Zhejiang NeoDen Technology Co., Ltd

User Manual
Reflow Oven NeoDen IN6

-Full hot-air convection
-Built-in welding smoke filtering system

Content

Attention ! Please read the user manual carefully before operating this machine.

1. Brief Introduction

IN6 is a newly designed, environmentally friendly reflow oven with stable performance. It can achieve full hot-air convection, excellent soldering performance. It has 6 temperature zone, light and compact. Intelligent temperature control with high sensitivity temperature sensor, temperature can be stable within ±0.2°C. It adopts Japan NSK hot air motor bearing and Swiss imported heating wire, which is durable and stable. CE approved, provide authoritative quality assurance.

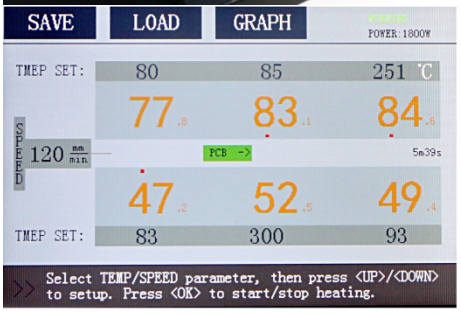
2. Specification

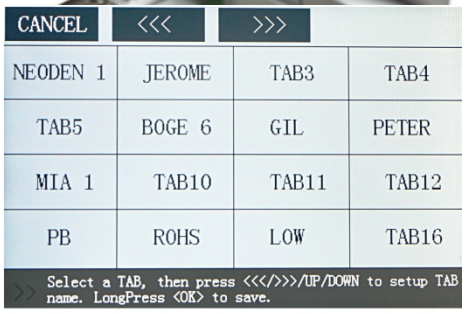
Model	IN6
Heating Zone Quantity	Upper 3/ Down 3
Heating Type	Nichrome wire and aluminum alloy heating
Cooling Zone Quantity	1
Conveyor Speed	5~30cm/min（2~12inch/min）
Standard Height Max(mm)	30mm
Temperature Range	Room temperature ~ 300℃
Heat-up Time	Approx. 20-30min
Soldering Width	260mm(26.8inch)
External Dimension	1020mm*507mm*350mm
Max Rated Power	~2000W
Working Power	~700W
Electricity Supply	110V/220V Single Phase
Operating Direction	Left → Right
Net Weight	49kg

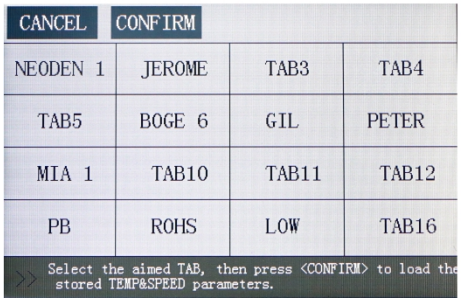
3. Main Parts

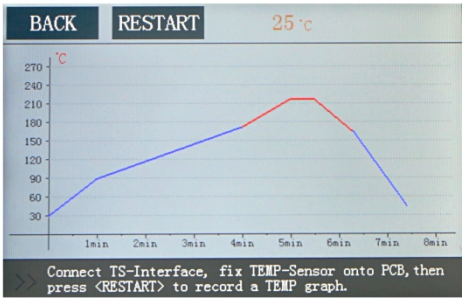
3.1 Reflow Oven Main Body

3.2 Operating Panel







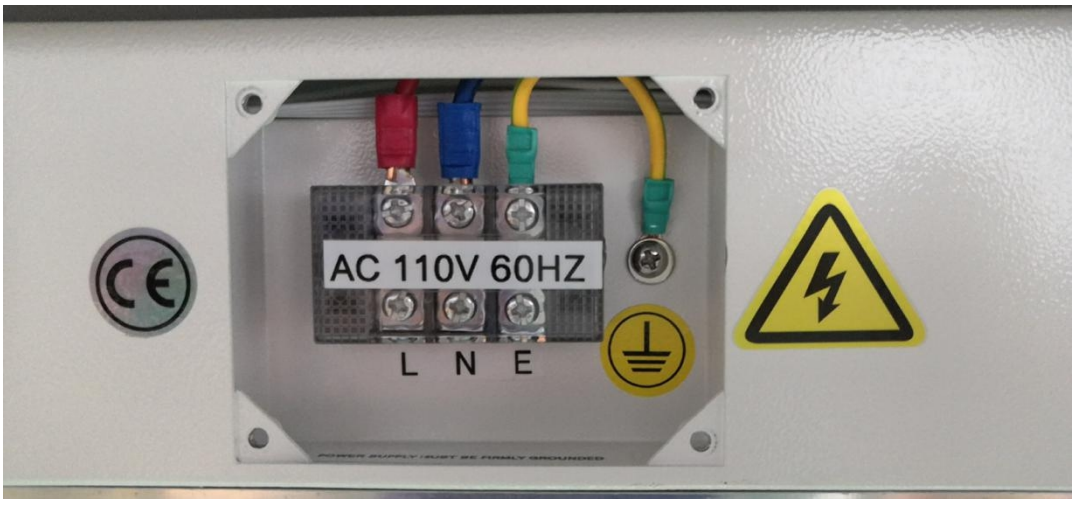


3.3 Pedestal

4. Installation Instruction

4.1 Power Supply Connection

IN6 is used in 110V/220V single-phase connection mode and is connected according to the user environment. Wires connection method is shown as picture. L stands for the live wire, N stands for the zero wire, and E stands for the ground wire, connect to the 220V (110V) power supply. According to the wiring requirements, the L should be connected to one live wire, and the N should be connected to one zero wire; the E should be connected to one ground wire properly



4.2 Installation Attentions

♦Power supply requirement:110V/220V

♦For desktop reflow oven, should be working on workbench, don't suggest to use wooden material

♦The machine should be set in standard SMT workshop, stay away from flammable and explosive if couldn't meet previous requirements.

