

## Design of High Frequency Power Oscillator Board Based on Rotary Encoder Control

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**Abstract:** Accurate and stable high frequency pulse power supply is studied to improve high-speed wedm machine tool's efficiency. Regarding to the shortcomings of traditional digital circuit high frequency oscillator board, we design a high frequency power oscillator board based on rotary encoder control, control accuracy and high-frequency waveform by programming, adjusting the frequency and display. It has six brakes of processing function, it also includes feedback function of emulsification oil. The high frequency will be shutdown and the emulsification oil will be changed if there is too much metal dust in emulsification. It has been proved by practice that high-frequency circuit board is simple and reliable and can greatly increase efficiency of wire cutting.

**Keywords:** High-frequency power oscillation plate, MCU control, rotary encoder, WEDM

### INTRODUCTION

WEDM (Wire Electric Discharge Machine) is mainly composed of instrument, impulse power, working liquid cycle system and NC system and machine accessories and so on. High frequency electric spark electrical erosion mold piece is used, which is essential to modern mold processing and it is widely used in China (Wu, 2008). The performance of line high-frequency pulse power is the key factor to decide wire-cutting processing efficiency and processing quality. Currently, traditional digital circuits with switch or potentiometer are used by WEDM to cut work piece by producing high-frequency pulse wave. For the adjusting frequency of traditional high frequency oscillation board can't reach the accuracy of the rotary encoder, it is subjected the restriction of high frequency accuracy when cutting different kinds of piece work (Lin, 2003). This study designs a high frequency power supply through the program control precision of high frequency vibration plates, the frequency adjustment can show, six processing function gear, with rotary encoder tuning frequency, can improve the efficiency of the line shears. Its output sockets and traditional high frequency board arrangement replaces the digital circuit structure of the traditional high frequency oscillation board completely.

**Overall design of the high frequency board of pulse power in WEDM:** In this study, overall control diagram of WEDM high frequency plate is shown as Fig. 1. It consists of the single chip microcomputer control system module, detection feedback control circuit module, button and rotary encoder input module, the high frequency wave packet circuit module, the high frequency wave output and power circuit module and intelligent energy-saving power supply module.

MCU detects the number of pulses when turning by rotary encoder, control the pulse width and between pulses accurately using the recursive form of position type PID control algorithm. The high frequency wave generated from the single chip circuits and the pulse signal synthesis of high frequency PWM control the generation after the intermittent pulse wave through the power amplifier level of the high frequency amplifier after input to the level. To produce high-frequency spark cutting work piece, at the same time in the digital display on the pulse width values. Through the metal dust sensor test between the work piece and molybdenum wire cutting and the dust produced cause a short circuit, feedback adjustment of emulsified fuel processing liquid level and it can avoid the short and cause cutting efficiency reduce or even broken wires (He *et al.*, 2009).

**Hardware design of the high frequency board control circuit:**

**Control design of the revolving encoder:** Rotary encoder is a high precision Angle measuring sensor, with high resolution, fast response and other characteristics, widely used in position or Angle for the object of the control system. This design chooses general incremental rotary encoder, incremental encoder axis rotation, which have corresponding phase output. The rotation of the direction of discrimination and pulse of the increase and decrease of the quantity, the microcontroller programming realize. The starting point count can be arbitrary set and can achieve more laps of infinite accumulation and measurement. When the pulse has been fixed, the need to improve the resolution, with 90° can use phase difference of two signals to the original pulse number time's frequency (Qiu and Zhu, 2000). Its input waveform is shown in Fig. 2.

