



Aluminum Electrolytic Capacitors for Traction Applications

By Theo van de Steeg, Jules Spanjaars, and Harm van Driel

INTRODUCTION TO THE APPLICATION

Traction is a blanket term for applications in trains or “rolling stock.” Both the electrical propulsion systems as well as the electrical systems supporting the brakes, lighting, and power supply are focus areas included in this application category.

SELECTING THE BEST CAPACITOR FOR YOUR TRACTION APPLICATION

Aluminum electrolytic capacitors are used in two main traction applications:

- As DC-link capacitors in traction drives used to control the speed of large electrical motors
- As DC-link capacitors in auxiliary power supplies in rolling stock, e.g. for air conditioning

In both applications the aluminum capacitor is used as an energy buffer to ensure stable operation of the switch mode inverter driving the motor or auxiliary power circuit. The aluminum capacitor also functions as a filter to prevent high-frequency components from the switch mode inverter from disturbing the board net.

The key selection criterion for the aluminum capacitor is the needed ripple current, which corresponds to the 8 kHz to 20 kHz high-frequency ripple currents generated by the inverter.

To maximize its operating life, the aluminum capacitor should be located on the coolest possible location. Forced cooling or mounting of the capacitor on a heatsink will increase component lifetime, especially in combination with the extended cathode construction inside the aluminum capacitor.

It is advisable to specify a minimum capacitance to ensure stable operation of the drive. A low inductance (ESL) also improves the filtering of switching noise. ESL values below 13 nH can be reached for screw-terminal devices in large case sizes.

Both series and parallel connections are commonly used with aluminum capacitors, as the voltages in rolling stock may well reach up to 1200 V. In such cases three aluminum capacitors can be used in series. Care should be taken to balance the intermediate voltage between the capacitors, usually with so called bleeder resistors (also available from Vishay).

For higher voltage ranges or higher power applications, power film capacitors, also available from Vishay, are the best option.



Aluminum Electrolytic Capacitors for Traction Applications

OUR SOLUTIONS

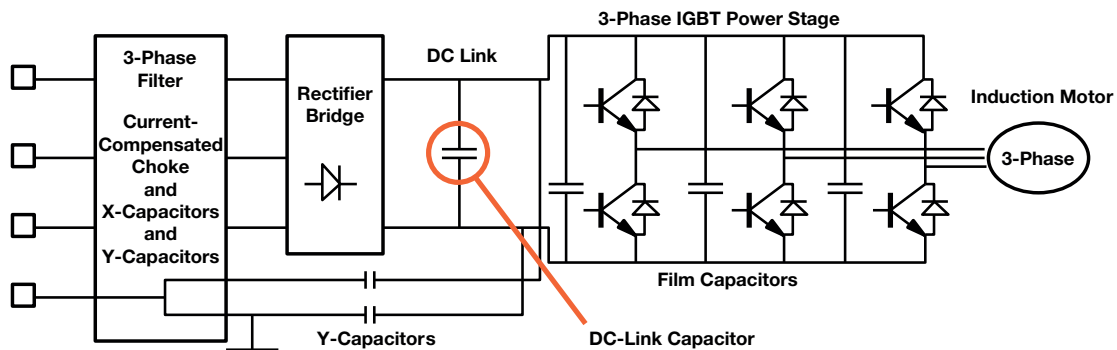
For this kind of application we highly recommend our 110 PHT-ST series. This series is designed for use in traction applications and offers high ripple current capabilities along with long lifetimes. Our experience with screw terminals goes back beyond 1988, at that time under the brand name of Philips.

Typical examples in the traction market are:

VOLTAGE	250 V	300 V	350 V	400 V	450 V
Capacity (case size)	20 000 μ F (\varnothing 76 mm x 220 mm)	6000 μ F (\varnothing 76 mm x 220 mm)	6000 μ F (\varnothing 76 mm x 220 mm)	15 000 μ F (\varnothing 90 mm x 220 mm)	10 000 μ F (\varnothing 90 mm x 220 mm)
	27 000 μ F (\varnothing 76 mm x 220 mm)	18 000 μ F (\varnothing 76 mm x 220 mm)	12 000 μ F (\varnothing 76 mm x 220 mm)		
			16 000 μ F (\varnothing 90 mm x 196 mm)		

Our products have been approved for use in OEM applications and as replacement parts for existing rolling stock in drives from diverse manufacturers, such as AEG, Alstom, GE, and Siemens.

In refurbishment projects, realizing mechanical exchangeability and providing engineering support to select the best replacement are key characteristics when the decision is taken to not work with the OEM supplier. We can offer customized products based on your needs, with temperature ranges from 85 °C to 105 °C and lifetimes from 2000 h to 15 000 h at maximum temperatures. A lifetime of 100 000 h at 70 °C is another standard guideline that is reachable with our professional components. We can provide lifetime calculations to support the capacitor's performance for the given lifetime in your application. Terminations are available from metric M5-8 mm to M6-18 mm, as well as U.S. tread ¼-28 UNF. Screws and washers are supplied with the capacitors.



A typical block diagram of the application

