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# Unified Power Quality Conditioner (UPQC) for Harmonic Suppression and Voltage Stabilization: A Control Strategy Approach Validated through MATLAB Simulation

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**Abstract**: *The rapid evolution of communication technologies, digital electronics, and control systems has amplified the reliance on sensitive loads that demand a stable sinusoidal voltage supply for optimal functionality. Consequently, adherence to power quality standards necessitates the implementation of advanced compensation strategies. This research addresses prevalent power quality challenges—including voltage fluctuations, harmonic distortions, transient disturbances, and reactive power imbalances—by proposing a Unified Power Quality Conditioner (UPQC). The UPQC integrates series and shunt active power filters (APFs) in a back-to-back configuration, interconnected via a shared DC-link capacitor, to simultaneously mitigate grid-side and load-side disturbances. While the series APF compensates for voltage-related anomalies, the shunt APF alleviates current-related distortions, ensuring compliance with regulatory frameworks. The growing complexity of power demand patterns, driven by non-linear and dynamic loads, underscores the urgency for such hybrid solutions. This study evaluates the proposed UPQC topology through MATLAB Simulink-based simulations, demonstrating its efficacy in stabilizing voltage profiles, suppressing harmonics, and balancing reactive power under varying load conditions. The results validate the UPQC's ability to enhance grid reliability, offering a robust solution for modern power systems grappling with escalating quality and stability demands.*

**Keywords**: Power Quality, UPQC, Power Distribution system etc



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