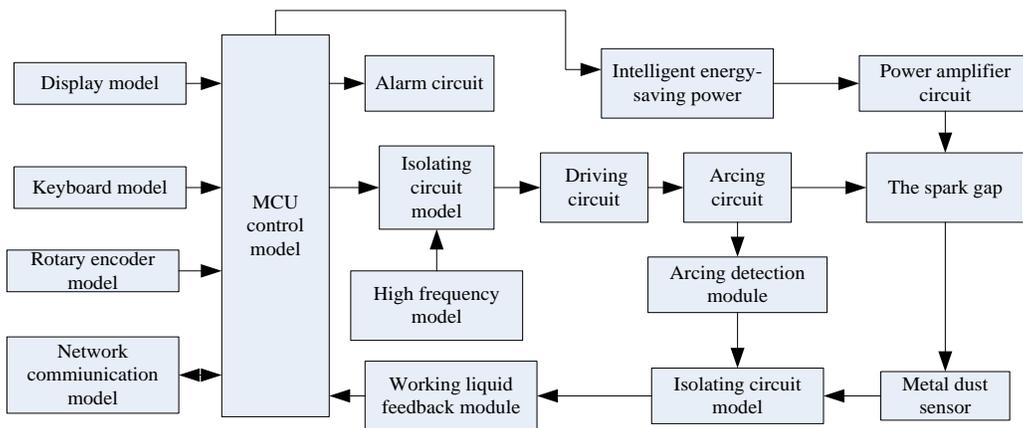


Fig. 1: Overall control diagram of WEDM high frequency plate

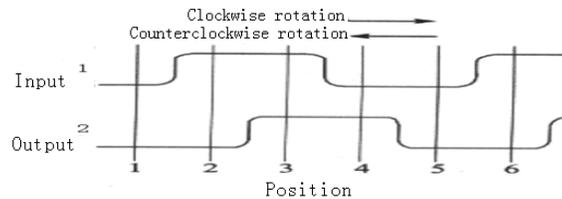


Fig. 2: Rotary encoder wave

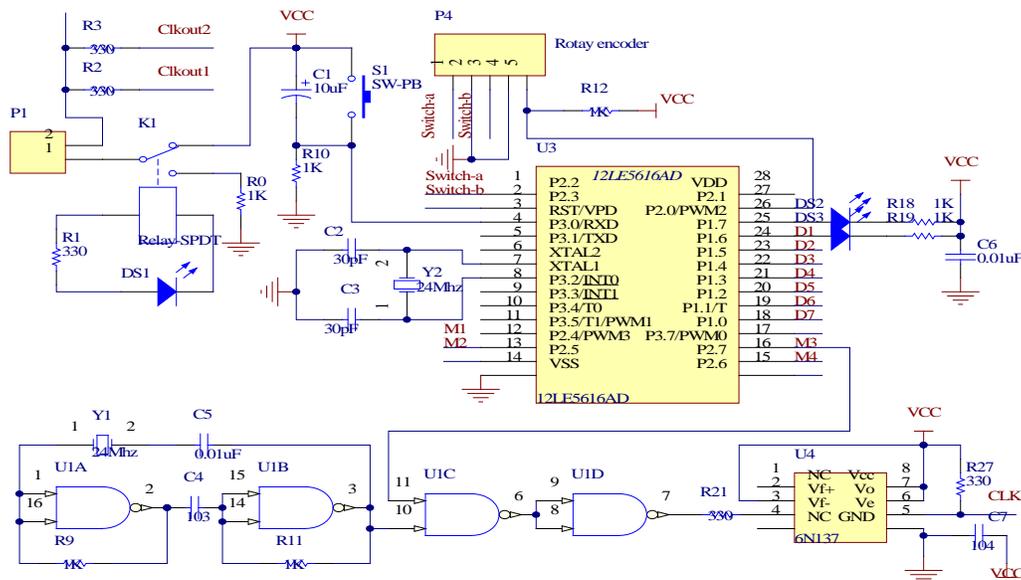


Fig. 3: Circuit diagram of master control module

**Design of microcontroller master control module:**

The master control module circuit is designed by STC12 series microcontroller, low power consumption, high anti-static, strong anti-interference. It has PWM function, 24 MHz crystals, completely meet the design requirements. Spin encoding output pulse signal access port P2.3 and single chip microcomputer P2.4 pin, use of rotary encoder fine-tuning pulse intermission and pulse width, digital pipe display frequency, light touch

button selection process work piece type and processing method function. Four digital tubes are to show the high processing mode and pulse width (Yang *et al.*, 2002). Circuit part principle diagram is shown in Fig. 3.

