Abstract:

In this paper, a direct power control (DPC) approach is proposed for grid-tied AC MG's photovoltaic (PV) voltage source inverter (VSI) to regulate directly active and reactive powers by modulating microgrid's (MG) point of common coupling (PCC) voltage. The proposed PCC voltage modulated (PVM) theory-based DPC method (PVMT-DPC) is composed of nonlinear PVM, nonlinear damping, conventional feedforward, and feedback PI controllers. For grid synchronization rather than employing phase-locked-loop (PLL) technology, in this study, direct power calculation of the PCC voltage and current is adopted. Subsequently, at PCC, the computed real and reactive powers are compared with reference powers in order to generate the VSI's control signals using sinusoidal pulse width modulation (SPWM). Because of the absence of the PLL and DPC method adoption, the suggested controller has a faster convergence rate compared to traditional VSI power controllers. Additionally, it displays nearly zero steady-state power oscillations, which assures that MG's power quality is improved significantly. To validate the proposed PVMT-DPC method's performance real-time simulations are conducted via a real-time digital simulator (RTDS) for a variety of cases. The results demonstrate that PV VSI using the suggested PVMT-DPC approach can track the reference power quicker (0.055 s) along with very low steady-state power oscillations, and lower total harmonic distortion (THD) of 1.697% at VSI output current.