CURRENT-PROGRAMMED MODULATION OF FLYING CAPACITOR MULTILEVEL CONVERTERS

Tech ID: 34183 / UC Case 2025-187-0

PATENT STATUS

Patent Pending

BRIEF DESCRIPTION

Flying Capacitor Multilevel Converters (FCMLCs) are widely used in high-power applications, but they present significant control challenges, particularly in maintaining stable and balanced voltages across the numerous flying capacitors while achieving continuous and fast output voltage regulation. This innovation, developed by UC Berkeley researchers, discloses a novel current-programmed modulator with smooth bin transitions that inherently addresses these challenges. The modulator achieves continuous full-range output voltage regulation and, critically, fast flying-capacitor voltage-balancing dynamics . By programming the current and ensuring smooth transitions between the modulator's operational bins, the technology overcomes the limitations of traditional control methods, resulting in a more reliable, efficient, and robust converter topology suitable for demanding high-power applications.

SUGGESTED USES

- High-power motor drives and grid-tied inverters where FCMLCs are employed.
- Renewable energy conversion systems, such as solar and wind power inverters.
- Electric vehicle (EV) charging infrastructure requiring precise and stable high-voltage conversion.
- Uninterruptible Power Supplies (UPS) for critical applications.

ADVANTAGES

- Achieves inherent capacitor voltage balancing, simplifying control circuitry and improving reliability.
- Provides fast flying-capacitor voltage-balancing dynamics, critical for stable operation under transient conditions.
- Enables continuous full-range output voltage regulation.
- Features smooth bin transitions in the current-programmed modulation scheme, reducing undesirable switching noise and stress.
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INVENTORS

- Pilawa-Podgurski, Robert C.N.

OTHER INFORMATION

CATEGORIZED AS

- **Energy**
  - Other
  - Storage/Battery
  - Transmission
- **Engineering**
  - Engineering
  - Other
- **Nanotechnology**
  - Electronics
- **Transportation**
  - Automotive

RELATED CASES

2025-187-0

Offers a robust and efficient control solution for Flying Capacitor Multilevel Converters.

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Multi-Phase Hybrid Power Converter Architecture With Large Conversion Ratios
- Enabling Partial Soft-Switching Within Regulating Switched Capacitor Converter
- Thermal Test Vehicle For Electronics Cooling Solutions

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