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Study of Harmonic Suppression in Single-Phase Power Systems

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Abstract: *Harmonic distortion in single-phase power systems significantly impacts power quality, leading to equipment malfunction, increased losses, and reduced efficiency. This study uses simulation-based analysis to investigate harmonic suppression techniques using passive, differential, and active filters. Passive filters are evaluated for their cost-effectiveness and simplicity in attenuating specific harmonic frequencies, while differential filters are examined for their ability to mitigate common-mode harmonics. Active filters, employing power electronics and adaptive control algorithms, are analyzed for their dynamic compensation capabilities across a wide harmonic spectrum. A comparative performance assessment is conducted in a simulated single-phase system under varying load conditions, considering factors such as total harmonic distortion (THD) reduction, transient response, and implementation complexity. The results demonstrate the effectiveness of each filtering approach, providing insights into optimal filter selection based on system requirements. The findings contribute to improved harmonic mitigation strategies, enhancing power quality in single-phase electrical networks.*

Keywords: Harmonic suppression, passive filters, differential filters, active filters, power quality, THD, single-phase systems.