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The Research and Desige of the CNC Constant Voltage Power

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Abstract

CNC constant voltage power is composed by the analog power circuit, MCU control circuit, pulse width modulation circuit, a power driver amplifier, analog to digital conversion circuit, the input voltage setting circuit and the output voltage display circuit. The power possesses the functions of digital regulator, high precision output, short-circuit & over-current protection and alarm functions, especially for a higher accuracy requirements for various occasions.

Keywords: *CNC power, C8051F410, TL494, constant voltage*

1. Introduction

The role of the constant voltage power is output constant voltage, which is one of the devices commonly used in electronic technology and widely used. Traditional DC power supply features a simple, difficult to control, low efficiency, low accuracy, bulky, but all have the following problems: The output voltage is set by course (band switch) and fine (potentiometer) to adjust. The difficulty is very greater when the output voltage requires accurate output or require changes within a small range of (1.02~1.03V). In addition, with the use of time increases, the band switches and potentiometers inevitably bad, have an impact on the output, often carried out by the hardware limit for overload protection or closure type, circuit complexity, regulation accuracy is not high. This paper presents a microcontroller as the core of the pulse-width-adjustable high-precision numerical constant voltage power supply, a DC voltage source to overcome the traditional shortcomings, with a high application value.

2. The Generating Principle of the Constant Current Power

In this design, the output voltage through the microcontroller C8051F410 real-time sampling, the sampling value compared with the settings, use the results to adjust the comparison SCM DA output, TL494 using microcontroller DA output voltage adjust the PWM duty cycle, by feedback control, to achieve the purpose of the constant voltage output [1]. TL494 is a fixed frequency pulse width modulation circuit, built-in linear saw tooth oscillator, the oscillation frequency can be an external resistor and a capacitor for adjusting, the oscillation frequency is as follows:

$$f_{osc} = \frac{1.1}{R_T \times C_T} \quad (1)$$

If the capacitor unit is "micro-Law", the resistance unit with "thousands of Europe", the unit of frequency is the "kHz." After commissioning, the output frequency range of 25KHz~35KHz best output waveform more stable.

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3. The Design of the Circuit

The design of the circuit, the microcontroller C8051F410 to achieve the overall control circuit, in order to make the circuit more stable and joined two filters. The filter is called by the capacitors, inductors and diodes and other electronic originals composed. The role of the filter is part of the power supplied to the load using the energy, while the other part of energy stored in short supply when the power supply is interrupted or inadequate, the capacitor and the inductor is released to put the stored energy, power supplied to the load to continue in order to ensure uninterrupted power supply can provide current to the load. The main part of the circuit shown in Figure 1:

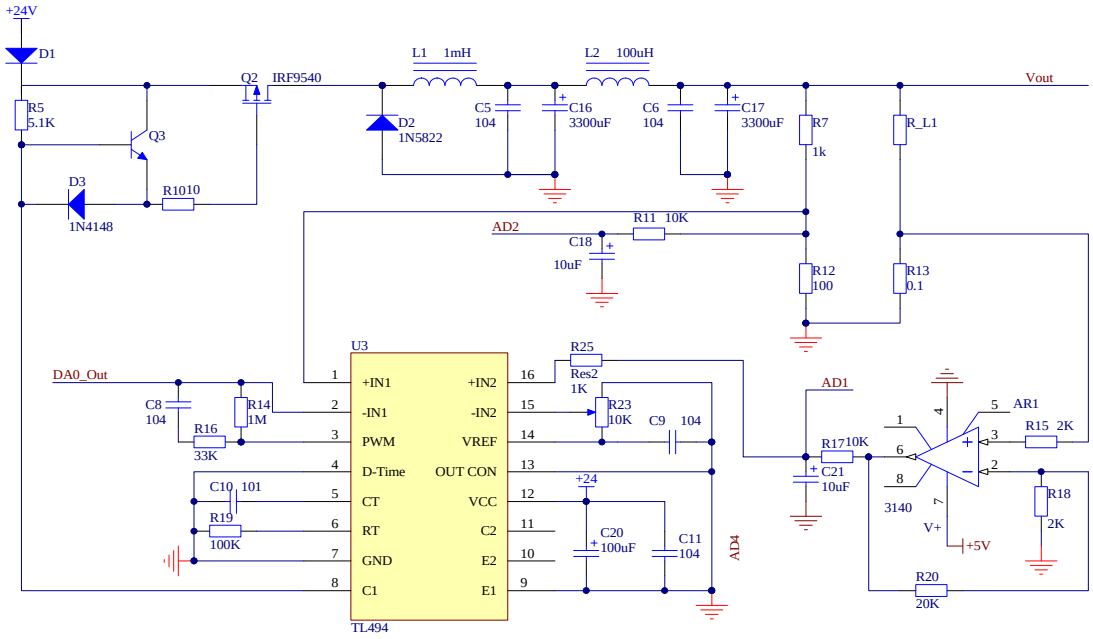

Figure 1. Main Part of the Circuit

As shown above, the first (1) feet for the first group of the error amplifier AMP1 inverting input. By the output voltage is fed through the sampling circuit sampling section (1) foot. Section (2) feet for the first group of the error amplifier AMP1 inverting input. Section (1) pin voltage and the second (2) pin voltage for comparison. When the power supply output voltage change, load voltage change with the sampling resistor voltage also changes, and sent to the TL494 first (1) foot, and subsection (2) feet of the voltage remains constant, so that the internal PWM chip comparing the sampled voltage with the voltage will change, if the output voltage rises, the comparator voltage increases along with the comparator A2 output pulse becomes narrower, and finally the FET conduction time becomes shorter, the output voltage reduced, thereby inhibiting the output voltage increases, so that to achieve a stable output voltage purposes. If the output voltage is reduced, the comparison voltage is followed ¬ ¬ reduced, the output of the comparator A2 pulses wider, finally the FET conduction time becomes longer, so that the output voltage increases, thereby suppressing the output voltage, the output voltage stability. Because the operational amplifier is very high magnification, in order to prevent high frequency parasitic oscillations, this also applied AC negative feedback circuit, generally the output of the operational amplifier and the "-" input terminal, connected to a hundred of PF capacitors can be, or the capacitor and resistor in series in Jieshangqu can be, this capacitor is called "eliminate parasitic oscillation capacitor" or called "eliminate parasitic oscillation circuit." Put the power supply resistors and capacitors connected in series after the first (2) feet and (3) is formed between the legs eliminate parasitic oscillation circuit. Section (4) feet for the dead zone control side. Comparator A1 of the " - " input, is sent by the oscillator OSC sawtooth voltage, and its "+" side is the TL494 's first (4) feet, so the comparator A1 output pulse is very wide. The output

waveform A1, the low-potential part is called the "dead zone", it is capable of limiting the output pulse width of the widest [2]. A2 If the comparator output pulse width than the width of the pulse output of A1 is narrower, then the output of the OR gate HM pulse width of the input pulse width is wide, and A1 is the same as the width of the output pulse, so that it functions the role of the pulse width limit. Change the waveform shown in Figure 2: Change the waveform shown in Figure 2.

4. The Design of the System Software

System software design includes the use of single-chip clock frequency, each port initialization procedure, modulus, digital-analog conversion process, key scanner, LCD driver with analog output automatically and quickly adjust the program as well as digital/analog interstate matching algorithm and so on [3].