♦Exposed wire harness should be well protected, prohibit to expose at the passage or flue in

case of causing any accident.

4.3 Status of Indicators

There is a green bar indicator at the PCB entrance that indicates whether the temperature in all zones has reached the set temperature. This indicator lights up when the actual temperature of all zones reaches the set temperature.

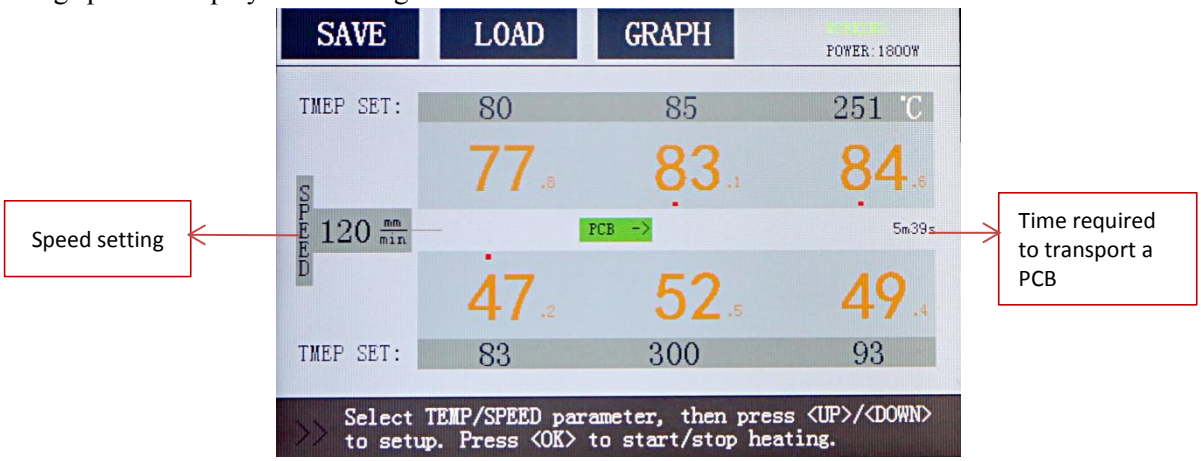
4.4 Operation instructions

♦ Power-on

Turn the red power switch to the ON position and the machine starts.

♦Transfer chain speed setting

Tap the speed parameter on the screen and press the Up/Down button to set the appropriate transfer chain rotation speed. When the speed is set, the time required to transport a PCB at this setting speed is displayed on the right side of the screen.



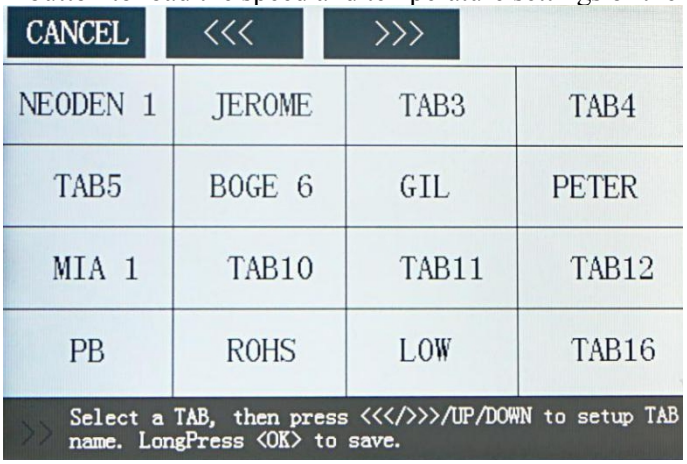
♦Temperature zone setting

Tap the temperature parameter on the screen and press the up/down buttons to set the temperature. Black is “the set temperature”, and orange is “the real-time temperature”.

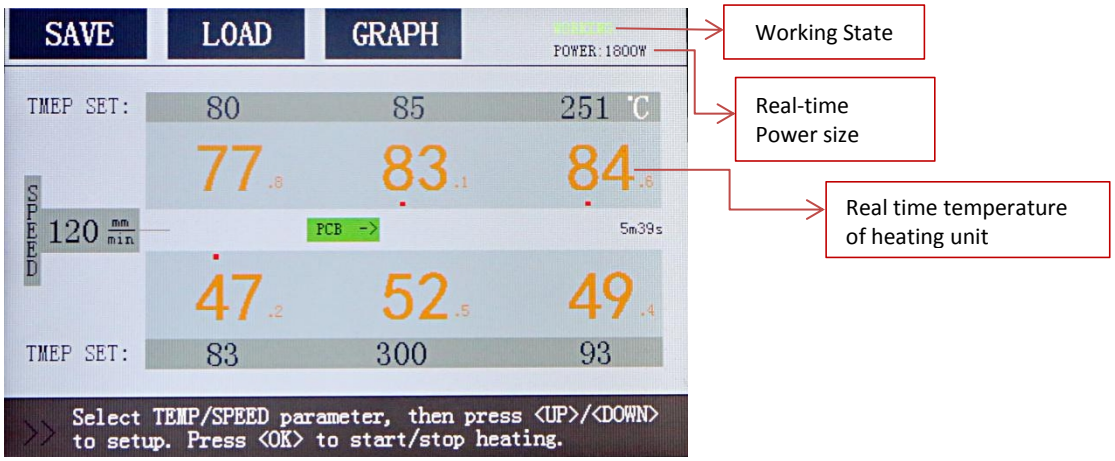
♦Save and Usage of speed and temperature settings

