Photovoltaic DC Bridge

Article Overview

A Photovoltaic DC Bridge is a DC-DC converter topology, such as a dual active bridge (DAB) or full-bridge converter, used to efficiently interface PV modules with energy storage or grid systems while enabling bidirectional power flow and maximum power point tracking.

Overview

Photovoltaic DC bridge converters are specialized DC-DC converters designed to manage power from PV modules. They serve multiple purposes: stepping up or down voltage, isolating circuits, enabling bidirectional energy flow, and ensuring maximum power extraction from PV modules under varying conditions . These converters are particularly useful in systems with energy storage, microgrids, or grid-connected PV arrays.

Key Topologies

1. Dual Active Bridge (DAB) Converter

o Consists of two full-bridge circuits connected via a high-frequency transformer.
o Provides bidirectional power flow, allowing energy to move between PV modules, batteries, and the DC bus .
o Offers high voltage conversion ratios and electrical isolation.
o Uses phase-shift control to regulate power transfer efficiently, often achieving zero voltage switching (ZVS) to reduce losses .
o Suitable for small-scale residential PV systems and integration with batteries for energy storage . 2. Phase-Shifted Full Bridge (PSFB) Converter
o Designed for medium-voltage DC collection networks in PV power plants.
o Composed of a low-voltage inverter, medium-frequency transformer, rectifier, and output filter .
o Controlled by adjusting the phase shift between leading and lagging legs to regulate DC-link voltage.
o Provides unidirectional power flow with high efficiency and fault tolerance, making it suitable for grid-connected PV systems . 3. Microconverter Implementations
o Single PV modules can be paired with small DC-DC converters (microconverters) that operate in buck, boost, or intermediate bridge modes .
o These microconverters implement module-level MPPT, mitigating issues from partial shading or mismatched modules.
o Efficiency can exceed 95% over a wide load range, ensuring optimal energy harvesting .

Applications

o Standalone PV systems: Step up PV voltage to match load requirements or battery voltage.

o Grid-connected PV systems: Interface PV arrays with high-voltage DC buses or micro-inverters.
o Energy storage integration: Enable bidirectional charging and discharging of batteries while maintaining PV power output stability .
o Partial shading or mismatched modules: Microconverter-based DC bridges allow each module to operate at its maximum power point independently .

Advantages

o High efficiency and reduced power losses due to ZVS and optimized switching.
o Flexibility in voltage conversion and bidirectional energy flow.
o Improved energy harvesting under non-uniform irradiation conditions.
o Electrical isolation for safety and system reliability.
o Scalability for both residential and utility-scale PV installations. Photovoltaic DC bridge converters are therefore critical components in modern PV systems, enabling efficient energy conversion, storage integration, and reliable operation under variable environmental conditions .

In this system, an LLC type DC-DC converter based on IGCT and magnetically integrated transformer was proposed

To mitigate the effect of power ripple, a single phase DC-AC Dual Active Bridge (DAB) converter for photovoltaic applications is

This paper focuses on a bidirectional dual active bridge (DAB) based dc/dc converter to fulfill the required function of regulating the

This article addresses the challenges of the reduced efficiency in phase-shifted full-bridge series resonant converters

Qin G, Ma H, Lei J, Hao C. Advanced Control Strategies for Enhancing the Performance of Phase-Shifted Full-Bridge

The dual active bridge (DAB) dc-dc converter is identified as one of the most promising

In the wake of the global energy crisis, the integration of renewable energy resources, energy storage devices, and

A large-scale grid-connected PV system with cascaded H-bridge cells connected to PV modules through isolated

Photovoltaic DC Bridge

To acquire a high voltage gain in photovoltaic (PV) and other renewable energy

Medium-voltage (MV) multilevel converters are considered a promising solution for large scale photovoltaic (PV)

Abstract: In this paper, a fault-tolerant Multiport Single Diode Bridge (MSDB) converter is proposed for distributed photovoltaic

Download Citation | Design and implement of photovoltaic dc grid-connected converter based on boost isolated full

This article presents the application of a phase-shifted full bridge (PSFB) converter for medium voltage dc collection

The dual active bridge (DAB) converter is widely used in industrial applications where high power density, isolation and bidirectional

A DC/DC converter scheme based on a boost full bridge isolated power module cascaded in input parallel output

The implementation of soft-switching across all three bridges enhances the converter"s overall efficiency. presents

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