European Solar and Energy Storage Solutions

Reasons for circulation suppression in energy storage systems

Overview

The structural characteristics of modular multilevel converters (MMC) lead to circulating current problems, which increases the requirements for device capacity and withstand voltage levels. Therefore, this paper proposes a circulating current suppression strategy based on new sliding mode control.

The structural characteristics of modular multilevel converters (MMC) lead to circulating current problems, which increases the requirements for device capacity and withstand voltage levels. Therefore, this paper proposes a circulating current suppression strategy based on new sliding mode control.

A new composite circulating current control structure based on the repetitive controller is proposed in this paper to suppress the harmonics of circulating current well and have good dynamic response performance. The causes of circulating current and the principle of repetitive control are first analyzed in this paper.

However, the circulation causes bridge arm current distortion and converter station loss. This paper designs circulation suppression strategy based on quasi-PR controller, which can effectively suppress the double, quadruple, and six-frequency circulation component by setting four quasi-PR controllers.

The results show that the method can effectively suppress parallel circulating current and solve the problems of difficult parameter adjustment and poor adaptability to power mutation in .

This study analyzes the circulating current according to its causes and reviews the reduction methods. The reduction methods for modular inverters are compared in terms of efficiency, performance, and reliability.How is circulating current suppressed?

Part of the circulating current is suppressed, but there are nevertheless a small quantity of high-order harmonics, at 1 s, the combined circulation suppression method of active disturbance rejection and virtual impedance is added, the amplitude of the bridge arm circulating is reduced, essentially suppressing the circulation current.

What is circulating current suppression method based on active disturbance rejection control?

Circulating current suppression method based on active disturbance rejection control. By setting the virtual impedance of the MMC system, the internal resistance of the system can be increased, so as to aspect the fluctuation of the AC component of the circulating current. The virtual impedance link can be realized by a first-order inertia link.

How to reduce circulating current?

Another common method involves adding high-impedance inductors or modified LCL filters to restrain the circulating current . These methods are only effective for high-frequency circulating current. However, the additional passive hardware decreases the power density of the system.

Can a high-accuracy clock source reduce the circulating current?

The carrier difference can be reduced using a high-accuracy clock source; however, it cannot eliminate the circulating current completely. In a previous report , the amplitude of the circulating current was calculated as follows through the variation of the circulating current during half of the switching period.

How can MMC circulation suppression be achieved?

The existing MMC circulation suppression methods are mainly divided into hardware methods and software methods. Literature [4] proposes that the circulation suppression can be achieved by increasing the bridge arm reactance, but at the same time it also increases the system volume and cost.

How to reduce circulating current in a modular inverter?

The reduction methods for modular inverters are compared in terms of efficiency, performance, and reliability. The possible approaches for circulating current reduction are categorized into three groups–hardware, control, and modulation. Each reduction method is discussed according to the category.

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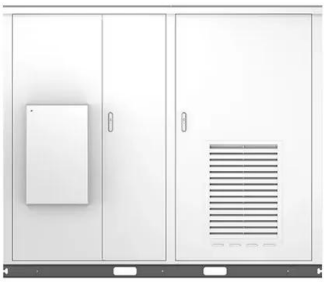

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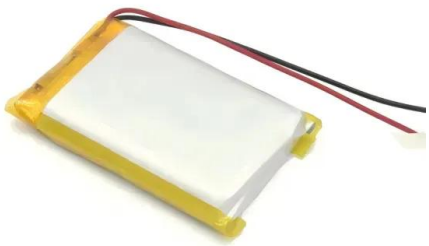

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