After setting the transfer chain speed and the temperature of each zone, you could press the SAVE button to save the setting parameters of the transfer chain and the zone temperature. When the SAVE button is pressed, it will enter the TAB interface. Click on a TAB, then you

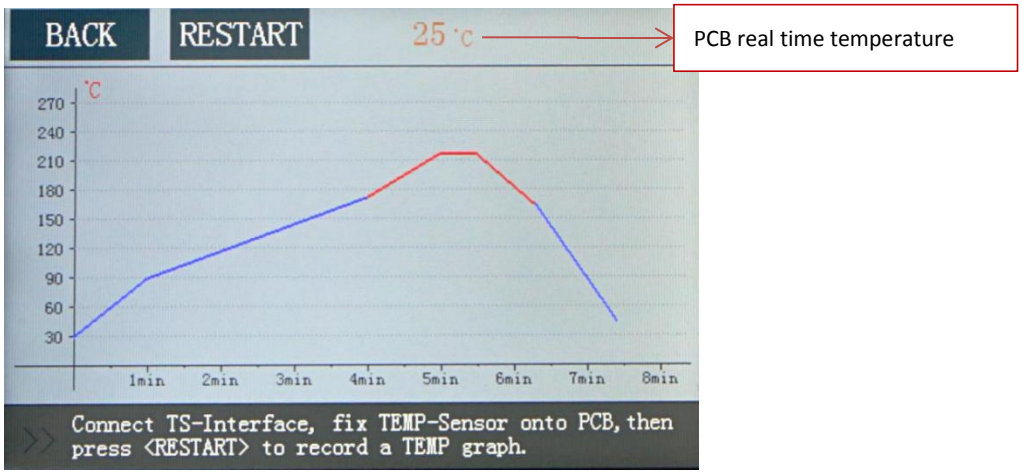
can use the "<<<", ">>>" "Up" and "Down" buttons to change the TAB name, long press OK to save these parameters to this TAB.
When you would like to call the previously saved speed and temperature of the transport chain, click the LOAD button on the screen to enter the TAB interface, click the TAB name, and then click the CONFIRM button to load the speed and temperature settings of the transport chain.



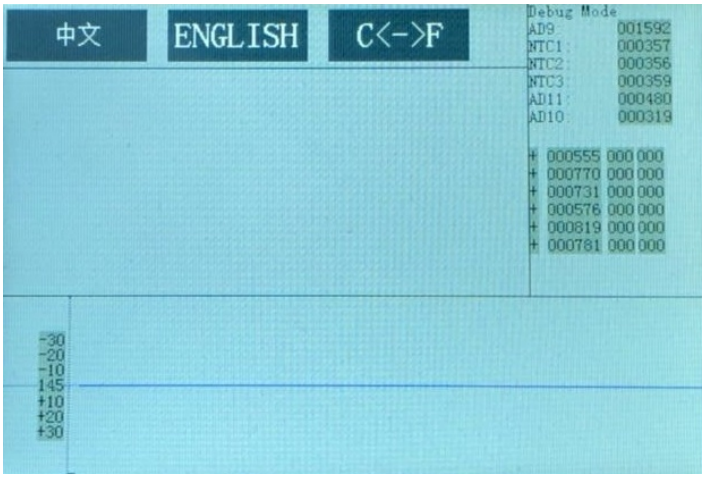
♦Start or stop heating
Press the OK button in the main interface, the machine will switch from STANDBY state to WORKING state, and begin to warm up.
If you need to switch from WORKING state to STANDBY state, just press the OK button in WORKING state.



♦Temperature curve
Connect the temperature sensor to the TEMP SENSOR connector, attach the temperature sensor to the PCB, and then click the “Restart” button on the Graph interface after PCB is put into the oven to get the temperature curve.



♦Power-off
Turn the red power switch to the OFF position and turn off the machine.
♦Change language and the unit of temperature in machine
After the power switch is turned to ON, the NeoDen logo will be displayed on the screen. Long press the OK button to enter the Debug mode interface. In this interface, you can change the language and temperature unit of the machine.



5. Temperature wave setting principle

5.10 what is the heating unit temperature?
The heating unit temperature refers to the real-time temperature of the heating plate.
5.11 what is furnace temperature?
Furnace temperature refers to the air temperature between the chain surface and the heating plate.
5.12 what is PCB surface temperature?
PCB surface temperature refers to the temperature of component welding feet during PCB welding. (the guiding temperature on the welding curve provided by the solder paste manufacturer refers to the plate temperature.)
When working, the temperature displayed on the panel is the actual temperature of the heating unit, which does not represent the temperature in the furnace and the actual temperature of the board. Therefore, the displayed temperature will be about 20-40 degrees higher than the temperature in the furnace. The actual temperature is related to the chain speed, PCB size, thickness, material and component density.

5.1 The reflow soldering theory and the temperature wave

When the PCB goes into heat up area (dry area), the solvent and gas in the solder paste will evaporate. At the same time, the flux can wet the pad and the component tip and foot. The solder paste melts, caves in and covers the pad, leading to the pad and component pins insulate the oxygen. PCB goes into heat preservation area. PCB and components get full preheating. In case of damaging the PCB and components when it goes into the welding area and the temperature heats up quickly. When PCB goes into the welding area, the temperature heats up and the solder paste melts. When PCB goes into cooling area, the liquid solder paste the soldering points solidify. The reflow process is finished.
The temperature is the key to welding quality. The actual and the setting temperature warming slope and the peak temperature should be accordant. Before the temperature reaches 160℃, please control
the heat up speed in about 1℃/S. If heat up too quickly, the PCB and the components will be damaged, and the PCB may be out of shape. On the other side, the flux volatilizes too fast. And it is easy to make soldering tin ball. Set the peak temperature 20℃-40℃ higher than the solder paste melting point. Set the reflow time 10S-60S. If the peak temperature is low or the reflow

time is short, it will affect the welding quality, and serious is causing the solder paste does not melt. If the peak temperature is high or the reflow time is long, the metal power will be oxidized and affect the welding quality and serious is causing the component and PCB damaged.

