

DC breakers

ASTROL



Solid-state, ultra-fast
0.8-1.5 kV DC breakers
for data centers



*Designed for electrical power systems
for data center infrastructures*

Zone level protection against short-circuit situations and power overload within μ s

Modern data centers are rapidly transitioning toward DC-based power distribution to improve efficiency, scalability, and integration of renewable energy and battery storage systems. Astrol solid-state DC breakers are specifically designed to protect these advanced power systems with ultra-fast interruption, high reliability, and seamless integration.

- **Ensure safety by preventing short-circuits and power overload**
- **System-independent and modular design**
- **Cost-efficient and green solution**
- **Enabling innovative and SMART system topologies**
- **Technical consultancy and DC experience**

The primary and most important function of the Astrol solid-state DC breaker for data center applications is its ultra-fast interruption of faults. Our ultra-fast liquid and air-cooled DC breakers are available in 800 - 1500 VDC and nominal currents between 0.125 up to 10 kA.

The Astrol DC breaker is based on the latest, powerful semiconductor technology. It guarantees reliable protection against short-circuit currents in any part of the grid and allows the system integrator to achieve selectivity in the most flexible way. We use Insulated Gate Bipolar Transistors (IGBT) as well as diode modules.

Features

- Independent solution for integration in any type of DC-grid and drive system
- Autonomous switch-off capability
- Ultra-fast switch off-time within micro seconds
- Modular system
- Suitable for spinning reserve mode
- Switch-off current ≤ 20 kA
- High di/dt capability up to 1000A/us
- Bi or uni-directional current detection
- Liquid and air cooling possible
- Topology optimized for low power loss and maximum lifetime
- Internal self-diagnostics
- Customized interface to overall controller
- Optical (Glass or POF) connections
- Modbus-TCP, PROFINET, WEB based, etc.

Certifications

- UL94 certified
- Vibration tested according to IEC 60068-2-6
- Our range of maritime DC breakers is based on the same technology and has been marine type approved by DNV, Lloyds Register, CCS, Rina, and ABS

Main specifications

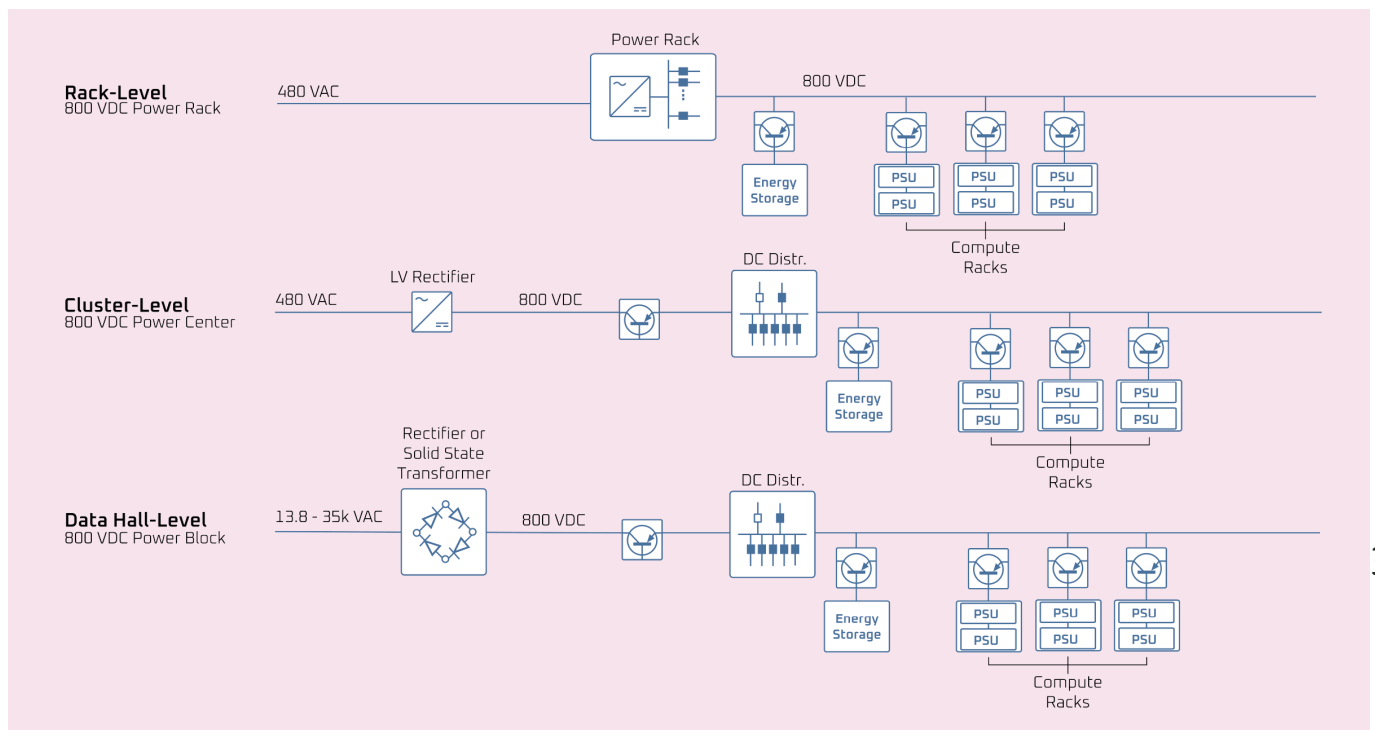
- Current classes from 0.125 up to 10kA
- Voltage class 0.8 up to 1.5 kV
- IP Protection ranging from IP20 to IP54
- Ambient temperature range: +5°C ... + 60°C

