A CIRCUIT FOR CONTROLLING VOLTAGE STRESS IN A POWER CONVERTER CIRCUIT AND A METHOD

IITM Technology Available for Licensing

Problem Statement

- Achieving soft turn-on switching is crucial for designing compact converters with high power densities, especially with Wide Band Gap (WBG) devices like SiC and GaN, where turn-on switching losses outweigh turn-off losses.
- Existing solutions for achieving natural zero current turn-on switching often overlook the issue of voltage overshoot in commutating diodes, which is critical for fast switching devices like SiC MOSFETs and GaN devices.
- There is a need for a circuit and technique that effectively controls voltage stress in power converter circuits, particularly with WBG devices, while ensuring simplicity, compactness, and robustness against parasitic inductances in snubber loops.

Technology

- **Soft Turn-On Switching for WBG Devices:**
  The increasing adoption of Wide Band Gap (WBG) switching devices like SiC and GaN necessitates achieving soft turn-on switching to minimize losses and enable higher switching frequencies for compact converters.
- **Addressing Voltage Overshoot and Stress in Power Converters:**
- Existing techniques for soft turn-on switching often overlook the voltage overshoot in commutating diodes, which is critical for fast-switching devices. Additionally, there's a need to limit voltage stress in power converter circuits to ensure efficient operation and reduce losses.
- **Simplified and Robust Snubber Circuits:**
- There's a demand for innovative snubber circuit designs that accommodate the ultra-fast switching times of WBG devices while maintaining simplicity, compactness, and robustness against parasitic inductances. These circuits should effectively control voltage stress and recover switching losses without adding complexity or increasing circuit size.

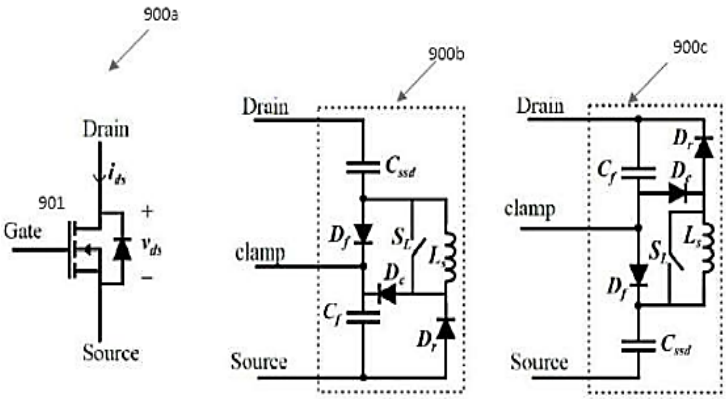

FIG.1 Depicts improved snubber circuit for switching device configurations to limit the ringing and overshoot in Dr diode.

Technology Category/ Market

Category - Power Electronics
Applications- Renewable Energy Systems, Electric Vehicles (EVs)
Industry - Power Electronics & Automotive

Market- Global power converter market was valued at $20.9 billion in 2022 and is estimated to reach $44.6 billion by 2032, exhibiting a **CAGR of 7.8%.**

Intellectual Property

- IITM IDF Ref. **2140**
- **IN 486370 - Patent Granted**

TRL (Technology Readiness Level)

TRL - 3, Proof of concept stage

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Key Features / Value Proposition

1. Voltage Stress Control:
Efficiently control voltage stress in power converter circuits using innovative snubber circuit configurations, enhancing reliability and longevity.

2. Versatile Device Compatibility:
Compatible with various power diode and switching device configurations, ensuring adaptability to different converter designs and applications.

3. Uninterrupted Operation:
Maintain stability and functionality during switching operations with unaffected snubber circuit configurations, minimizing disruptions and downtime.

4. Precise Voltage Regulation:
Achieve precise voltage regulation with clamp terminals connected to Stiff Voltage (SV) elements, optimizing performance and efficiency.

5. Reduced Size and Complexity:
Streamlined snubber circuit designs offer simplicity and compactness, reducing overall size and complexity of power converter systems.

6. Enhanced Efficiency and Robustness:
Improve efficiency and robustness of power converter circuits by effectively controlling voltage stress and mitigating parasitic inductances in snubber loops.

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