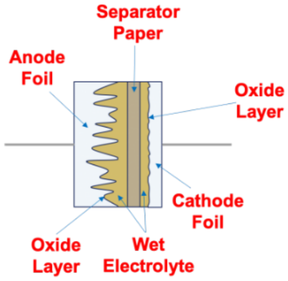



**Figure 1 – Typical wet electrolytic capacitor** **(Courtesy of KEMET)**

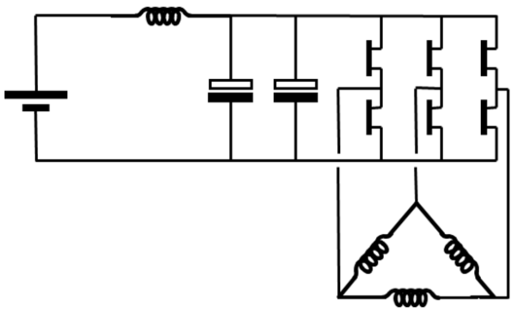
Since capacitance is a function of surface area, aluminum foils are first etched to create a rough contour with maximal contact area, resulting in high capacitance and optimal CV-value.

A second foil layer and a paper separator are added to fully complete the capacitor structure, producing an excellent terminal contact with this electrolyte. This aluminum-electrolyte-paper sandwich is then rolled or “wound” into a can and sealed with two terminals.

# 2. Aluminum Electrolytic Capacitors in Automotive Systems

## 2.1 DC-Link Capacitors

DC-link capacitors are used in order to provide a stable DC-voltage, limiting voltage fluctuations even under high ripple current loads and fluctuations created by the inverter. The DC-link capacitors are acting as a local energy source, connected to the DC- board-net close to the power electronics (⇒ low impedance).



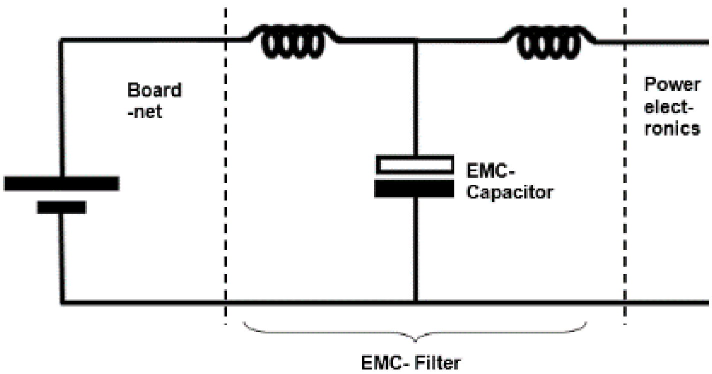
KEMET
a YAGEO company

***Key requirements, for automotive DC-link capacitors:***

- Ripple current capability
- Low ESR
- High temperature capability
- Low thermal resistance (…especially when mounted heat-sinked to metallic chassis)
- Operational life
- Low impedance
- Low inductance
- High reliability

### 2.2 EMC Capacitors

An EMC- filter is often used to protect the board-net from voltage spikes created by the switching power electronics.



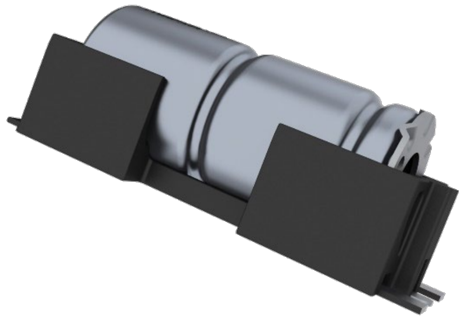

The requirements for an EMC filter capacitor in automotive inverters is similar to that of DC-link capacitors.

## 3. Advancing from Through-Hole to SMD Designs

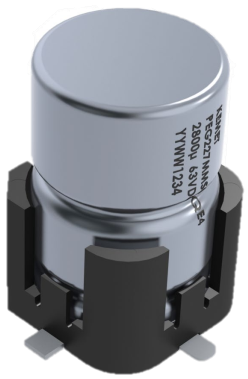
Increasing levels of miniaturization have forced the development of SMD alternatives to what was once only served by through-hole options.

The PES and PEV series of SMD aluminum electrolytic capacitors is based on the successful PEH and PEG series of through-hole radial crown capacitors. This introduction brings the expectations of high CV and high ripple current performance to an SMD solution.