Powering next-generation data centers: 800 VDC architecture

To support the massive compute workloads of modern AI and high-performance computing, data centers are rapidly shifting to high-efficiency 800 VDC microgrids. However, the immense energy density of DC power introduces high risks: traditional mechanical switchgear is simply too slow to clear massive DC fault currents. Our ultra-fast Solid-State DC Breakers (SSDCBs) solve this critical challenge. By isolating faults within microseconds, they deliver the absolute safety, selectivity, and uptime required across all three infrastructure layers:

- **Rack-level protection:** High-density power conversion happens directly at the individual rack, backed by integrated battery storage. At this level, compact SSDCBs safeguard sensitive AI servers. In the event of a localized short circuit or thermal runaway threat, the breaker isolates the fault instantly, preventing energy feed-in and securing neighboring hardware.
- **Cluster-level control:** Power is managed through a centralized DC distribution grid to seamlessly feed multiple compute racks. Our Solid-State Breakers act as smart zone barriers. Thanks to their sub-millisecond response time, they isolate faulty zones immediately, maintaining full voltage stability on the main DC bus and preventing cascading failures.
- **Data hall-level resilience:** Designed for maximum scalability, this layer takes medium voltage directly into high-capacity rectifiers, delivering a robust 800 VDC backbone across the entire data hall. Here, heavy-duty SSDCBs ensure complete system selectivity, providing the bi-directional fault clearing needed to decouple massive energy storage units instantly during major faults.

By embedding solid-state intelligence at every junction, this 800 VDC framework eliminates the dangers of DC fault currents, cuts infrastructure costs, and provides the ultimate foundation for sustainable, high-density AI data factories.