4.1. The Regulation of Output Voltage

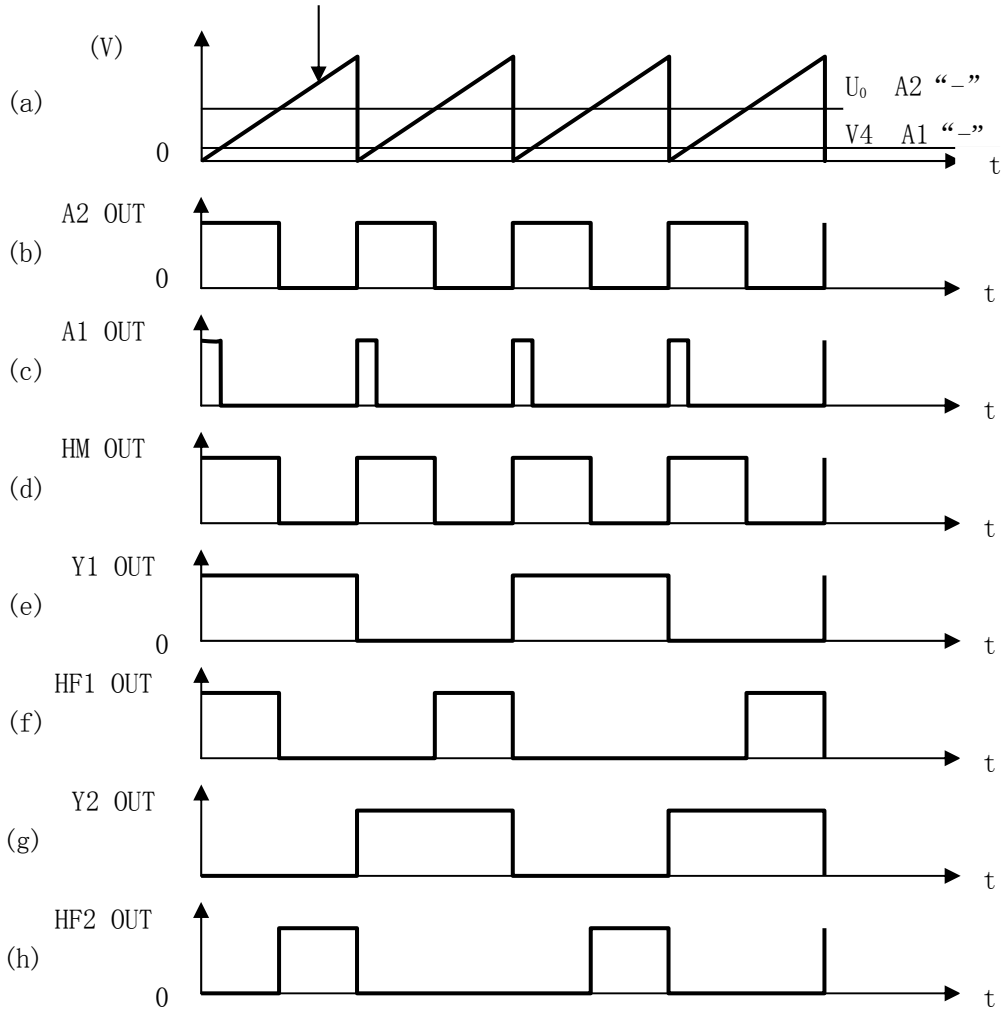

Figure 2. The Change of TL494 Output Wave

Voltage adjustment process is such that we set the output voltage, the output voltage increases from 0V, the width adjustment process, the chip after the adjustment of the voltage continuously measured to obtain the value of the sampled voltage and increase the DA output, so that the second pin voltage rises TL494, TL494 through internal comparison, the final increase in the duty cycle of the power switch, the output voltage increases, contrary to the

above adjustment process, programming flowchart shown in Figure 3. In order to detect whether the system is being output voltage is regulated, in the device added an LED, when the system adjustment, LED lights will blink once, so you can adjust the program has to be a better process monitoring, if the system stop adjustment, LED will stop flashing until commissioning is completed [4-5].

4.2. The Conversion of Output Analog

AD code values collected by the system how to convert analog voltage and current values, that is, digital/analog match between. In the range of allowable error, this study selected the calculation speed of linear interpolation [5].

Linear interpolation method of the data processing is performed by the analog signal has been deposited and the amount of digital signal measurement sequence (x0, y0), (x1, y1), (x2, y2), ..., (xn-1, yn-1), to calculate the required match each requested data. In this design, that is already stored in the digital/analog between the corresponding values, where the voltage value is corresponding to the voltage A / D code and the D / A code shown in Table 1.

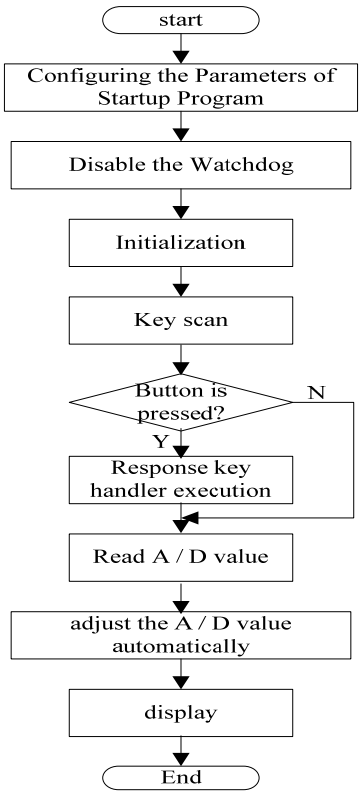

Figure 3. The Main Flow Chart

Table 1. The Value of A/D & the D/A and Output Voltage

Number	D/A	A/D	Voltage
1	0	18	0.09
2	500	253	1.45
3	1000	496	2.86
4	1500	738	4.26
5	2000	978	5.66
6	2500	1220	7.06
7	3000	1462	8.46
8	3500	1705	9.85
9	4000	1947	11.23
10	4500	2189	12.61
11	5000	2432	13.99
12	5500	2674	15.35