5.2 The set of the temperature wave

Set according to the temperature curve of solder paste and the welding principle provided above. Solder paste with different metal content should use different temperature curve, and set specific reflow temperature curve according to the temperature curve provided by solder paste manufacturer. In addition, the temperature curve is also related to the density and size of the heated PCB and components.

In the assembly of printed circuit board (PCB) using surface mount components, an optimized reflow temperature curve is one of the most important factors to obtain high quality solder joints. The temperature curve is a function of the temperature on the circuit assembly to the time. In the reflow process, at any given time, it represents the temperature on a specific point on the PCB to form a curve.

Several parameters affect the shape of the curve, the most important of which is the belt speed and the temperature setting of each zone. The belt speed determines the duration of the board exposed to the set temperature in each zone. Increasing the duration allows more time for the circuit assembly to approach the temperature setting in that zone. The total duration of each zone determines the total processing time.

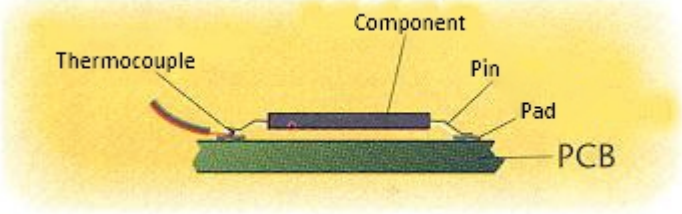
The temperature setting of each zone affects the temperature rising speed of PCB, and high temperature produces a large temperature difference between the PCB and the zone. The set temperature of the increase zone allows the board to reach the set temperature faster. Therefore, a graph must be made to determine the temperature curve of PCB. Next is the outline of this step, which is used to generate and optimize graphics.

Before starting the curve making process, the following equipment and auxiliary tools are required: high precision temperature curve instrument (in6), thermocouple (in6), tool for attaching thermocouple to PCB (mainly high temperature tape) and solder paste parameter table. There are several ways to attach thermocouples to PCB, the better way is to use high-temperature solder such as silver / tin alloy, and the solder joints are minimized.

Another acceptable method is fast, easy and accurate enough for most applications. A small amount of thermal compound (also called thermal conductive paste or thermal grease, which is often used on computer CPU or graphics card CPU) spots cover the thermocouple, and then use high-temperature tape (such as Kapton) to stick it.

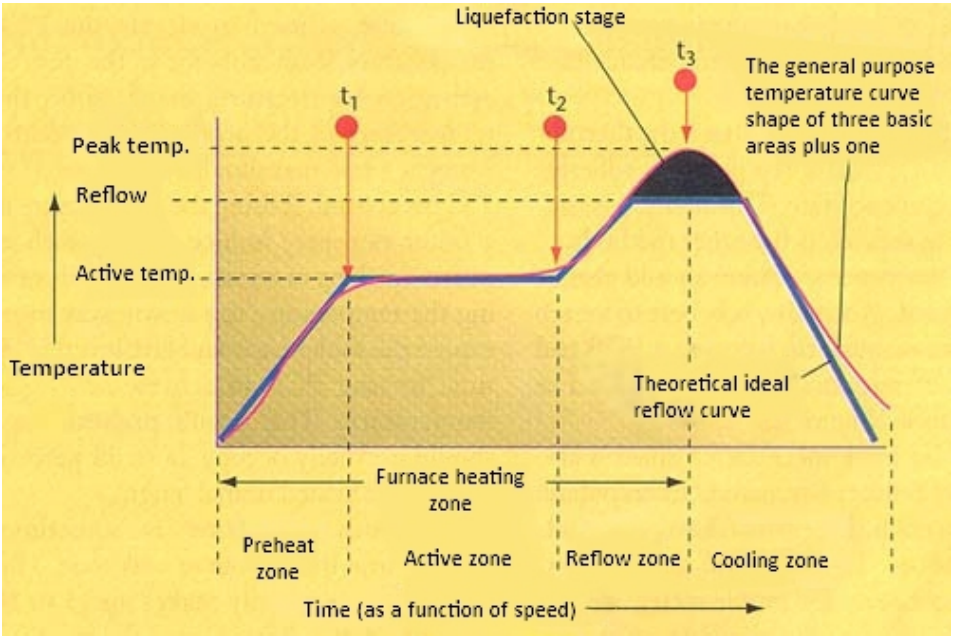
Another way to attach thermocouples is to use high-temperature adhesives, such as cyanoacrylate adhesives, which are generally not reliable.

The attachment position should also be selected. It is usually best to attach the thermocouple tip between the PCB pad and the corresponding component pin or metal end.



(Figure 1. Attach thermocouple tip between PCB pad and corresponding component pin or metal end)

The solder paste characteristic parameter table is also necessary. The information it contains is very important to the temperature curve, such as the desired temperature curve duration, solder paste activity temperature, alloy melting point and the desired maximum reflow temperature. Before we start, we must have a basic understanding of the ideal temperature curve. In theory, the ideal curve consists of four parts or intervals, the first three zones are heated and the last zone is cooled. The more the temperature range of the furnace, the more accurate and close to the setting of the temperature curve. Most pastes can be reflowed successfully in four basic temperature zones.