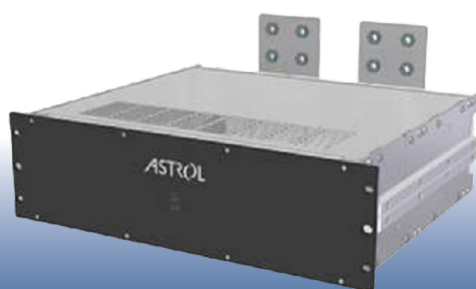
System-independent, compact and modular design



Breaker Model	D10kA	D7.5kA	D5kA	D3.6kA	D2.5kA	D1.8kA	D1.5kA
Rated Voltage	800 Vdc	800 Vdc	800 Vdc	800 Vdc	800 Vdc	800 Vdc	800 Vdc
Switching technology	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT
Cooling mode	Water-cooled	Water-cooled	Water-cooled	Water-cooled	Water-cooled	Water-cooled	Water-cooled
Breaker type	4-module breaker	3-module breaker	2-module breaker	2-module breaker	Single module breaker	Single module breaker	Single module breaker
Rated current	10kA	7.5kA	5kA	3.6A	2.5kA	1.8kA	1.5kA
Overload current	12kA	9kA	6kA	4.3kA	3kA	2.15kA	1.8kA
Minimun system inductance requirement	none	none	none	none	none	none	none
di/dt limit	none	none	none	none	none	none	none
Dimensions (WxHxD) in millimeter	510x1170x610	510x950x610	510x730x610	510x730x610	482x222x450	482x222x450	482x222x450
Bi-directional breaker	✓	✓	✓	✓	✓	✓	✓
Directional breaker, reverse-blocking	✓	✓	✓	✓	✓	✓	✓
Efficiency 1)	>99.65%	>99.65%	>99.65%	>99.65%	>99.65%	>99.65%	>99.65%
Directional breaker, reverse-conducting	✓	✓	✓	✓	✓	✓	✓
Efficiency 2)	>99.8%	>99.8%	>99.8%	>99.8%	>99.8%	>99.8%	>99.8%

The compact mechanical design supports the control concept of the DC breaker to work as a standalone solution. The power-modules are accessible from the front and the back side. The basic configuration is a modular built DC breaker with integrated sensor communication and control unit.

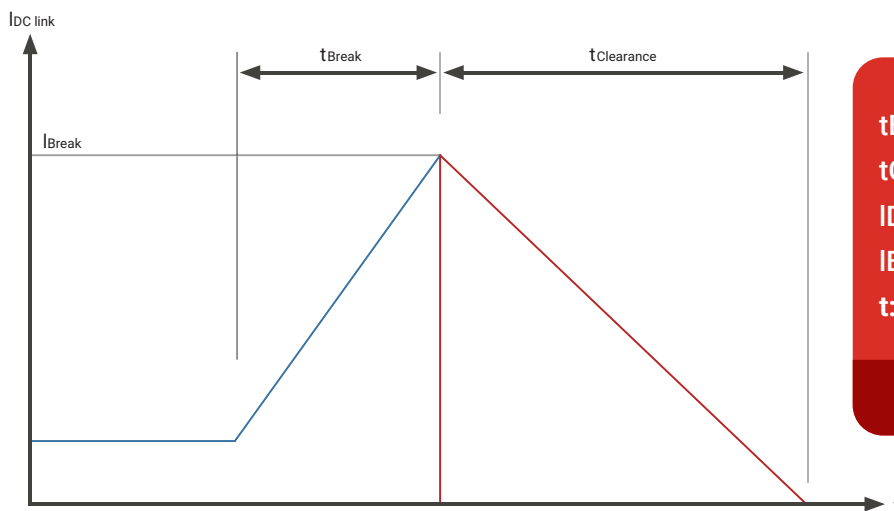
The table shows the currently available current ratings and dimensions. Customized versions are available upon request.



