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Selecting the right contactors

The C310 DC contactor safely isolates the inverter in electric aircraft tractors.

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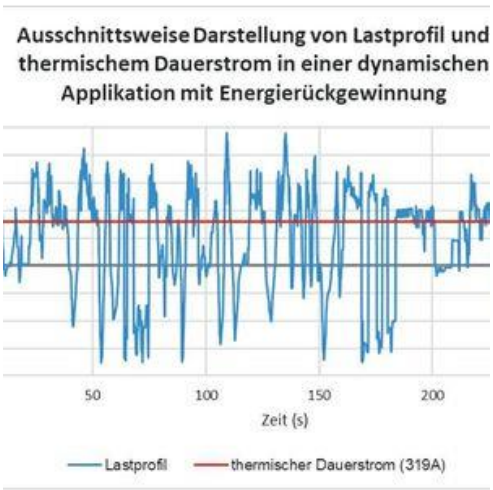
C310 in electric aircraft tractors

DC power contactors ensure safe operation in the drive train in electric vehicles among other things. The experts at Schaltbau GmbH know how to select the right contactor for your needs.

To disconnect the inverter in the drive train of an electrically operated aircraft tractor, the manufacturer was looking for a bidirectional DC contactor. Since the braking energy is recovered and fed back into the battery pack, bidirectionality was an important selection criterion. He the right decision using the C310 from Schaltbau GmbH. With air as the insulating medium, there is no risk of leaking, unlike encapsulated/gas-filled contactors. The high current-carrying capacity was also decisive. In the selected C310A/500 version, the contactor can carry up to 500 A permanently; in the event of a short circuit, even 3000 A may flow for one second without the contact welding.

Selecting the right component is by no means an easy task. It is important to precisely define the real application requirements and to be in dialogue with the switchgear manufacturers at an early stage of development. Rated insulation voltage and rated operational current are important values here. While the voltage is usually easy to define, problems can arise when determining the current. The rated operational current, or thermal continuous current, describes the average current that flows during normal operation.



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Rated operational current of DC power contactors

Depending on the contact resistance of the main contacts in the contactor, which depends primarily on the contact material and contact force, the rated operational current heats the contactor. It is defined by the manufacturers under specified ambient conditions. Depending on the installation conditions, the value can also deviate without any damage being expected. When the DC contactor is installed in a ventilated switch cabinet, it is not uncommon to exceed this value by 25 %. An individual agreement with the manufacturer is, of course, important.
On the other hand, the breaking capacity can in some cases be significantly higher than the design parameters, but also significantly lower. Depending on the application, there are operating points at which short-term current peaks occur. These are negligible from a thermal point of view. Nevertheless, the DC power contactor should still be able to switch off safely at these operating points in the event of a fault. In addition to the current and voltage values, the inductance in the circuit is a decisive factor that can significantly influence the breaking capacity. Due to the inductive properties, depending on the level of inductance, a voltage peak occurs during switch-off, which increases the arc intensity. In the C294 DC power contactor from Schaltbau GmbH, for example, the breaking capacity increases by 300 % if the inductance is reduced from τ = 15 ms to τ = 1 ms (see table).

Auszug aus dem Datenblatt Baureihe C294	
Ausschaltvermögen pro Kontaktsystem	1.200 V DC, L/R 1 ms: 60 A; L/R 15 ms: 13 A
Ausschaltvermögen Reihenschaltung der Hauptkontakte	1.500 V DC, L/R 1 ms: 120 A; L/R 15 ms: 30 A

The breaking capacity of the DC power contactor C294 from Schaltbau GmbH increases by 300 % if the inductance is reduced from τ=15 ms to τ=1 ms.

The application decides on the DC power contactor

When selecting the DC power contactor, further criteria must be taken into account: For instance, not all contactors are designed for bidirectional applications - as required in electric aircraft tractors - and can only switch off currents in one direction. Inrush current also plays a role in many applications. If the DC power contactor is suitably selected, an additional pre-charge circuit may not be required under certain circumstances. As with all applications, the short-circuit must be considered. If the DC power contactor and main fuse are appropriately matched, damage to the contactor in the event of a short circuit should be prevented. In the end, it must also be determined whether the switching state of the contactor must be monitored for possible safety functions. An acknowledgment circuit must be provided in this case.

The service life requirement for a DC power contactor is essentially defined by the application. The decision is made between mechanical (switching cycles without load) and electrical (switching cycles under defined load) service life. For many current applications, such as battery storage or in the automotive sector, the contactor usually switches without load. The power electronics regulate the power before the contactor provides galvanic isolation. The requirement, in this case, is based on the mechanical service life, which is significantly higher. Shutdowns under load in this scenario are exclusively emergency shutdowns, which usually occur only a few times during the entire service life of the system.

Contactors for industrial and railway applications

In some applications, the switchgear plays the "hot switching" role. Industrial or railway applications require the contactor to switch off the rated operational current several 100,000 times. With the CT and C310 series, Schaltbau offers various DC contactors that are designed for a similar continuous thermal current. The larger of the two (CT series), however, features a high breaking capacity and a long electrical life with high inductance (τ = 15 ms). The smaller contactor (C310 series), on the other hand, is designed for use in applications where switching cycles under load are rare and the inductance is less than τ = 0.1 ms. Differences are reflected in installation space, weight and cost.