Chapter No.2 -Literature Review

The AC supply current in a phase-controlled drive is non-sinusoidal. This will affect the performance of the drive as far as supply is concerned. The performance can be assessed in the terms of the parameters like Input fundamental power factor \((SPF)\), Input displacement factor \((DF)\), and Harmonic factor \((HF)\).

The non-sinusoidal nature of the input current drawn by the rectifiers increases reactive power, input current harmonics and input voltage distortion. This can be over come by using number of passive and active current wave shaping techniques [1-11] suggested in the literature. But the passive power factor correction techniques have the disadvantages like large size of reactive elements, power factor improvement for a narrow operating region, large output dc voltage ripple [1]. Active current wave shaping techniques overcome these disadvantages and significantly improve the performance of rectifiers. Hysteresis current control is a simple active current wave shaping technique that gives close to unity power factor operation while delivering near sinusoidal currents. But when applied for three-phase rectifier requires three such identical stages of single-phase rectifiers [2]. Three-phase diode rectifiers using discontinuous conduction of rectifier input current with a single boost switch gives close to unity power factor at constant turn-on time and frequency of the boost switch [3-4]. Current control technique may use continuous conduction mode or discontinuous conduction mode. The popular continuous mode of conduction with switch mode rectifiers are hysteresis current control with constant hysteresis window, Bang hysteresis current control and constant switching frequency current control with error triangulation [5-7]. Discontinuous mode of conduction operates with constant switching frequency and variable turn-on time using one or two switches [8-9]. In EAC it should yield the same area for the discontinuous current pulse as that of the area under reference input current in every switching period. Thus the criterion yields grater accuracy for single-phase rectifiers since it has a freedom to vary the turn-on time [10]. Several dedicated power factor controller integrated circuits such as Microlinear’s \textit{ML4812} [11] and Unitrode \textit{UC2854} [12] are currently available.
Zheren Lai proposed a family of constant switching frequency Pulse-Width-Modulated controllers for power factor correction that uses continuous conduction mode [13-15]. For PF improvement the different techniques used are just touched upon. Each method is having its own advantages and drawbacks. Depending on the application in hand and the cost one has to select the method. The methods are Phase Angle Control (PAC), Asymmetrical Angle Control (AAC), Extinction Angle Control (EAC), Symmetrical Angle Control (SAC) and Pulse Width Modulation Control (PWMC).

New generation of ac-ac single-phase and three-phase power converters with more commutations per half cycle is proposed for ac power due to the increasing availability and power capability of high frequency controlled-on and off power semiconductor switching devices. Three phase ac-ac converter whose control strategy is based on modified sinusoidal pulse-width modulation switching technique. As majority of the industrial loads are being inductive, the power factor is less. To improve the power factor, the delayed current is shifted to the input voltage, through a modification of the classical sinusoidal pulse width modulation switching technique. In this way, the decrease in the phase angle between the input current and voltage is feasible, and consequently, high cost compensation capacitors can be avoided. The improvement of power factor through this switching technique on the proposed converter is investigated and verified via simulation using the software Matlab/Simulink [30-32].

The need for solid-state ac-dc converters to improve power quality in terms of power-factor correction (PFC), reduced total harmonic distortion at input ac mains, and precisely regulated dc output have motivated the proposal of several topologies based on classical converters such as buck, boost, and buck-boost. Additionally, novel control techniques dedicated to PFC has introduced, motivating the manufacturing of commercial integrated circuits to impose sinusoidal currents in the front-end stage of switch-mode converters. Boost converters operating in continuous current mode (CCM) have become particularly popular because reduced electromagnetic interference (EMI) levels result from its utilization. Within this context, this work deals with a comprehensive review of some of the most relevant ac-dc singlephase boost converters for PFC applications. The evolution
of the conventional boost converter is demonstrated in terms of improved characteristics achieved by other boost-based topologies. Besides, it seeks to establish a fast and concise guide on ac-dc boost converters to researchers and experts in power electronics by comparing the topologies [33-34].

The method of using Boost type of converter was proposed for a 300W single-phase rectifier. By designing the necessary techniques and methodology, the overall Power Factor (PF) and Total Harmonic Distortion is improved to the expectation. The cause of having low PF and high THD for a diode-capacitor type of rectifiers is related to non-linearity of the input current. Method of re-shaping the input current waveform to be similar pattern as the sinusoidal input voltage is done by the Boost converter and the related controls that act as a Power Factor Correction (PFC) circuit. The results of the designed system were compared against with and without PFC control. The international standard IEC 61000-3-2 on harmonics was used as the reference to determine the performance of the project.