D1.25kA	D0.75A	D0.5A	D0.3A	DA1.5kA	DA1.25kA	DA1.25kA	DA0.5A	DA0.3A
800 Vdc	800 Vdc	800 Vdc	800 Vdc	800 Vdc	800 Vdc	800 Vdc	800 Vdc	800 Vdc
IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT	IGBT
Water-cooled	Water-cooled	Water-cooled	Water-cooled	Air-cooled	Air-cooled	Air-cooled	Air-cooled	Air-cooled
Single module breaker	Single module breaker	Single module breaker	Single module breaker	2-module breaker	2-module breaker	2-module breaker	Single module breaker	Single module breaker
1.25kA	750A	500A	300A	1.5kA	1.25kA	750A	500A	300A
1.5kA	900A	600A	360A	1.8kA	1.5kA	900A	600A	360A
none	none	none	none	none	none	none	none	none
none	none	none	none	none	none	none	none	none
482x133x450	482x133x450	482x133x450	482x133x450	480xtbdx450	480xtbdx450	480xtbdx450	480xtbdx450	480xtbdx450
√	√	√	√	√	√	√	√	√
√	√	√	√	√	√	√	√	√
>99.65%	>99.65%	>99.65%	>99.65%	>99.65%	>99.65%	>99.65%	>99.65%	>99.65%
√	√	√	√	√	√		√	√
>99.8%	>99.8%	>99.8%	>99.8%	>99.8%	>99.8%	>99.8%	>99.8%	>99.8%

Ultra-fast fault isolation and protection

In case of an event, the breaker interrupts the current within microseconds. With the response time requirement, local fault protection must be performed autonomously by the control system without the need for external control or fault detection. The fast opening time of our solid-state breaker limits the fault current and reduces the negative impact on the load to a minimum. The current does not reach damaging energy levels and can be interrupted without forming an arc. In addition to the fast over-current protection, the breaker opens on a configurable time-current profile (I_{2t}) for overload protection.

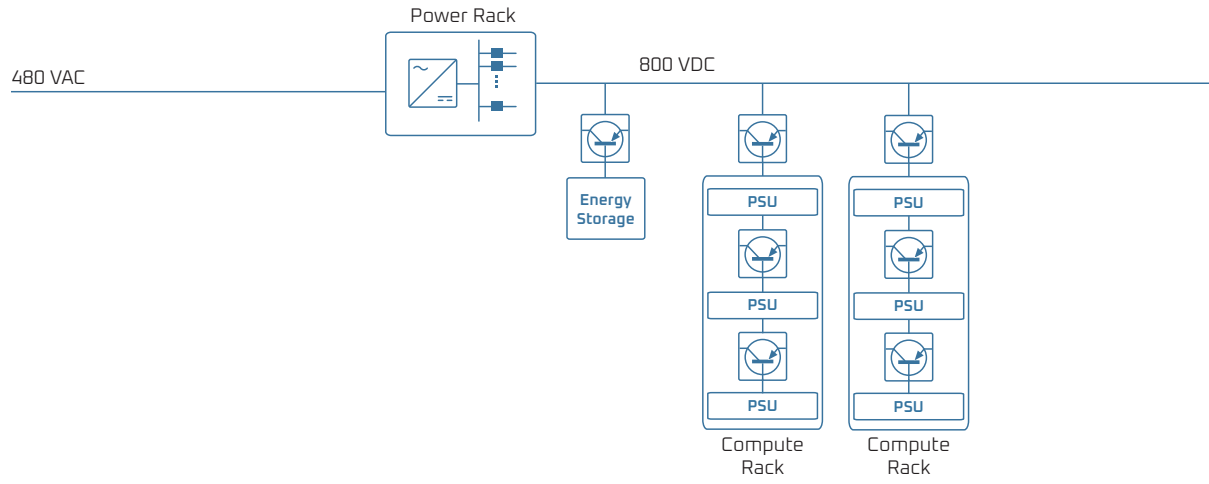


t_{Break} : breaking time
 $t_{Clearance}$: clearance time
 $I_{DC \text{ link}}$: DC link current
 I_{Break} : current interruption
 t : time

