Abstract

In the present paper, design and numerical implementation of a Multi-loops quasi-linear control technique is proposed for a three-phase three-level boost-type AC/DC Vienna converter. Acquiring high stability and perfect rejection of disturbances and initial conditions, the lately introduced quasi-linear theory is very suitable for power electronic circuits, subjected to diverse operating disturbances and parametric changes. Inner feedback loops ensures *dq* currents tracking and cross-decoupling cancellation with respect to the *dq* control inputs, thus adequately controlling the power flow from the grid to the load. In the same inner loop, the zero-sequence component of control inputs ensures the symmetry of split DC bus voltages. The obtained *dqo* components for control variables, transformed into their *abc* equivalents to generate the converter switches duty cycle profiles, are, thereafter, pulse-width modulated, thus yielding the I.G.B.Ts gating signals. The outer voltage loop is designated to ensure total DC voltage regulation by adjusting the magnitude of the current reference for the inner current loops. The proposed control strategy is based on a previously established and experimentally validated small signal model, expressed in the *dqo* reference frame. At a first stage, the proposed theoretical control approach is simulated using the converter switching function model built on SIMULINK/ Matlab. Then, the proposed control scheme is experimentally validated on a 1.5 k W laboratory prototype using the DS 1104 controller board of dSPACE. Low AC line currents Total Harmonic Distortion (THD), unity Power Factor (PF) operation and regulated split DC bus voltages are achieved, for a wide clan of operating conditions, including severe utility and load disturbances.

Keywords—AC-DC power conversion, power conversion harmonics, multi-level converters, multivariable systems, time-varying systems, robustness, tracking loops, real-time processing.