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The Design of Frequency Converter Based on TMS320 F28035

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***Abstract*—This paper introduces a design and realization method of frequency converter based on DSP,In this design, the DSP chip is selected TMS320F28035 and SPWM control technology is adopted.**

Keywords—Frequency converter,TMS320F28035

I. INVERTER INTRODUCTION

The inverter is a kind of electric electronic device that converts the constant voltage and constant frequency power of the power network into variable voltage and frequency conversion power.The inverter is a kind of electric electronic device that converts the constant voltage constant frequency power of the power grid into variable voltage frequency power. Most modern general frequency converters use diodes to rectify and PWM inverters composed of fast-speed fully controlled switchgear IGBT or smart power rate die blocks，compose AC_DC_AC voltage source inverter. Man-Machine interface module

The basic model of the inverter is shown in Figure 1.

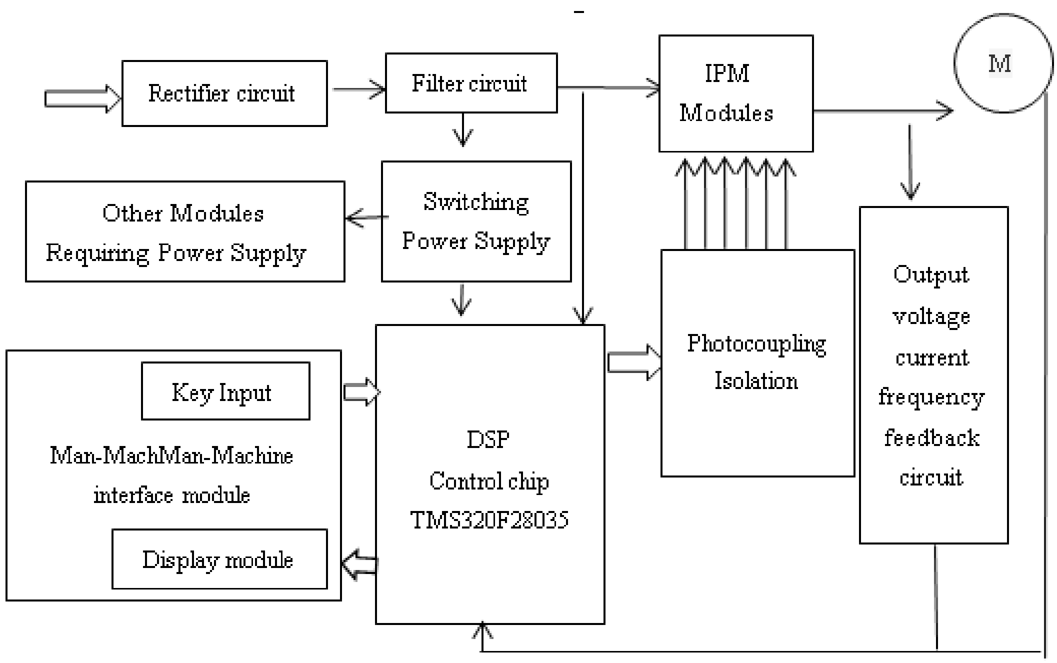

Figure 1. Basic model of frequency converter

The inverter circuit is divided into 4 parts: rectifier, intermediate DC link, inverter link and control circuit.The main circuit adopts a typical voltage type AC-DC-AC general frequency converter structure; The control circuit mainly includes a DSP digital controller, which consists of a DSP, a drive circuit, a detection circuit, a protection circuit, and an auxiliary power supply circuit.

II. TMS320F28035 CHIP INTRODUCTION

The MS320F28035 chip has a high-performance C2XLP kernel. It adopts an improved Harvard structure and four-level pipeline operation. It not only has powerful high-speed computing power, but also integrates a wealth of motor control peripherals. For example, event manager EVA and EVB each include 3 separate bidirectional timers; Supports the production of programmable dead zone control PWM output; The 40 independently programmable multiplexing I/O ports can be selected for keyboard input and oscilloscope display input/output, and so on. These provide great convenience for the realization of AC motor variable frequency speed control.

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III. Overview of the System Master Design Scheme

Figure 2shows the system hardware block diagram. In this system, TMS320LF2407A is the main control chip, and the inverter uses the SPWM modulation control method to implement the frequency conversion control algorithm. The system hardware consists of the main circuit, the display circuit, the keyboard input circuit, and the detection and protection circuit. The DSP first collects the required frequency signal from the keyboard, and then generates the corresponding SPWM signal by operation, and then controls the power tube conduction and shutdown in the inverter bridge through optical coupling transmission to the drive circuit. At the same time, the relevant signals in the main circuit are collected and the fault output is judged. If there is a fault, the SPWM output of the DSP is turned off, thus turning off the main circuit.