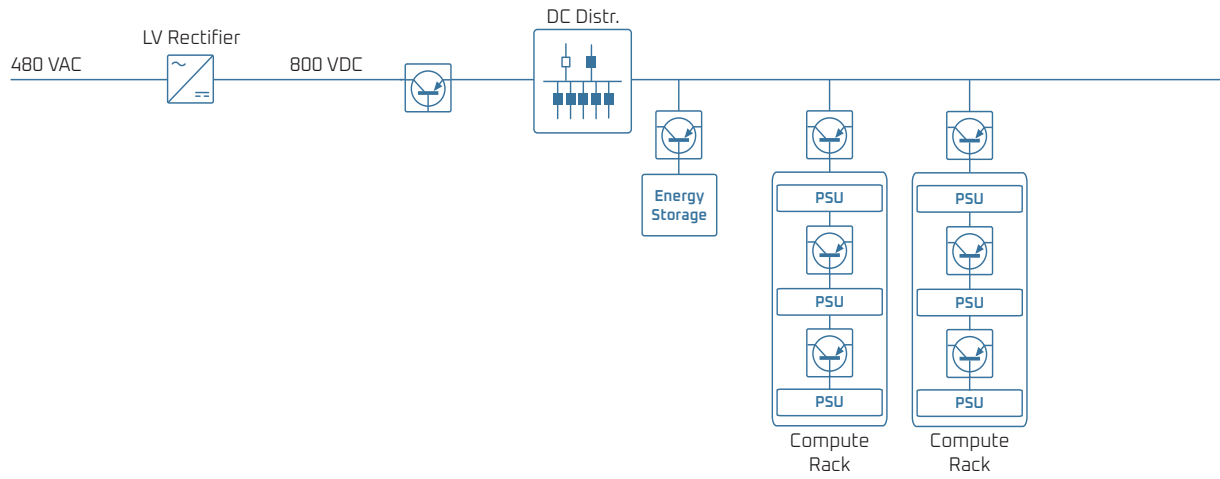
Mechanical design

The isolating fiberglass housing allows easy integration into an enclosure, but also the installation within an open rack. With its modular design, the focus lies on standardized power modules, that can be combined into different voltage and current ratings with minimal mechanical changes. The power modules are fully accessible from both the front and the rear.

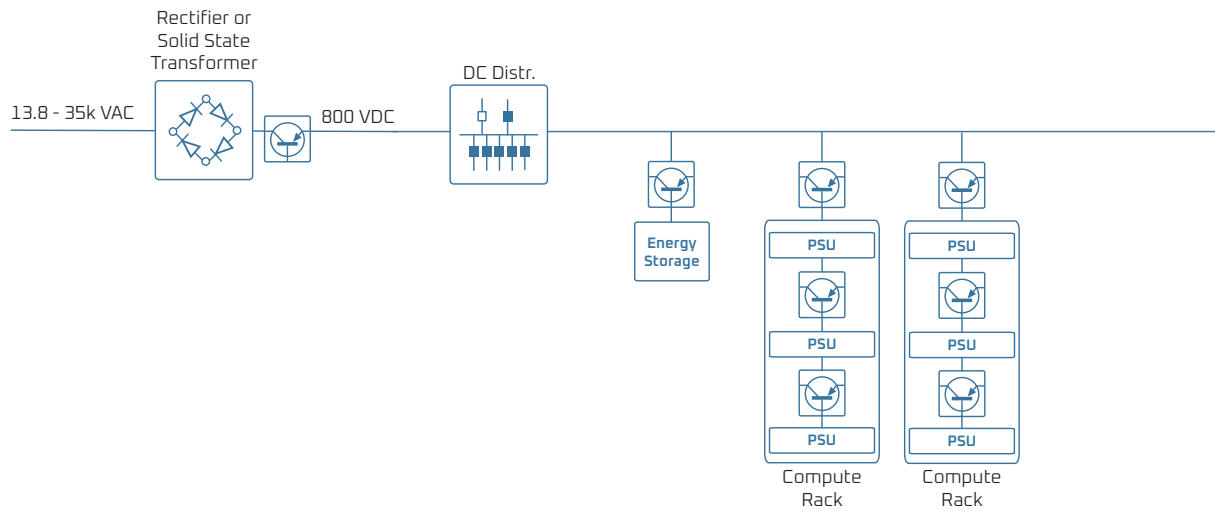
Rack-level
800 VDC Power Rack



Cluster-level
800 VDC Power Center



Data Hall-level
800 VDC Power Block



Expert insights



Explore our latest blogs on how solid-state DC protection, laminated busbars, and smart power distribution are reshaping modern data center architectures for high-density AI workloads.

