WHY SOLID-STATE BREAKERS?

MAKING THE TRANSITION TO A RENEWABLES-INCLUSIVE POWER GRID

The electrification of everything is a key step in the global transition to clean energy. This shift requires increased flexibility in the current power grid's infrastructure to accommodate the integration of more renewable energy sources, including the addition of distributed energy resources (DERs). It also requires enhanced load management at the edge of the grid. Our current system is not designed to integrate DERs in a way that is effective and scalable. What's needed is a nimble, adaptable technology at the edge of the grid that can manage energy in real time and optimize current grid capacity. Managing energy at the circuit breaker level is the perfect way to achieve granular management since all electrons must flow through a circuit breaker before reaching their final destination.

Breaking Down the Basics of Electromechanical Circuit Breakers

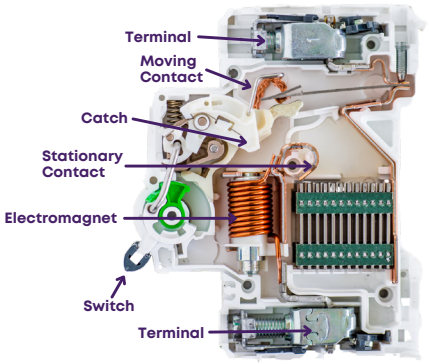
Circuit breakers are tried-and-true electromechanical devices that manage the flow of electricity. They are designed to turn off automatically (i.e., interrupt the flow of current) in the case of an electrical ground fault, short circuit, or overload current, protecting against fire risk and shock and electrocution hazards. Because their core function is safety, circuit breakers are not designed for switching a circuit on and off repeatedly. That is why a downstream device, like a relay, is often used in tandem with a circuit breaker to perform this function. The circuit breaker acts as the safety mechanism while the relay performs the remote on/off control for the circuit.

Although electromechanical circuit breakers are a pervasive technology, their inability to handle a high number of on/off control operations makes them ill-suited to manage load optimization for a renewables-inclusive power grid. Electromechanical circuit breakers are also prone to degrade over time due to physical wear and tear from temperature, humidity, and carbon buildup caused by plasma arcing from repeatedly breaking the circuit.

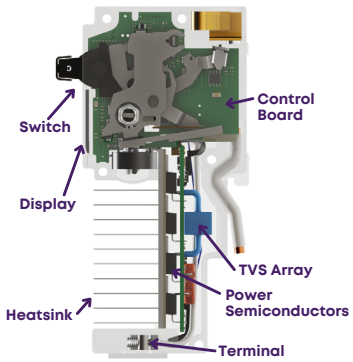
Introducing the Solid-State Circuit Breaker

The solid-state circuit breaker is an emerging technology that offers the same safety benefits as an electromechanical circuit breaker along with some key advantages. Solid-state circuit breakers have no moving parts – they use semiconductors to control the flow of electricity. During a short circuit, the semiconductor opens first followed by the mechanical separation of contacts. Opening the circuit with the semiconductor first significantly reduces the wear and tear on the electrical contacts relative to electromechanical circuit breakers by eliminating plasma arc. As a result, solid-state circuit breakers operate much faster than electromechanical circuit breakers, are safer due to the elimination of arc faults, and can handle a high number of on/off operations without risk of failure. Solid-state circuit breakers also eliminate the need for multiple discrete peripheral devices (e.g., relays, current transformers, voltmeters, microcontrollers) since these capabilities are built into the breaker's electrical infrastructure.

Traditional Circuit Breaker



Solid-State Circuit Breaker



A Comparison of Mechanical and Solid-State Switching Performance

	Mechanical Relay	Solid-State Switch
Short Circuit Withstand	Up to 5,000 amps	200,000 amps
On-resistance	Low initially but increases after loaded operations.	Stays consistent throughout the life of the product.
Number of Operations Under Load	Up to 10,000	Over 1,000,000
Switching Speed	20ms	50us (400x faster)
Surge Event Handling	Surge passes straight through to the load.	High speed pulsing blocks surge events from reaching the load.

Solid-State Breakers are the Future of Energy Management

Solid-state circuit breakers are an ideal technology to measure and control energy usage at the edge of the grid. Breaker operations are managed digitally using software that remotely meters, monitors, and controls loads at the breaker level. By effectively placing the meter at the edge of the grid, solid-state circuit breakers can give utilities access to information such as what loads are being used, where they are located, how they are being used, and at what time during the day. This information can help utilities manage variability and make decisions that lessen the burden on the power grid.