Intelligent Temperature Control System for Chip Soldering Station

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Abstract

Chip is the general name of semiconductor component products, mainly by the semiconductor material, solid state electronic devices, silicon wafers and other materials processed through a number of responsible processes. According to the functional requirements, the intelligent temperature control system of the chip welding bench is designed with PLC as the control core. In the PLC system design using PID instructions, when the temperature is close to the specified temperature using low-power heating, when the temperature difference is large high-power heating. In this paper, we design the temperature control system of chip soldering bench with Siemens S7-200 PLC as the control core.

Keywords: MCGS, Temperature Control, Siemens S7-200 PLC, PID

1. Introduction

Due to the needs of industrial process control, higher and higher requirements have been placed on automation equipment. With the miniaturization, integration and functional diversification of electronic components, it makes the integrated circuit (IC) manufacturing process increasingly complex. And the density of IC packages is increasing, thus making the problem of thermal deformation of chip solder joints particularly prominent [1]. However, with the development of science and technology and the application of computer technology, the research technology of temperature control system has also risen rapidly. To ensure the highest efficiency and production quality of the equipment, and has been widely used in various fields [2].

The design of this temperature control incorporates the practical requirements of a patch soldering workstation. S7-200PLC was utilized to complete the study of the temperature control system: temperature acquisition, operation and analysis. This controller is designed primarily for temperature control devices for patch soldering stations in modern industrial automated production processes. The use of PID control to replace the more traditional temperature control methods, so that the temperature control can be utilized more effectively. Finally, through the configuration monitoring screen for simulation and auxiliary display [3].

Information collection and study on the process flow of chip soldering station temperature control system. Make the overall program of the temperature control system for the chip soldering station. Utilize PLC-200 model to complete the control of the system. The ladder diagram temperature control program is written for PLC, and PID algorithm is adopted to complete the temperature control. Use MCGS configuration software to simulate the monitoring screen of the temperature control system of the chip soldering station to monitor and simulate the real-time temperature.

The rest of this article is organized as follows. The second section introduces the main research techniques. In the third part, a description of the control algorithm is presented. The fourth section describes the design of the screen. The fifth part summarizes the main content of this paper.

2. Introduction to Research Techniques

Intelligent temperature control system for chip soldering station adopts S7-200 PLC, CPU model 224, and extends EM231 module. For the study of MCGS software, the establishment of a complete chip soldering station intelligent temperature control system simulation. The main system design is as follows:

Programmable Logic Controller (PLC) is a kind of industrial digital operating system. PLC is characterized by small size, strong anti-interference ability, simple and flexible programming, easy to expand and easy to network with computers. In the field of automatic control has been widely used. PLC is structurally very similar to the general control machine. Its main features are good versatility, strong anti-interference ability, easy maintenance, short debugging cycle and so on.

The PLC main unit can be matched with individual I/0 expansion units. And each extended unit has its own use function and purpose, and connected to the host computer through the bus. Each expansion unit can be expanded or used in combination as needed to meet the performance requirements of controllers for different occasions. The basic structure of PLC is shown in the figure Fig.1 below.

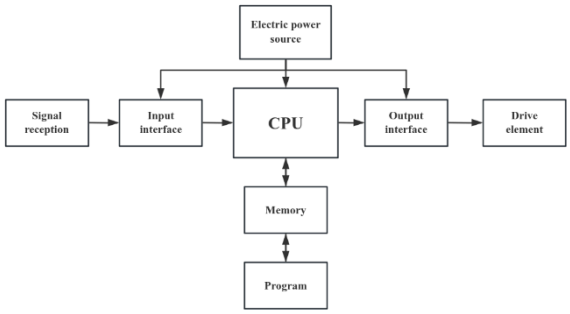

Fig.1 PLC Infrastructure Diagram

Configuration software provides testers with visual monitoring screens for real-time site monitoring. In MCGS configuration software, the monitoring screen can be created conveniently through the graphic editing function. Various controls in the screen are graphically displayed, and the control devices are animated with alarm windows, historical curves, real-time trend curves, reports and other functions. The composition of the MCGS configuration system is shown in Fig.2 below.

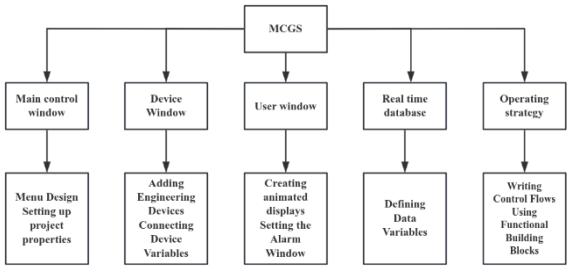

Fig.2. MCGS Structure Diagram

In the selection of the module EM231 is used, which has high accuracy. Since the PLC can only receive digital signals, this module is required to convert the detected temperature analog signals to digital signals. To create an analog input channel, an EM231 module equipped with 4 analog input channels is used to complete this design.

3. Description of the Control Algorithm

PID control is a relatively simple and convenient method, and has been widely used in industrial production control systems to achieve precise control of the production process on site [4]. The main PID descriptions are as follows:

PID program control module: this controller uses a new type of fuzzy control technology for control, which can automatically adjust the operating state of the controlled object according to the objective function and constraints set by the system.

PID function instruction: the combination of analog input module and analog output module can do and PID process control similar effect, compared with the lower cost, more affordable.

PID closed-loop control of their own programming: due to the lack of functional instructions and process modules, you can use their own throughout some of the program to control.

First the PID controller is designed, then the PID controller in digitized form is rewritten into PID equations in discrete form and finally the program is written.