(Figure 2. Theoretically, the ideal reflow curve consists of four zones, the first three zones are heated and the last zone is cooled.)

Preheating area, also known as slope area, is used to raise the temperature of PCB from the ambient temperature to the required active temperature. In this area, the temperature of the product rises continuously at the speed of no more than 2-5 ° C per second. If the temperature rises too fast, some defects will be caused, such as the tiny crack of ceramic capacitor. If the temperature rises too slowly, the solder paste will be over sensitive to the temperature, and there is not enough time to make the PCB reach the active temperature. The preheating area of the furnace generally accounts for 25-33% of the total length of the heating channel.

The active area, sometimes called drying or wetting area, generally accounts for 33-50% of the heating channel. It has two functions. The first is to sense the temperature of PCB at a fairly stable temperature, allowing different quality components to be homogeneous in temperature and reducing their considerable temperature difference. The second function is to allow the flux to be activated and volatile substances to evaporate from the paste. The general active temperature range is 120 ~ 150 ° C. if the temperature of the active zone is set too high, the flux does not have enough time to activate, the slope of the temperature curve is an upward increasing slope. Although some solder paste manufacturers allow some temperature increase during the activation, the ideal curve requires relatively stable temperature, so that the PCB temperature is equal at the beginning and end of the active region. Some furnaces on the market can not maintain a flat active temperature curve. Choosing a furnace that can maintain a flat active temperature curve will improve weldability. Users have a larger processing window.

Reflow zone, sometimes called peak zone or final heating zone. The function of this area is to increase the temperature of PCB assembly from the active temperature to the recommended peak temperature. The activity temperature is always a little lower than the melting point temperature of the alloy, and the peak temperature is always at the melting point. The typical peak temperature range is 205-230 ° C. if the temperature setting in this area is too high, the

temperature rise slope will exceed 2-5 ° C per second, or the reflow peak temperature will be higher than the recommended one. This may cause excessive crimping, delamination or burning of PCB and damage the integrity of components.
Today, the most commonly used alloy is Sn63 / Pb37. This ratio of tin and lead makes the alloy eutectic. Eutectic alloy is an alloy melted at a specific temperature, while non eutectic alloy has a melting range, rather than a melting point, sometimes called plastic loading state. All examples described in this paper refer to eutectic tin / lead, which is widely used and has a melting point of 183 ° C.

The ideal cooling zone curve should be a mirror image of the reflow zone curve. The closer the mirror image relationship is, the closer the solid structure of the solder joint is, the higher the quality of the solder joint is, and the better the integrity of the joint is.

The first parameter to be considered in making the temperature curve is the speed setting of the transmission belt, which will determine the time spent by the PCB in the heating channel. A typical solder paste manufacturer's parameters require a heating curve of 3-4 minutes. Dividing the total heating channel length by the total heating sensing time is the accurate transmission belt speed. For example, when the solder paste requires a heating time of 4 minutes, using a six foot heating channel length, the calculation is: 6 feet ÷ 4 minutes = 1.5 feet per minute = 18 inches per minute.

Next, it is necessary to determine the temperature setting of each zone. It is important to understand that the actual zone temperature is not necessarily the display temperature of this zone. The displayed temperature only represents the temperature of the thermistor couple in the area. If the thermocouple is closer to the heating source, the displayed temperature will be relatively higher than that in the area. The closer the thermocouple is to the direct channel of PCB, the displayed temperature will be more able to reflect the temperature in the area. It is advisable to consult with the furnace manufacturer to understand the relationship between the clearly displayed temperature and the actual interval temperature. In this paper, we will consider interval temperature rather than display temperature. Table 1 lists the interval temperature settings for typical PCB assembly reflow.

Table 1 temperature setting of typical PCB return section

Area	Temperature Setting	Actual plate temperature at the end of zone
Preheat	210°C(410°F)	140°C(284°F)
Active	177°C(350°F)	150°C(302°F)
Reflow	250°C(482°C)	210°C(482°F)

After the speed and temperature are determined, they must be input to the furnace controller. Once all parameters are input, start the machine, and after the furnace is stable (that is, all the actual displayed temperatures are close to the set parameters), the curve can be made. The next PCB is put into the conveyor belt, triggering the thermometer to start recording data. For convenience, some thermometers include a trigger function to automatically start the thermometers at a relatively low temperature, which is slightly higher than the human body temperature of 37 ° C (98.6 ° f). For example, an automatic trigger at 38 ° C (100 ° f) allows the thermometer to work almost as soon as the PCB is put into the conveyor belt and enters the furnace, so as not to cause false triggering when the thermocouple is handled by hand.

Once the initial temperature profile is generated, it can be compared with the profile recommended by the solder paste manufacturer or the profile shown in Figure 2.

First, it must be confirmed that the total time from ambient temperature to reflow peak temperature is in line with the desired heating curve residence time, increasing the conveyor

belt speed proportionally if it is too long, and vice versa.
Next, the shape of the graph curve must be compared with the desired one (Fig. 2). If the shape is inconsistent, it shall be compared with the following graph (Fig. 3 ~ 6). Select the curve that best matches the shape of the actual shape. The deviation from the left to the right (process sequence) should be considered. For example, if there is a difference between preheating and reflow area, first adjust the difference between preheating area correctly. Generally, it is better to adjust one parameter at a time, and run the curve setting before making further adjustment. This is because the change of a given area will also affect the result of the subsequent area. We also suggest that the adjustments made by novices should be relatively small. Once experience has been gained in a particular furnace, there will be a better "feel" for how much adjustment to be made.