**PES 227/ 228- series**



**PEV 227/ 228- series**




**PEH 227/ 228- series**

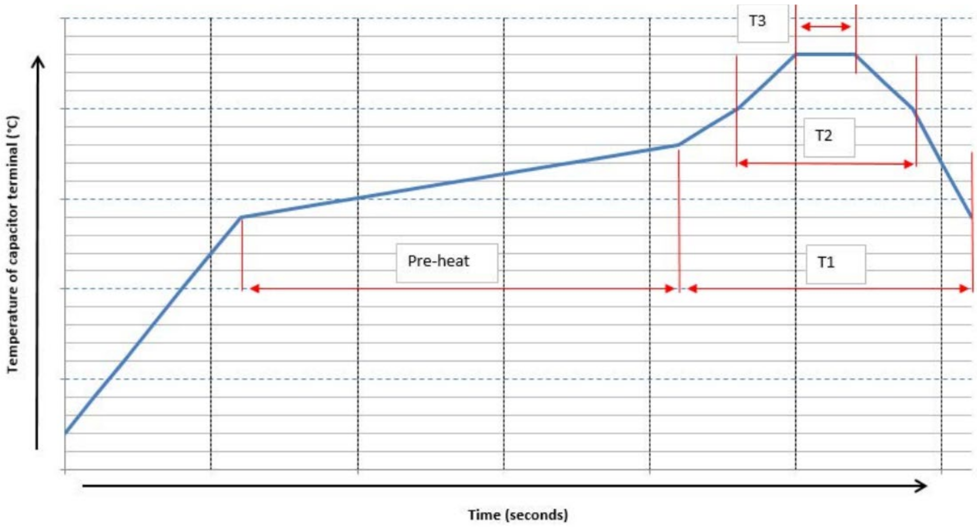
## 4. Reflow Recommendations

The following considerations should be remembered when implementing a reflow process:

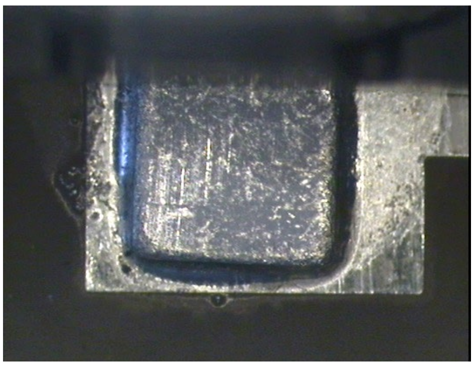
1. Vapor heat transfer systems are not recommended
2. Thermal systems such as infrared radiation and hot blast should be used
3. Avoid repeated reflowing

Recommended reflow profile:

| Time Period | Preheating | T1 | T2 | T3 |
|---|---|---|---|---|
| Temperature (°C) | 150 – 180 | ≥ 200 | ≤ 230 | ≤ 240 |
| Time (seconds) | | 60 – 180 | ≤ 40 | ≤ 20 |
| Reflow can be performed per the above parameters up to 2x | | | | |




**Solder Paste Alloy:**
Solder passed allow should be selected to be suitable for the above recommended reflow profile. Sn/Ag or Sn/Ag/Cu allows with recommended peak solder temperatures in the range of 235C to 240C should be used.

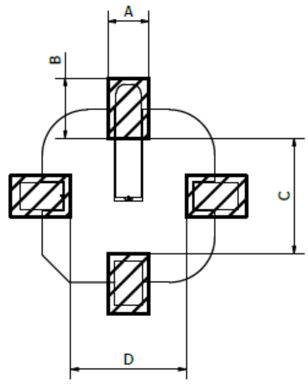


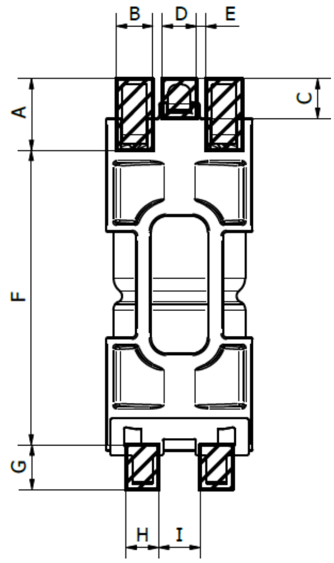
Example of successful reflow

# 5. PCB Land Patterns and Footprints

PEV22x Series Footprint:

| Size Code | A | B | C | D |
|---|---|---|---|---|
| KL, KP | 4,5 | 6,65 | 12,7 | 12,7 |
| LL, LP | 4,5 | 6,65 | 14,7 | 14,7 |




| Size Code | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| KP | 8,85 | 4,5 | 4,9 | 4,2 | 1,15 | 36,3 | 5,5 | 4,0 | 5,1 |
| LP | 8,85 | 4,5 | 4,9 | 4,2 | 2,15 | 36,3 | 5,5 | 4,0 | 7,1 |

## 6. Heatsinking Considerations

The ripple current capability of the capacitor is further increased if the capacitor body is mounted to a chassis or metallic body with low thermal resistance. The information in the datasheet shows both natural convection and heat-sinking conditions.