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Digital Charger Powersource for Electric Vehicle Based on TMS320LF2407A

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Abstract

The significance of researching on digital charger was simply introduced firstly. The theory of digital charger main circuit was particularly analyzed composed of shift-phase full bridge inverter and secondary rectifier. Control system circuit based on the TMS320LF2407A, software and digital PID controller was particularly designed. Outcome of the experiment and technical parameter were given. The charger has good output characteristic with soft switching, digital control and could meet the need of complex charging method of different kinds of battery.

Keywords: Electric Vehicle; Charger; Digital control; Soft-switching; PID

1. Introduction

With the continuous development of electric vehicle industry, suitable for electric vehicles special requirements of power battery is also in constant development, so the requirements of special charger is also enhanced unceasingly. The ever-improving DSP technology marking the rise of digital technology makes the control field also face a major technological change. Therefore, researching for digital control technology of special charger electric vehicles will have very important theoretical significance and application value to develop domestic electric vehicle charging devices [1].

Lord loop of charging machine is the basis of digital charger, affects the performance of charger directly .Inverter type power has characteristics of small volume and light quality; It has the very high

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response speed because of the high working frequency, and it easy to realize complex output characteristic to meet the need of charging curve of different charging strategy. Therefore, this paper regards the scheme of full- bridge with secondary rectification as the main circuit of charger.

Main circuit principle diagram is shown in Fig.1,Vs represents DC voltage which get from single-phase or three-phase ac rectifier, Q1 - Q4 is the power switch IGBT, T1 is the power transformer, D1, D2 is rectifier diode in the secondary-side of transformer, Lf and Cf is output filtering inductance and filter capacitance respectively.

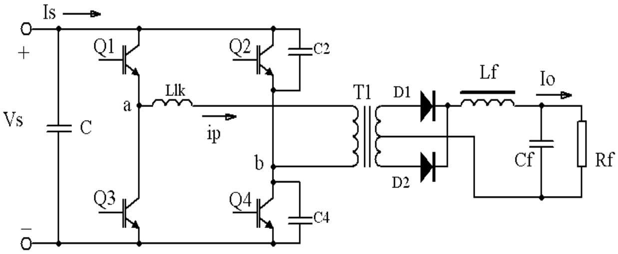

Fig.1 The main circuit schematic

Driving pulse timing diagram is shown in Fig. 2, it is almost as same as the traditional phase shifting control, but the dead time between Q2 and Q4 vary with duty cycle (such as the shaded part shows). When the bus voltage is with higher or lighter load, it will have more delay time between Q2 and Q4. In each half a cycle, Q4 and Q1 will be opened at the same time, but Q4 will be turned off first. So Q2 and Q4 compose early bridge arms, and the Q1 and Q3 compose lag bridge arms [2].

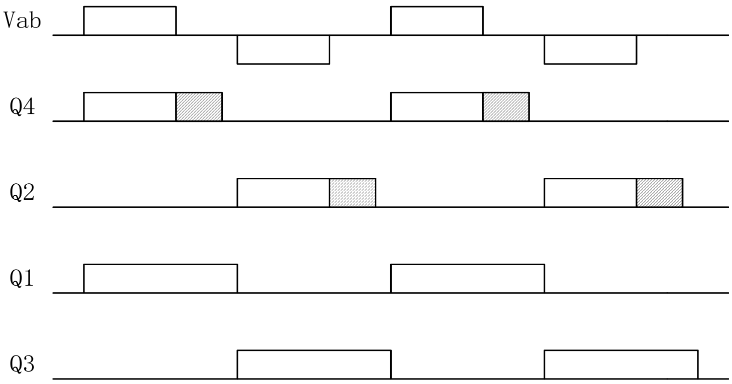

Fig.2 Driver pulse order of the main switch

Assume the Q1 and Q4 working in the on-state at first, and the C2, C4 will be buffer capacitance for ZVS of Q4 when it was turned off at one time. Although trailing current still exist in Q4, but turn-off losses of ZVS will be reduced largely. Llk (Refers to high-frequency transformer leakage inductance and line equivalent inductance) will make the voltage of C4 continue to grow until the reverse voltage applied to Q2 exceeds 30V, and causes reverse avalanche. At that time, Q2 is similar to a zener diode. Avalanche stop when energy (1/2Llkip2) has been transferred to the Q2, meanwhile it make ip attenuate to zero. The potential of b remains above busbar voltage when ip reduced to zero just now, and the voltage difference between b and busbar equal to the IGBT reverse avalanche voltage, so there is low current will reverse