When every microsecond matters: how AI dynamics change DC protection in data centers



Author *Peter van der Berg*



The future of solid-state DC breakers for AI data centers



Author *Peter van der Berg*



From ships to servers: why AI is reshaping data center power



Author *Michael Geissmann*



Maximize facility uptime and safety while minimizing consequential damage during a short-circuit or power overload.

Best in category di/dt capability allowing ultra-fast switch-off

The IGBT technology guarantees ultra-fast switch-off times. Typically short-circuit detection and IGBT switch-off takes less than 8 μ s. The DC breaker detects, clears and separates short-circuits from healthy system parts before they reach dangerous levels. Depending on the rating of the DC breaker and inductance of the system a clearance time of 7 - 13.4 μ s is feasible.

Stand-alone solution for any DC data center

The Astrol DC Breaker is system independent and can be integrated in any type of DC distribution infrastructure. It constantly monitors current and voltage on the DC bus and reacts autonomously according to predefined settings. Protection functions include protection against short-circuits and power overloads. Internal self-diagnostics constantly monitors the health state of the internal breaker functions and reports irregularities to the overall controller.

Maintenance free, robust and reliable solid-state DC breaker

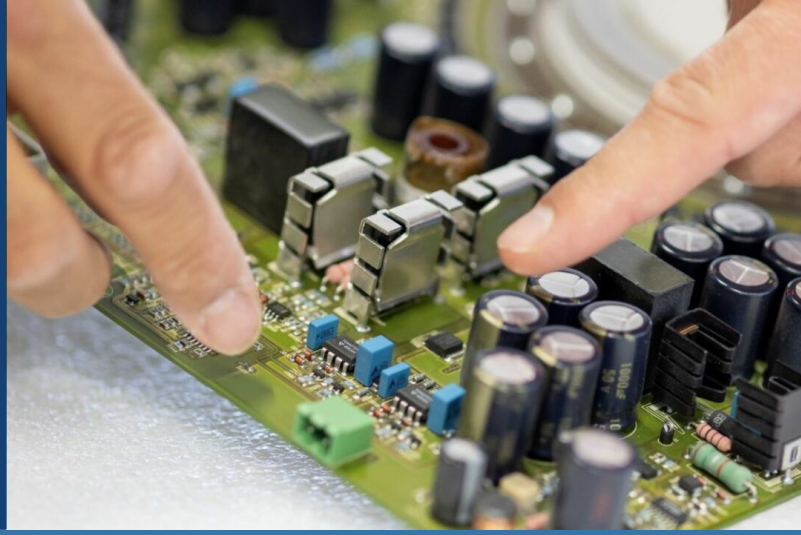
Thanks to sufficient redundancy, the lifetime of our solid-state breakers (which is 15 years) exceeds the lifetime of a typical power distribution system. No maintenance is needed. The redundancy also leads to a very robust system. This has been proven by the extremely high number of short-circuit and switching-off (fault) conditions without showing any degradation.

Electrical design / topology

An optimized topology reduces the temperature cycles of the semiconductor modules. This leads to a longer lifetime of the IGBT's and contributes to a maintenance free system. Due to the ultrafast detection and switching time, the DC Breaker can safely control low system inductance without adding more inductance to the circuit. With the Astrol DC breaker, the system integrator benefits from maximum design freedom (common DC bus architectures and zone protection).



