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REFLOW OVEN VERIFICATION SYSTEM

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ABSTRACT

In competitive commercial world most of the companies try to minimize the production time, production errors and the cost so now a days most the organizations are tend to the automation rather than manual works. Reflow oven one of automated technique which use to solder SMT (Surface Mounting Technology) component in to PCB. Reflow oven verification system is temperature reading and analyze system that used to verify the temperatures in reflow oven. In the Reflow Oven having different temperature zones and it is important to verify those temperatures and manufacturing company also need to control that temperature levels. Because temperature is one of the most important factor in soldering process. The system contains 10 different heating zones and those zones used to measure the different temperatures in different zones which placed in Reflow oven. They also had a controlling unit with the oven, but there has not existed system to verify the temperature levels inside Reflow Oven. In my project I introduced a separate temperature verification and analysis system using K-type Thermocouples, amplification circuit with graphical user interface using National Instrument LabVIEW program. So it is useful and the company could save more time and money by using this system.

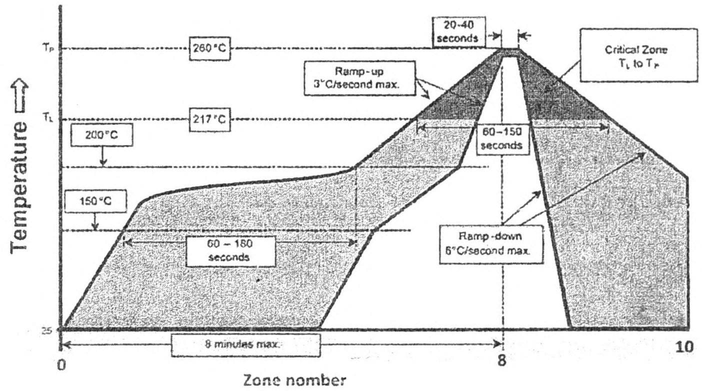
Keywords: Reflow oven, Temperature, k-type thermocouple, LabView

1 INTRODUCTION

In PCB assembling section have basically two sub arias, they are SMD assembling And THT assembling. SMD assembling process is shown as figure 1.

Figure 1: SMT Line process

IPC standard is one of major acceptable criteria which used in PCB manufacturing. Manufacturing company should maintain their process according to the international standard. SMT is one basic method which used to PCB assembling process. Reflow oven is use to soldering SMD component on to PCB. This project basically focused to verify and analysis the temperature in reflow oven of CCS Lanka (Pvt) Ltd. Normally Reflow oven have ten or eight temperature zones. Each Zone has two top and bottom heaters. Basically zone's temperature variation like graph 1.In my system, I proposed to create a user friendly interface with the real-time temperature monitoring system in the PC Monitor screen and then can analyses and compare temperature in Reflow oven.



Graph 1: TEMPERATURE PROFILE

2 EXPERIMENTAL

2.1 Block Diagrams

I used K-type thermocouple as the temperature measuring sensor in this system and amplifying circuit was designed to amplify the thermocouple output because thermocouple output was within millivolt (mV) range. This amplifying circuit communicate Labview program through the NI USB devise.

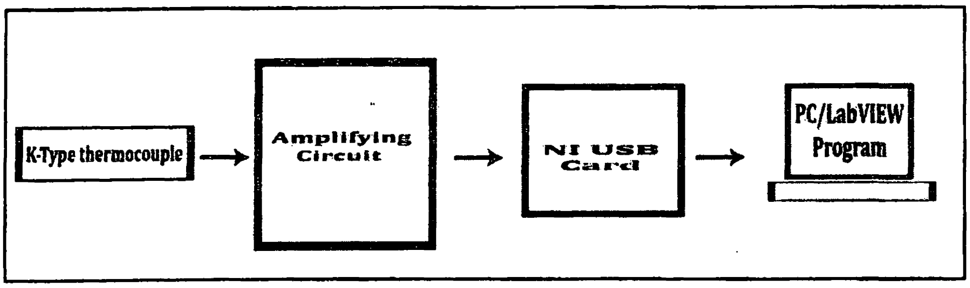


Figure 2: block diagram of the proposed system

2.2 Amplifying Circuit

This circuit contains mainly 4 sections which are thermocouple, thermocouple output linear section, amplifying section and summing section. An inexpensive, battery-powered, cold-junction-compensated, thermocouple thermometer with an output of 1 mV/°F can be constructed using type-K thermocouple wire. Because type-K thermocouple wire has a relatively linear output characteristic, only an ice-point reference and a scaling factor are necessary to produce an output that can be measured with a digital meter. By plotting the thermoelectric voltage versus temperature, it can be seen that the slope of the type-K thermocoupleapproaches a constant over a range of –0° to 500°F. The best straight-line fit between –40° to 500°F yields the equation

