DC Circuit Breaker for Emerging Power Systems

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DC circuit breaker utilizes coupled inductance to automatically switch off; eliminating the need for Fault Detection

Market Overview

This circuit breaker naturally distinguishes between a fault on a DC power system and load charges which occur regularly, effectively improving the manufacturing and reliability of DC systems. Many non-traditional energy sources, such as solar panels, fuel cells, and batteries, supply direct-current (DC) power. This has led to development of DC power systems for a number of applications since conversion to alternating-current (AC) can be eliminated. For example, DC distribution is now used for computer data centers, office buildings, and ship power and propulsion. Though the source, loads, and other components in a DC power system are well understood, there is an interest in experimental work on the protection scheme since a DC system does not have a zero crossing in the current and circuit breakers can't open up a faulted component without sustaining an arc. Clemson University researchers have developed a DC circuit breaker that uses a short conduction path between the breaker and load along with inductive coupling to automatically switch off in response to a fault. The breaker responds to faults such as abnormally high currents without the need for detection and control circuitry. The design also has fewer components than other solid-state breakers; improving manufacturability and reliability.

Technical Summary

Clemson University has developed new circuit breakers for DC applications that have fewer components, a common ground path, and that can easily distinguish between a fault and natural step changes in load. When an abnormally high current becomes present, the DC circuit breaker utilizes coupled inductance to automatically switch off. This intrinsic mechanism eliminates the need for detection and control circuitry. It also has a crowbar-type switch on the output so that it can be used as a DC ON/OFF switch. A prototype has been constructed that sustains a 200 percent step change in load, but switches off in response to a direct fault on a 100V DC circuit.

Application

Hybrid electric vehicles; battery energy storage; microgrid

Development Stage

Validated Prototype

Advantages

- Reduces the number of components required of a solid-state DC circuit breaker, improving manufacturability and reliability
- Automatically switches off in response to faults, eliminating the need for detection and control circuitry
- Designer can determine the amount of transient current that will be identified as a fault, providing variability and flexibility for the user

App Type	Country	Serial No.	Patent No.	CURF Ref. No.	Inventors
Utility	United States	14/988,838	NA	2015-017	Dr. Keith Corzine

About the Inventor

Dr. Keith Corzine

Warren H. Owen-Duke Energy Distinguished Professor of Electrical and Computer Engineering at Clemson University

Dr. Keith Corzine earned his Ph.D. in Electrical Engineering from the University of Missouri - Rolla. Prior to joining Clemson University, he was an Assistant and Associate Professor at the University of Wisconsin - Milwaukee as well as an Associate Professor and Professor at Missouri University of Science & Technology. His research interests focus in the areas of electric machinery, power conversion, and power systems.

For more information on this technology contact:

curf@clemson.edu
Please put technology ID in subject line of email.