Innovative Design



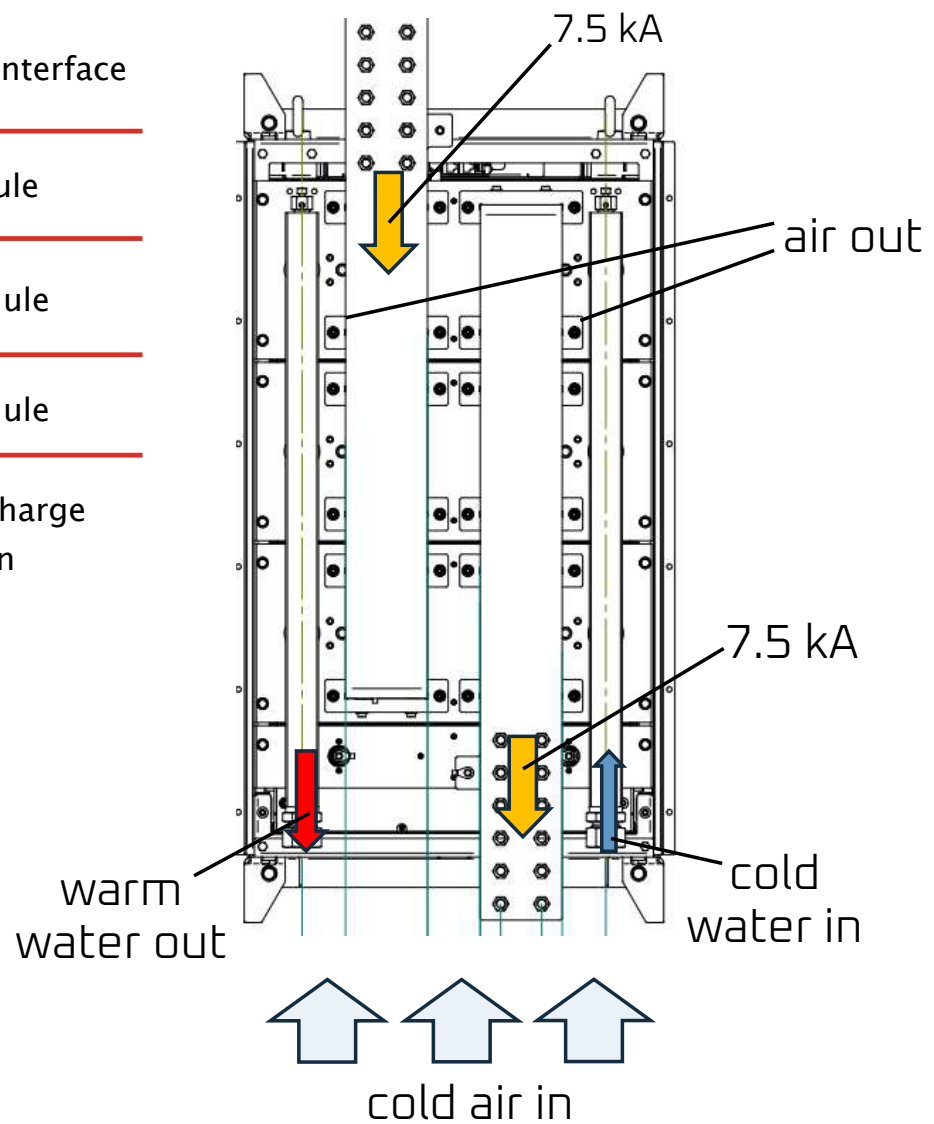
Control module / connection interface

800V – 2.5kA power module

800V – 2.5kA power module

800V – 2.5kA power module

800V auxiliary module pre-charge circuit and integrated fan



Control interface

For switching actions controlled by the overall system controller, the DC breakers provide different communication interfaces:

- Optical (Glass or POF)
- Modbus-TCP, Profinet, WEB based
- Wire Bus System with CAN and RS485
- 24V power supply with internal filter module

The controller of the breaker and the direct optical link between several breakers, in case of a multi DC Breaker topology, manage short-circuit protection of healthy zones.