In a closed loop control system with typical PID, Sp(t) is the input quantity for a given value, Pv(t) is the feedback quantity of the system and C(t) is the output quantity of the system. This is shown in Fig.3 below.

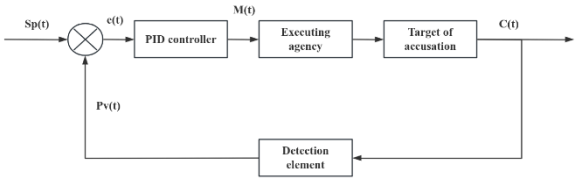

Fig.3. Typical PID closed-loop control system

Adjustment of proportional control: We should change the proportionality coefficient, slowly from small to large. At the same time, observe the corresponding system response until we get a curve with fast response and small overshoot.

Trimming the integration link: Reduce the proportionality coefficient of the first screening step to 50% to 80%, and then set the value of the integration time to a relatively large value. Observe the corresponding response curve.

Under the condition that this condition remains unchanged, the experimental study is carried out by changing different variables, the integration time is reduced, the integration effect is increased, and then the corresponding proportionality coefficient is adjusted by a small margin. After many repeated experiments and adjustments, a relatively ideal ratio parameter and a more ideal integration parameter are finally achieved.

Adjustment of the differential link: For the differential time, first set it to zero, and then slowly increase it. Several experiments and adjust the corresponding proportionality coefficient and integration time, to find the most compatible with the experimental effect of the PID control parameters.

4. Design of Configuration Screen

The system of this design is composed of S7-200PL and CMCGS configuration software, which can realize the following functions:

System control process: create relevant configuration screen in the system, which can clearly and intuitively observe the whole process of temperature control.

Temperature real-time monitoring: temperature changes during system operation are displayed and detected in real time through curves. System Fault Alarm: If the system temperature is too high or too low, the temperature high limit alarm and low limit alarm will be carried out.

When the system is running and working, it can monitor the process production situation and modify the control parameters in real time. When there is a fault or unexpected situation in the system, it can receive alarm signals and deal with it in time. The main screen monitoring diagram is as follows Fig.4 below.

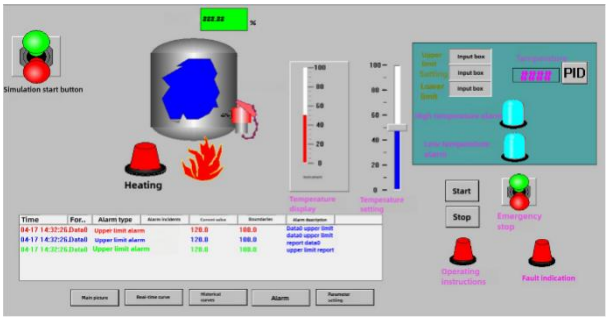

Fig.4. Main screen monitoring diagram

The process of animation screen monitoring display can be updated in real time the state of the temperature, so that the process and temperature control process more clearly show.

Starting and stopping the temperature control system of the chip soldering station through MCGS configuration software, you can view the current temperature, trend curve, alarm data and modify the PID parameters. When the temperature of the chip soldering station is higher or lower than the set alarm temperature, the fault light on the screen will be lit, and the alarm window will display the alarm data to facilitate processing. Configuration of the parameters of the temperature system is shown in Fig.5.

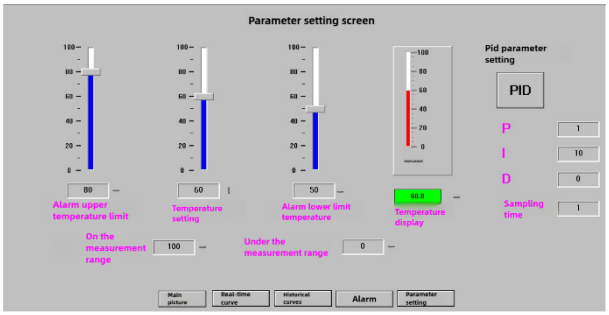

Fig.5. Parameterization of the temperature system

Open the MCGS configuration software and open the Patch Welding Station Intelligent Temperature Control System project monitoring interface. Entering the operation mode, you can display the temperature and status of the Patch Welding Station and the real-time and historical curves of the temperature in the monitoring screen. We can set the temperature according to the process requirements in the system control interface. PID temperature adjustment for the SMD station, its working status will change and the corresponding indicator light will be on. Fault Alarm Display: If the system temperature is too high or too low, the temperature upper limit alarm and temperature lower limit alarm will be carried out. The historical trend graph is shown in Figure Fig.6.

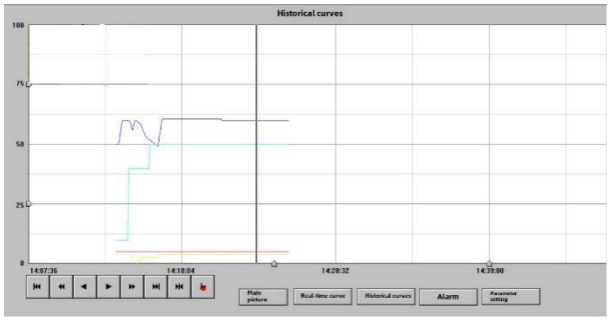

Fig.6. Historical Trend Graph

5. Conclusion

A design that combines temperature control with the practical needs of a chip soldering station. The use of S7-200PLC as the core control to complete the temperature control system. The controller is mainly for the modern industrial automation production process in the chip welding station temperature control device and design, the use of PID control instead of the more traditional temperature control. This can make the temperature control can be used more effectively. Finally, through the configuration monitoring screen for simulation and auxiliary display.

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