For any voltage AD values collected x, 1, x is in look-up table has the location of the sequence of measurements is xi ≤ x ≤ xi +1 (0 ≤ i ≤ n-2), over the same interpolation, can be drawn the AD code corresponding to the voltage y, calculated as follows:

$$y = y_i + \frac{y_{i+1} - y_i}{x_{i+1} - x_i}(x - x_i) \quad (2)$$

For example, the selected points and the interpolation data are calculated by interpolation of the corresponding voltage y is:

$$y = y_2 + \frac{y_3 - y_2}{x_3 - x_2}(x - x_2) \quad (3)$$

4.3. Key Detection

Keyboard stand-alone keyboard, first detected in the button is pressed, the key corresponding to the row line is low, the implementation of a 10ms delay subroutine, confirm that the line cord is still low, If the description of the line does have key press. When the key is released, the row lines low to high, the Executive 10ms delay line is still high detection line, indicating that key really lifted. After setting the number of keys, taking into account if the button too much will not only affect the running speed, but also the hardware design more complex and prone to error, so that the leftmost button with the exit function. Design set the four buttons, each of the function keys are different, such as adjusting the size of the sampled voltage value, the output voltage value of the size, the calibration D/A, A/D code value relationships. Keyboard detection flow chart shown in Figure 4:

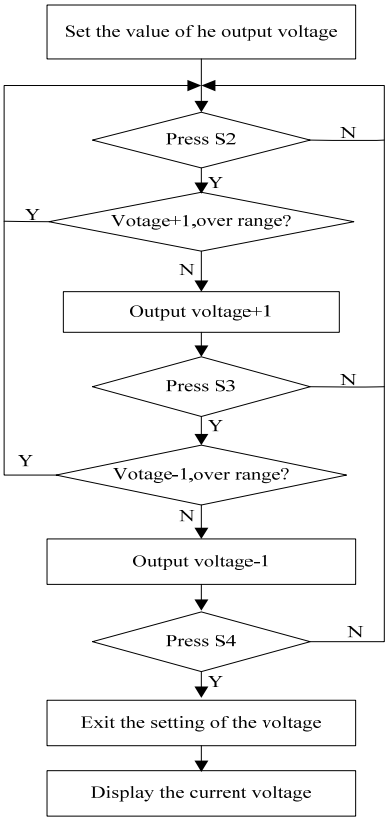

Figure 4. The Flow Chart Key Detection

When the system is running, the LCD screen displays the initial sampling voltage value, then if you click the S1 key, the LCD will display to set the output voltage value, press S2 button if the value of the output voltage does not exceed the range will be increased by one, if by S3 key value does not exceed the output voltage range will be reduced by one if the press S4 button will return to the initial screen that is displayed on the LCD sampled voltage values [6]. Is displayed on the LCD voltage value set in the case, if you click S1, the LCD display will switch to adjust the A/D value interface.

4.4. The Interface Program of LCD

Used in the design is 12232F LCD, its operating voltage range of +3V~+5.5V, 7.5 Chinese characters can be displayed. LCD process shown in Figure 5.

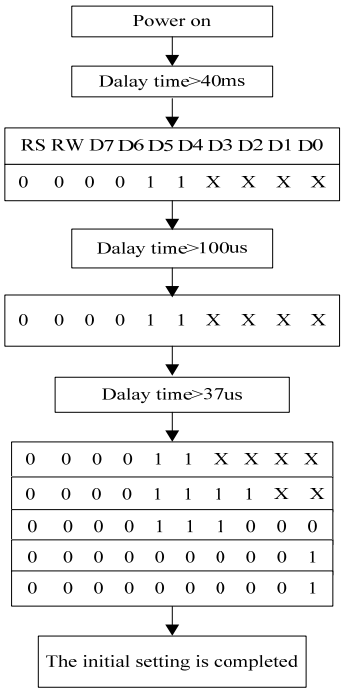

Figure 5. The Interface Program of LCD

5. Conclusion

C8051F410 as the device to the system's main control chip, TL494 pulse width modulator with drive hardware running software programming, using liquid crystal displays buttons adjust the voltage 12232F changing circumstances, with small size, light weight, small ripple characteristics, to achieve a stable output voltage.

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