Parametrization and customization

Typical items for customization are:

- Communication to overall controller
- Internal or external cooling
- Quick coupling connectors in the water cooling circuit
- External fan control with PWM
- Balancing switch
- Integrated fan
- Higher voltage ratings are possible

The DC Breaker provides application specific parametrization. Short-circuit and over current detection can be adjusted according to customer specific requirements. Different parameter settings do not require recertification. A customized DC breaker can either be an adapted standard of a certified version or a completely new version.

"Engineered for next-generation DC architectures. Fault detection within 2 μ s and full IGBT switch-off in less than 4 μ s, preventing dangerous fault energy levels in critical AI data centers."

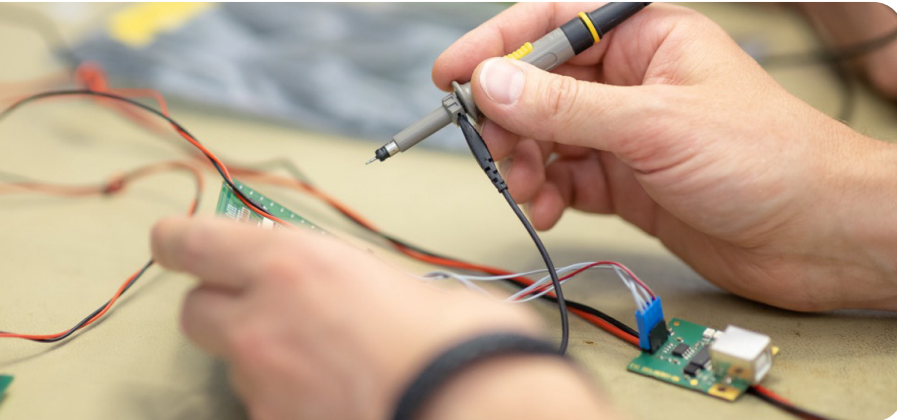
Balancing switch

When the bus tie breaker is open, the capacitors on each side of the breaker can be charged to different voltage levels. The closing of the bus tie will cause an inrush current, which will immediately trigger the short-circuit detection of the DC Breaker. To solve this problem, the Balancing Switch option is available for every Astrol DC breaker. The Balancing Switch is an IGBT controlled pre-charge device, which assures voltage balancing within the circuit and smooth closing of the DC breaker.

Spinning reserve mode

Our DC breakers are suitable for spinning reserve mode. This means that the breaker can handle an overcurrent of 20% for a period of 30 minutes for a maximum of 25 times a year. This mode is enabled when grid failure occurs. The ESS supplies power to maintain network continuity while the back-up generator is started and brought online.

About Astrol



Technology leader in pulsed power switches and solid-state circuit breakers

Astrol is a Switzerland based innovator and manufacturer of state-of-the-art power control and switching solutions. We design and produce electronic parts for technical high demanding industries such as medical, energy distribution and pulsed power applications since 1996. In our 25-year history we have developed from a designer of custom-built electronics to a technology leader in pulsed power switches and solid-state circuit breakers with a wide range of products and a world-wide customer base consisting of operating companies and research institutes.

Our main focus lies on power switching in the medium voltage range, from optimized gate drive units to fully integrated solutions of up to 100kV. Our products are designed, manufactured and tested in our production location and high voltage test laboratory in Othmarsingen and therefore are able to withstand harsh environments, extended temperatures and have a long lifetime.

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Astrol Electronic AG

Ahornweg 14
CH-5504, Othmarsingen
Switzerland
+41(0)564856020
info@astrol.com
www.astrol.com



Astrolkwx B.V.

Boompjes 40
3011 XB, Rotterdam
The Netherlands
+31(0)103163640
info@astrolkwx.com
www.astrolkwx.com

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