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This paper proposes a new concurrent UPQC scheme for improving the four different power quality issues in solar photovoltaic (PV) system. Voltage sag, voltage swell, load variations and current harmonics in a grid-connected solar PV system is the preliminary survey for this particular work. The operating regions of each power quality issue are examined in the I-V curves of PV specifications and the new operating modes of PV systems are mapped for every quality improvement considering the power, current, frequency of the grid and load as well. The pool of solutions is developed from the real power, reactive power and converter duty cycle and verified with the proposed scheme. Additionally, the designed switching frequency of the proposed system has a 5% variation for practical irradiance. The PV uniform irradiance profile matches the real various proposed concurrent UPQC schemes. The analysis of harmonic components after implementing the proposed concurrent UPQC scheme for PV system

Description: The proposed system is a novel concurrent Unified Power Quality Conditioner (UPQC) integrated into grid-connected photovoltaic (PV) systems to address and mitigate power quality issues such as voltage sag, voltage swell, non-linear load variations, and current harmonics. The system consists of series and shunt converters connected to the PV system and the electrical grid. The series converter is responsible for voltage compensation by injecting the necessary voltage to counteract sags and swells, while the shunt converter manages current harmonics and reactive power flow, ensuring the stability and quality of the grid power. At the heart of the system is an intelligent control mechanism that continuously monitors the power flow, voltage, current, and frequency parameters of the grid and the PV system. The control system performs real-time analysis of the PV system's I-V curves, mapping different operating modes based on irradiance levels, load demands, and grid conditions. By dynamically adjusting the converter duty cycle, the system ensures optimal power transfer and maintains grid stability. Claims: 1. A concurrent Unified Power Quality Conditioner (UPQC) system integrated with a photovoltaic (PV) system for improving power quality, wherein the system mitigates voltage sag, voltage swell, non-linear load variations, and current harmonics in grid-connected PV systems.

2. The system of Claim 1, wherein the series converter compensates for voltage variations by injecting or absorbing voltage to maintain consistent power delivery during voltage sags and swells.
3. The system of Claim 1, wherein the phase voltage error is maintained between 3 V and 12 V, providing higher voltage regulation accuracy compared to existing power quality control systems.
4. The system of Claim 1, wherein the concurrent UPQC system synchronizes the real and reactive power of the PV system with the grid's frequency and voltage requirements, ensuring uniform power matching and scalability across residential, commercial, and industrial applications.

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