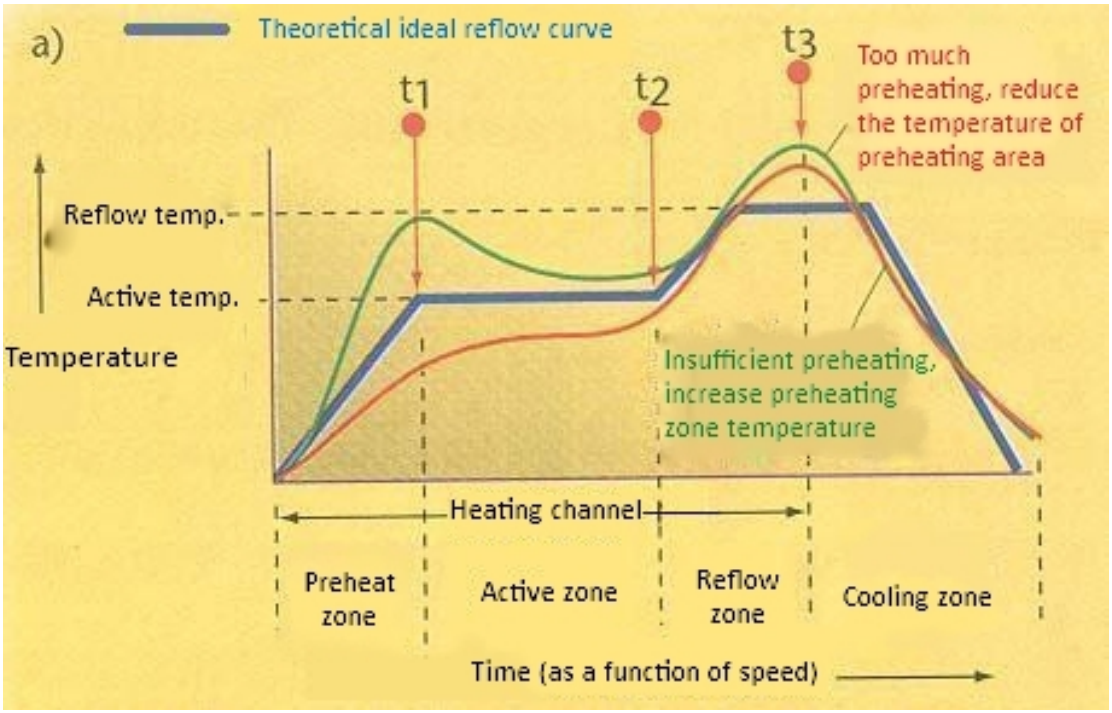


Figure 3. Insufficient or excessive preheating reflow curve

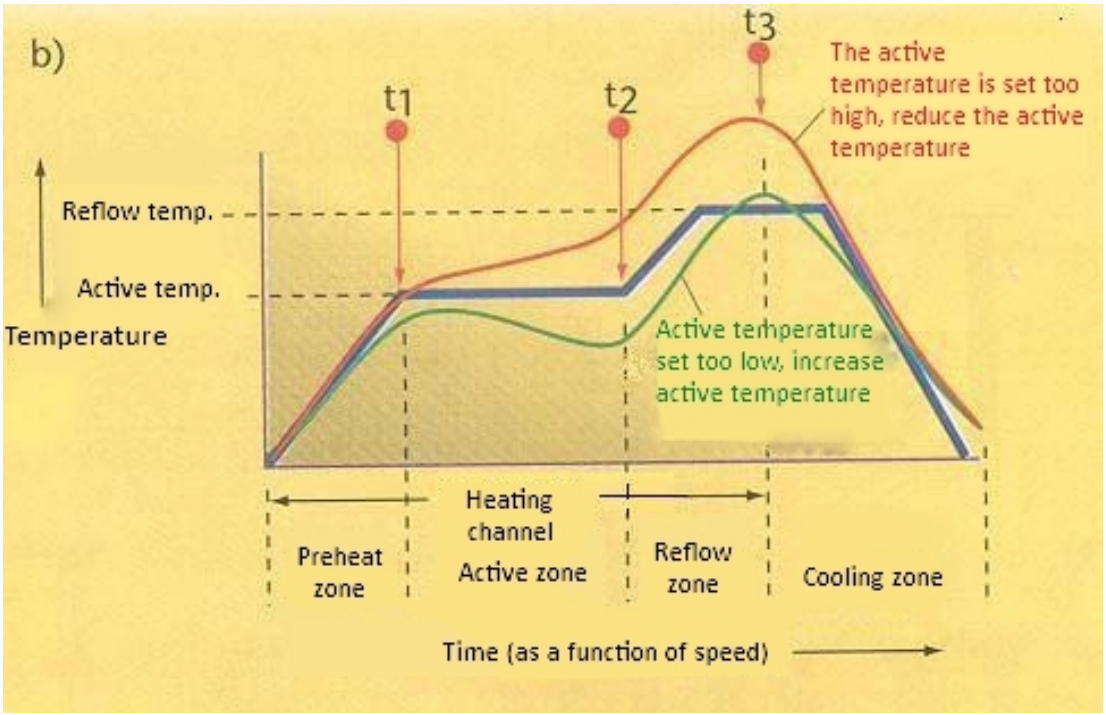


Figure 4. Too high or too low temperature in the active zone

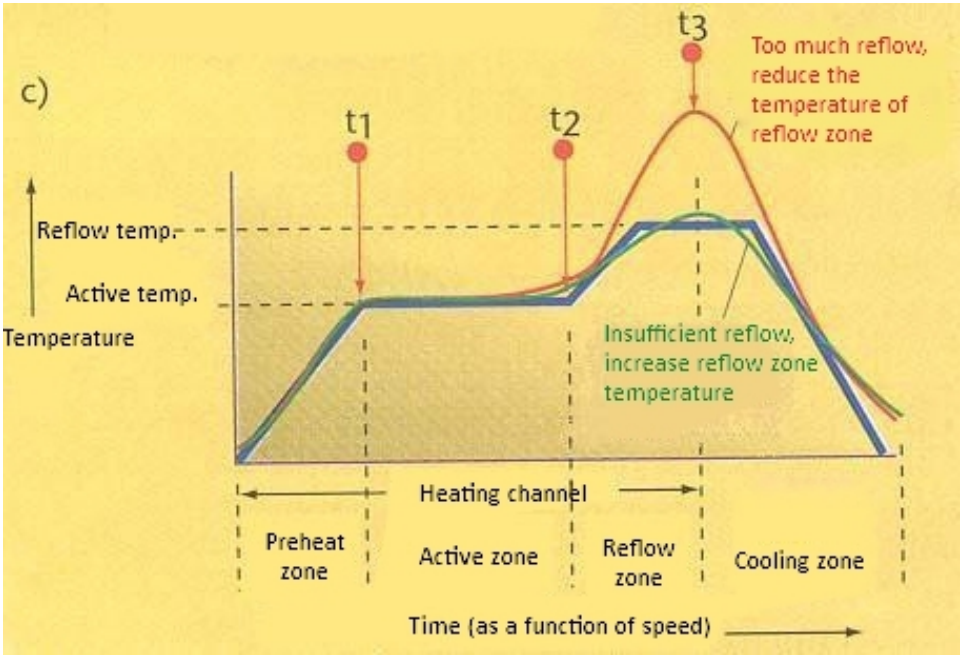


Figure 5. Too much or not enough reflow

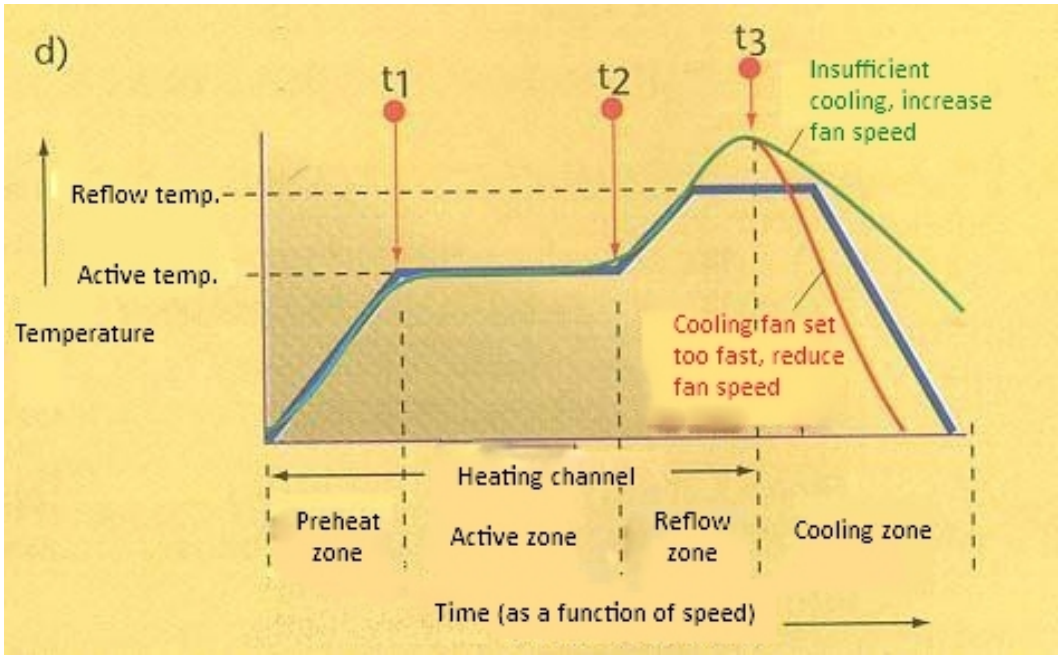


Figure 6. Cooling too fast or not enough

When the final curve is consistent with the desired figure as much as possible, the furnace parameters should be recorded or stored for later use. Although this process starts slowly and laboriously, it can finally achieve proficiency and speed, resulting in high-quality PCB production efficiency.

6. Details about temperature area setting

♦Set the temperature and belt speed to initial value, to the cooling oven, should be preheated for 25 minutes.

♦When the temperature is stable, let PCB pass heat reflow system. If there is no reflow, can properly reduce the transfer chain rotation speed. Another way is that, do not adjust the speed, and increase the temperature properly. When adjust the temperature, notice that it cannot exceed the PCB and component bearing capacity.

♦Let the PCB pass the reflow system in the new speed or new set temperature. If there is no reflow, turn to redo the above step. Otherwise, need temperature fine-turning.

♦The heat temperature wave is adjustable according to the PCB. You can adjust the transfer chain rotation speed to adjust the temperature. Reduce the transfer chain rotation speed can increase the product heat temperature. On the contrary, you can reduce the product heat temperature.

Attention：

♦If the PCB has been placed components, the PCB pass the reflow and it reflow not very completely, suggest you adjust then reflow again. Normally, it will not impact the PCB and components.

♦From low to high when set temperature. If the heat range is over the reflow temperature too high, should increase the transfer chain rotation speed or reduce the set temperature.