**Software design of system:** The whole system process design is shown in Fig. 4. The system firstly, initialized, including timer 0 and 1 and timer PWM initialization procedures. Next, it scans the keyboard and starts the

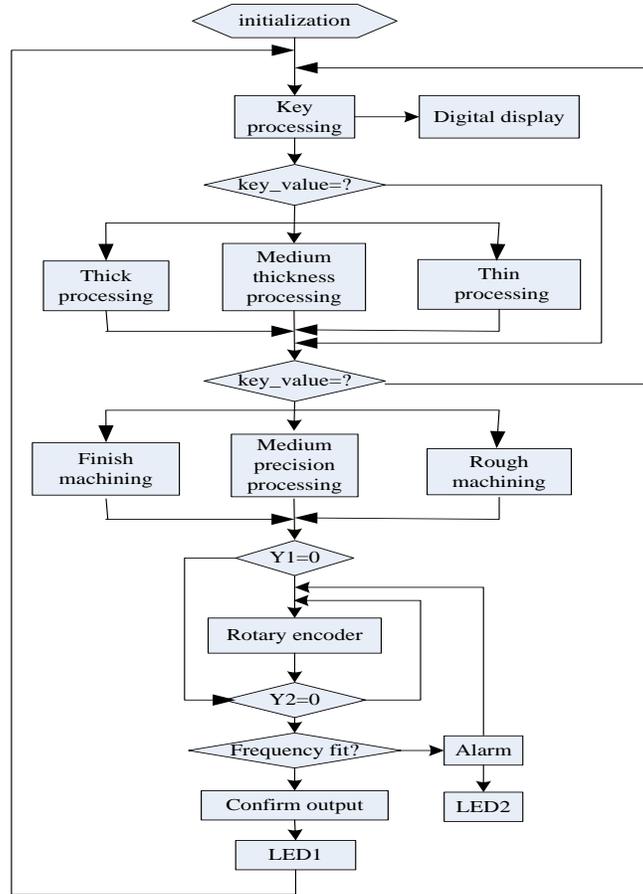


Fig. 4: Flow chart of the whole system

Table 1: Three processing type and processing method of interveinal and proportion

	Processing type			Processing methods		
	Think	Medium	Thin	Rough	Medium	Finish
Intrapulse	60us	40us	20us	40us-60us	20us-40us	4us-20us
Duty ratio	1:14	1:8	1:6	1:8-1:9	1:6-1:7	1:4-1:5

Rotary encoder can click "1, 0" progressive signal input and realized accurate adjustment

digital display. Judge whether the choice of the key processing type, carries on the corresponding processing program. E.g., key choice of method is thin processing. Then, starts the rotary encoder, continues to choose occupies empties compared, determines the selected interveinal after numerical, accurate to 1 us and confirm the output pulse waveform after required, at the same time indicator emit light (Duan *et al.*, 2002).

**System operation and test results:** The high frequency board designed by this study is convenient for operation; turn the choice of processing the three types, thin, middle, thick, respectively. For example, the choice of thin processing, it is a fixed value for 20 us, pulse width and the pulse of the ratio between all can not be adjusted, if want to try to adjust, can choose pure, medium and thick, three processing mode.

Which accounts for empty and pulse width and the pulse than between value as shown in Table 1? Such as press finishing mode, select processing proportion, levorotatory for 1:4, dextral for 1:5, selected after proportion by rotary encoder confirm key, enter fine-tuning, transferred to the best value to press the rotary encoder ok button, right now have waveforms output, the LED indicator emit light.

## CONCLUSION

This design employs revolving encoder to fine-tune frequency, controls precision of high frequency by program and high plasticity, function and parameter any programming adjustment, fine-tuning rotary encoder adjust pulse frequency between the precise. The use of revolving encoder has solved the biggest problem in

fine-tuning, improved the machining efficiency, prevented wire broken and saved the cost. The high frequency oscillation with rotary encoder board of high frequency power can be used in most of WEDM indeed.

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