

## 摘 要

多階轉換器架構一般皆用於大功率之場合，其主要目的在於降低每個開關上之電壓、電流應力，以及藉由多階合成輸出波形，以減小輸出波形之諧波失真量。然而近年來國際上不論是在單相或是三相系統有關之多階架構研究，絕大部份均著重於電壓等級高之多階電壓型直交流轉換器上，但針對三相或單相系統於大電流應用之多階電流型直交流轉換器之研究著作則寥寥無幾，緣此動機，本論文主要目的即在針對單相電流型直交流轉換器之多階架構進行研究。

本論文之主要貢獻可分下列四點說明之。第一，提出一新型單相多階電流型直交流轉換器架構，可以避免現有文獻中單相多階電流型電路架構開關電流分配不均之缺點，進而增加轉換器之可靠度與壽命。第二，除了分析所提出新型架構五、七階輸出電流情況外，同時並擴展此新型架構，可將其延伸至 $2n+1$  ( $n \geq 4$ ) 階型式。此外，此新架構亦可直接擴展成三相多階電流型直交流轉換器。第三，本文亦提出一簡易載波合成技巧，透過簡易合成方式，藉著將所得之載波信號與調變信號加以比較，即可輕易獲得開關所需之調變切換信號，而不需如以往必需用到許多額外邏輯閘元件進行邏輯運算，以獲得開關所需之切換調變信號。此項技巧不僅改善了以往利用多載波調變技術於實作上之繁複性，同時使得電路運作更為可靠與穩定，並亦可以降低製作成本。第四，本文所提出之新型控制策略，不僅可用以產生弦波輸出電流，並可使輸出負載電流追隨非正弦類參考信號，故可作為低頻功率放大器用。最後併實體製作一離型系統，提供一些實測結果，以驗證所提新型轉換器之可行性。

## Abstract

Multilevel converters are usually used in high power applications to reduce the voltage and current stress of the active switches and meanwhile to achieve better output waveform quality. Recent researches are basically focused on the voltage source multilevel dc to ac converters. Concerning the multilevel current source dc to ac converters, only very few papers are available in the literature. In view of this, the main purpose of this thesis is focused to the study of single-phase current source dc to ac converters.

The contributions of this thesis may be summarized as follows. First, a novel configuration of single-phase multilevel current source dc to ac converter is proposed to achieve better performance as compared with that of the existing literature. Second, operation principles of both five-level and seven-level configurations are presented. It turns out that the proposed multilevel configuration can be extended to  $2n+1$  ( $n \geq 4$ ) level as well as three-phase system easily. Third, a simple carrier signal synthesis technique is proposed to obviate using many logic gates for getting the desired carrier signal. Hence, by comparing the modulating signal with the carrier signal, one can obtain the switching signal easily and more reliably. Fourth, the proposed multilevel converter cannot only be used to generate clean sinusoidal output current but also can be used to track other nonsinusoidal command signals. In other words, it can be used as a low frequency power amplifier. Finally, a prototype is also constructed and experimental results are presented to verify the feasibility of the proposed converter.