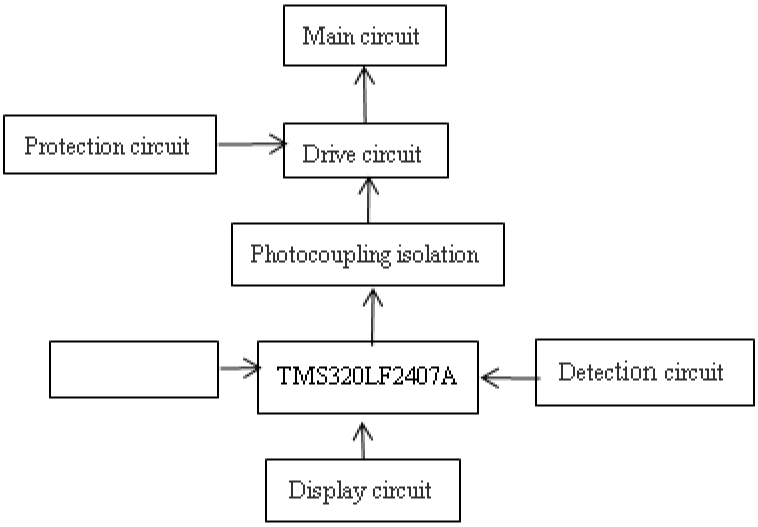

Figure 2. Hardware diagram of the system

IV. Design of Frequency Converter Hardware

A. Design of Frequency Converter Main Circuit

Figure 3 is the main circuit of the system and consists of three parts: rectifier circuit, filter circuit and inverter circuit. The rectifier circuit is a three-phase uncontrollable rectifier bridge, which converts 380 V and 50 Hz AC rectifier into pulsating DC. Filtering capacitance is used in the circuit to filter the voltage ripple, and the filter capacitor also acts as a decoupling between the rectifier circuit and the inverter to eliminate mutual interference. The power devices G1, G2, G3, and G4 in the main circuit diagram represent IGBT devices. The model is MG50 Q2YS40 with a voltage resistance of 1,200 V, a control voltage of 20 V, and a current of 50 A. R1 is a current limiting resistor to prevent damage to IGBTs by impact currents. L1 and L3 are common mode filters, and HL1 and HL2 are current Hall components. Their role is to detect the current value of the main circuit as the input signal of the protection circuit; In addition, voltage Hall components are also used to detect the voltage value as the input signal and voltage feedback signal of the protection circuit, which constitutes negative voltage feedback. The four IGBTs controlled by SPWM technology are reversed. After the output AC is changed by the transformer, the LC filter is used to filter and the 220V frequency variable AC is output.

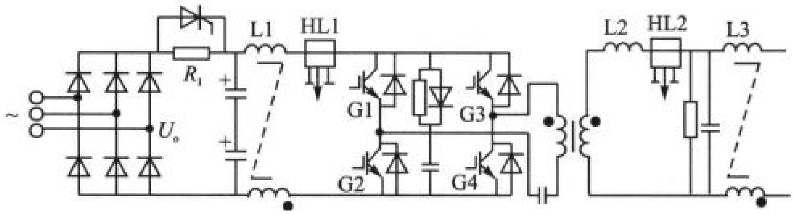

Figure 3. IGBT drive circuit

B. Design of Drive and Protection Circuit

Figure 4 is the driving circuit principle.The drive circuit uses four driver modules M57962 L produced by Mitsubishi. The driver module is a hybrid integrated circuit that integrates the IGBT driver and overcurrent protection. In Figure 4, the 13 feet of the M57962L are connected to the PWMl of the DSP(the other 3 M57962L are connected to PWM2, PWM3, PWM4, respectively), the 14 feet are grounded, and the 1 and 6 feet are connected to the power supply respectively. In addition, the M57962L uses a low voltage drive, that is, only the 13 foot input negative potential can drive the M57962L. The advantage of this is to prevent interference. When the interference waveform occurs, the low level driven M57962L can not drive. In addition, during the shutdown process, if the voltage change is too large, an Optimus phenomenon will occur, causing the IGBT to lose control and cause the upper and lower bridge arms to pass through. Therefore, the RC buffer circuit is used to suppress the overvoltage and voltage change rate du/dt.

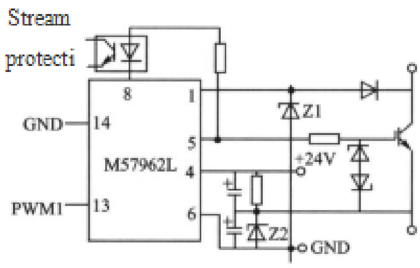

Figure 4. Drive circuit

V. SPWM CONTROL TECHNOLOGY

In order to facilitate digital implementation, a SPWM pulse sequence is generated by regular sampling, the principle of which is shown in Figure 5.Because the triangular carrier frequency is much higher than the sine wave frequency, the sinusoidal modulation wave UT within one cycle of the triangular wave UC is considered constant, so that in a triangular wave cycle, only one sampling at point B is required. The middle point of the generated SPWM pulse can coincide with the middle point of the corresponding triangular wave, thus greatly simplifying the calculation of the SPWM pulse.

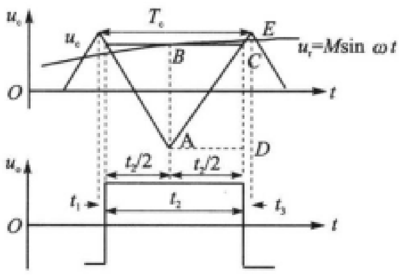

Figure 5. Rule sampling method

VI. SUMMARY

The frequency converter designed according to the above method is simple, stable, and reliable. It greatly simplifies the design of hardware circuits and software programming. At the same time, it enhances the flexibility of control, simplifies the system structure, and improves the stability and reliability of the entire system. It has good application prospect.

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