$$Y= 0.226X - 0.707$$

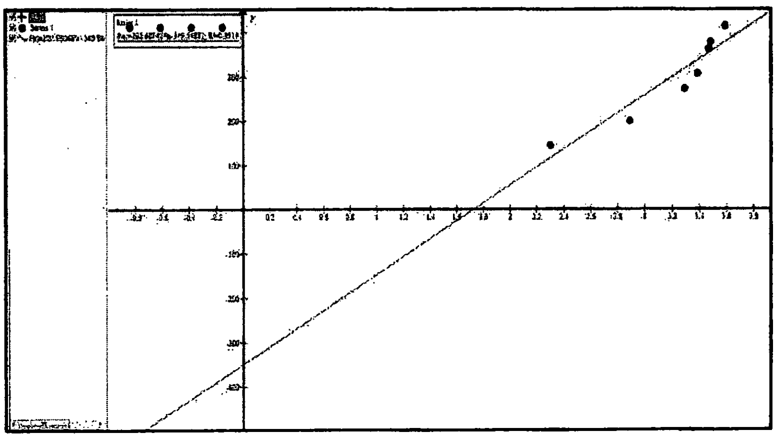
Where Y is the thermoelectric voltage in millivolts and X is the temperature in degrees Fahrenheit. Solving the equation for X and multiplying by 101 for the gain of the inverting amplifier, the following equation can be derived:

$$X= (101Y+71.4) / 22.8$$

Therefore, by adding 71.4 mV to the thermoelectric voltage (101Y) and dividing the summed voltages by 22.8, 1-mV/°F output can be obtained. The circuit shown performs this function by adding a cold-junction compensated voltage to the thermocouple (LT1025) and amplifying the output by 101 (LT1013) . Then 71.4 mV is added to the amplified signal and the voltages are summed together in the summing amplifier (LF356). Finally, the output voltage is divided using a 15-turn, 10k potentiometer.+6

To calibrate the circuit, used a digital voltmeter and adjust the 200-Ω 15-turn potentiometer until the meter reads 71.4 mV. Then obtain high-quality thermometer and connect a digital meter to the 10k, 15-turn output potentiometer and adjust it until it reads the same temperature as the thermometer.

A more accurate way to calibrate the circuit is to immerse the thermocouple in a foam cup filled with ice water (32°F) and measure the output at pin 6 of the inverting amplifier. Then repeat the procedure using boiling water (212°F). After that, plot the thermoelectric voltage versus temperature. When this is completed, a straight-line equation between these two points can be derived. This will give a more accurate value of b, the y intercept. Finally, adjust the 200-Ω, 15-turn potentiometer until the meter reads the same value as b. The adjustment of the 10k potentiometer is performed as described above. This method takes into account the small thermocouple voltages generated wherever dissimilar materials are joined together. They can be generated where the thermocouples are soldered to the circuit board, or can even occur at the junction between the IC package and sockets. The circuit was optimized to measure temperatures from −40° to 500°F, although higher temperatures up to 1800°F can be measured with lower accuracy.



Graph 2:Amplifying circuit unite calibration graph

3 RESULTS AND DISCUSSION

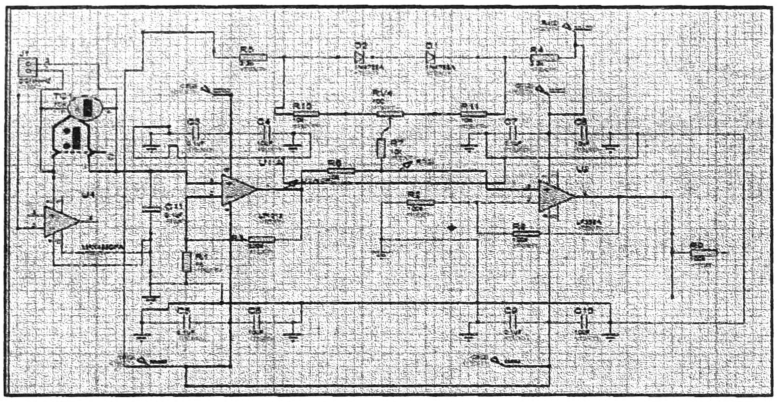


FIGURE 3: AMPLIFYING CIRCUIT UNITE

This circuit contains mainly 4 sections which are thermocouple, thermocouple output linear section, amplifying section and summing section. An inexpensive, battery-powered, cold-junction-compensated, thermocouple thermometer with an output of 1 mV/°F can be constructed using type-K thermocouple wire. Because type-K thermocouple wire has a relatively linear output characteristic, only an ice-point reference and a scaling factor are necessary to produce an output that can be measured with a digital meter. By plotting the thermoelectric voltage versus temperature, it can be seen that the slope of the type-K thermocouple

There is an interface to communicate my system to the end user. Basically it was divided in to three main parts such as Controlling Unit, Temperatures Displaying unit, analyzing and graphical data unit. The designed system displayed the more accurate temperature reading than the existed system. So this system can be used to verify temperature within any machine and as it is more accurate. But using another best method to calibrate this system it is possible to get more accurate results.

4. CONCLUSION

The resultant device has an K-type thermocouple they can measure Reflow oven heater's temperatures and the LabVIEW program show the measuring temperatures and It can give statistic detail about zone's temperature. The device contributes lot of advantages to verify the Reflow Oven. Such as No need to open oven to get measurement and analysis measurement details, can get much accuracy readings, user friendly GUI interface, measurement can be get very fast etc..

Limitation of this circuit is the system can't measure up to 450 ^{0}C and lower to 100 ^{0}C, because that temperature measurement unit gets linear values only for 100-450 ^{0}C range.

ACKNOWLEDGEMENTS

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