♦Different PCBs boards have different heat transmission rate and heat absorption capacity, so it requires the reflow oven offers different heated time and quantity of heating. To double-side PCB, multi-board and other PCBs with many bonding pads, they have a higher temperature setting. To one-side PCB, paper board and less bonding pads' PCB, they have a lower temperature setting. And it also be affected by quantity of PCB that you place. During actual work, reflow oven will adjust itself automatically to some changes of PCB. If based on our suggested temperature, the machine can work well, unless very big change of PCB's absorption capacity, then it needs to adjust properly.

7. Temperature measurement method

♦Attach the temperature thermocouple sensor to the PCB which is the same or similar size as the working PCB in order to observe the reflow. Put the PCB on the transfer chain, then will get the temperature profile, after that compare with the recommend temperature profile. If it is the same to the standard profile or correspond with automodulation profile, then you can start to produce, otherwise follow the temperature profile, the temperature controller with large temperature difference is used to set the compensation temperature by 5 degrees, or the whole machine integrated adjustment, in order to achieve the temperature profile can be produced

♦When starting to put PCB or abruptly change the number of PCB to be reflow oven, there is a difference between the actual temperature and setting temperature, put the PCB with constant speed for a period of time, the temperature difference will turn to normal temperature difference range.

8. Both side soldering instruction

♦Use hot air reflow soldering can finish double-side component soldering. Double-side soldering design means components are in double-side of the PCB need to soldering. Double side soldering includes double-side soldering tin and single-side soldering tin and another side drying glue, as for single-side soldering tin and another side drying glue, it is easier. First, finish one side's soldering tin as the same as single-side, then finish another side tape glue drying in low temperature, finish double-side SMT craft, after that carry on the next step plug-in or tin process on craft. Double-side soldering is generally treated as below follows:

♦Start the reflow oven, set up the transfer chain speed controller, finish the A side components reflow soldering with normal soldering craft.

♦Upend the PCB, repeat normal procedure to mount the component, adopt top heating strategy to let the B side reflow soldering, but the upend A side has been reflow soldering, the compounds in thick liquid volatilize, the melting point of tin is higher than the solder paste, which in order to keep the A side components not fall out.

9. Trouble shooting

9.1 Soldering analysis

Problem	Possible causes	Solutions be available
Incomplete reflow	Inadequate heating	lower the transfer chain speed
	Shadows from components	a. Increase the transfer chain speed b. Increase bottom heat
	Due to the middle layer of copper foil	Decrease transfer chain speed and increase temperature
Inadequate moist	PCB, components without enough solde paste	Pre-paste to components and PCB
	No enough moist time	Increase the temperature of heating zone
PCB bend	Exceeding upper and lower temperature difference limits	Reduce temperature difference between preheating zone and bottom temperature zon
		Increase transfer chain speed
PCB discoloration	Exceeding tin temperature on the board, exceeding temperature gradient or heating speed	Increase transfer chain speed
		Decrease the preset zone temperature
		Decrease transfer speed and temperature
Excessive fines	Top layer temperature out of limit	Reduce top heat and increase bottom zone temperature
Tin balls	Due to dry too fast	Decrease transfer chain speed and temperatu
	Solder pasting is unqualified or PCB re-paste	Use PCB after cleaning and drying
Flux coking	Over heating	Add transfer chain speed, lower temperature
Components wrong position	PNP wrongly, the tin on the solder pad i	Check place position
	irregular or asymmetrical, drying too fas	Check the shape and thickness of tin
	causes airflow to blow components	Lower transfer chain speed and temperature
Tin bridging	Misposition	Check position
Tin migration	Moist overtime	Increase the belt speed
		Lower pre-setting temperature
Solder skips	The solder paste is not enough on pad, the unevenness of the micro-component the PCB coplanarity problem	Thickened tin paste coating
		Try to make the solder on the pad even
		Check component pin stability
PCB over heat	Heating speed too fast	Decrease transfer chain speed and temperatu

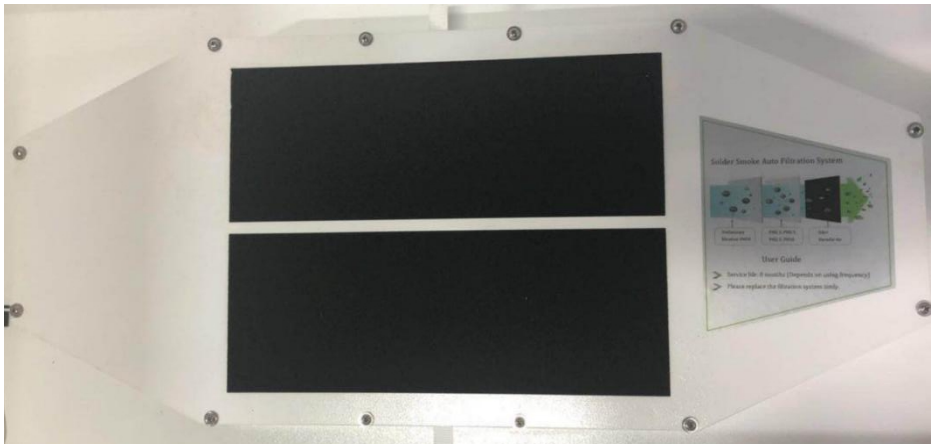
9.2 Precautions

If the PCB length is longer than the ESD tray, the ESD tray needs to be replaced by other suitable carriers to place the soldered PCB.

9.3 Machine maintenance

♦Change the filter regularly

It is necessary to replace the filter regularly. The service life of filter is 8 months (depending on the frequency of use). When it's needed to replace the filter, you could find the welding smoke automatic filter system in the figure below. Remove the 12 screws above and replace the filter.



♦Regularly add high temperature lubricating oil to transfer chain bearings.