BGA Rework Station ZM-R380C

Contents

A. Company Profile

Shenzhen Zhuomao Machine Co., Ltd. is located in one of the most prosperous parts—Xixiang, with Shenzhen International Airpot to its south and State Hwy. 107 as well as Shenzhen-Guangzhou Superhighway to its north, enjoying convenient transportation. It is a science & technology enterprise which holds research, production and sale in one. The main products are: BGA Rework Station, BGA Reball kit, BGA FCT Jig and so on.

Since it is established, Shenzhen Zhuomao Machine Co., Ltd. expands the market with advanced thinking and pioneering philosophy; seizes the market with strong technical expertise; ensures the high quality of the products with modern scientific management and mature advanced technology; and offers our clients the best service with perfect sales network and high-quality staff.

We sincerely hope that our products will bring you more and more profits and wealth.

B. BGA Rework Station

1. Knowledge about BGA

BGA is short for Ball Grid Array. It is a kind of package method which use organic carrier in IC. It has the following features:

①Small package area.　　　　　②Greater functions and more pins.
③Self-centerize while PCB puddle welding, easy to put on tin.　④More reliable.
⑤Good conductivity and low overall cost.

Memory which applies BGA can enlarge the memory capacity by 2 to 3 times while the volume of memory remains the same. Compared with TSOP, BGA is much smaller and better at radiating and conducting electricity.

2. Types and Features of BGA

a. Types
According to the encapsulation material, BGA can be classified into the following types:

(1)PBGA（Plastic BGA）
(2)CBGA（Ceramic BGA）
(3)CCBGA（Ceramic Column BGA）
(4)TBGA（Tape BGA）
(5)CSP (Chip Scale Package or MBGA)

b. Features
Compared with QFP, BGA has the following features:

(1) I/O terminal space is big (eg. 1.0mm, 1.27mm, 1.5mm), and it can accommodate more I/O.

(2) More reliable package, low rate of welding defects and welding spot durable.

(3) Paraposition of QFP is usually observed with naked eyes. When the pin space is smaller than 0.4mm, it is hard to paraposition and weld. While the pin space of BGA is bigger, by applying the paraposition-amplification device, it is easy to paraposition and weld.

(4) The welding coplanarity of BGA is better than QFP, because solder can make up the flat error between BGA and PCB after melting.

(5)Good electrical property. The pins are small, the selfinductance and mutualinductance

of the conductivity is low, and the frequency characteristic is good.
(6)The tension between solder points produces good self-centration effect in solder-reflow, allowing 5% error of patch precision.
(7)Compatible with original SMT mount technology and machines. The original screen printer machine, mounter and solder-reflow machine all can be used. The comparison between BGA and QFP is shown in Table 1. The main defect of BGA is the necessity of X-ray detection after welding.
c. Welding of BGA
    The success of welding BGA is affected by the assembly of PCB. So 3 key factors must be considered in the layout of PCB.

Features	BGA	QFP
Package size S/m^2	525	1600
Pin space L/mm	1.27	0.50
fault rate $(\times 10^{-6/pcs})$	0.60	100

(1)Thermal management
    Thermal management must be considered when we design the assembly of PCB. If many pieces of BGA gather on a small area of PCB, it will cause the imbalance of PCB in the reflow oven. If many big pieces of BGA gather on a certain area of PCB, longer heating period will damage some of the BGA. The areas with fewer components have reached the welding temperature, while those areas with BGA are still in low temperature. So the welding period is over before the flux paste withdraws from the welding spots, thus there may be poor soldering or no-melting of welding balls.
(2)Rabbet
    The design of rabbet on PCB should stick to relevant standards strictly. Any rabbet near BGA welding pad must cover the solder mask very well. If not, the extra welding paste will flow from the welding pad to the rabbet, then leads to short circuit between welding pad and rabbets nearby.
The geometric shape and diameter of welding pad:
    The compactness of pins has immediate impact on the geometric shape and diameter of welding pad. Similarly, BGA has different sizes, shapes and complexity. As the package size decreases, the geometric shape and diameter of the welding pad calls for higher precision in detection.

3. Inspection standards of BGA
    For BGA assembled on PCB, inspection standard is a very important issue. Before BGA is applied to the PCB, most BGA manufacturers don't use X-ray in process of inspection. Instead, they employ some traditional methods to test PCB, such as automatic optical inspection, man-eye inspection or on-line function test. However, these methods can't detect the invisible problems very exactly, such as poor soldering, cold welding and bridging. The X-ray can discover these problems very efficiently. At the same time, it can do live monitoring, guarantee the quality, and realize the in-time feedback of the process control,
a. Evaluation of X-ray
    When BGA is first used on BGA, X-ray can evaluate the solder-reflow according to the situation of un-solder area or areas around it. Open-circuit, non-touching and other similar situations show the solder paste has not reflow enough. Bridging may result from the fact that the temperature is too high for the solder to liquefy. So the solder flows from the pad to the interval between them, causing short-circuit.
    Poor welding should be evaluated objectively: it is not so terrible; the key point is that the welding spots can still be welded on the pad. The ideal situation is no poor

welding. Poor welding may be caused by pollution or the uneven distribution of flux paste. What's more, warped PCB may also lead to poor welding. Open-circuit welding spot may exist, too.

The quantity and size of poor welding are the key factors to decide whether it will be accepted. Generally the size of single poor welding should be less than 50% of the solder ball's diameter. If the ball is surrounded by reflow solder, BGA is able to work. It is a very critical standard. The electrical properties may meet the requirements but the mechanical strength will be affected.

PCB with BGA must use X-ray evaluation systems that can decern holes of less than 100 μm diameter. The X-ray must be able to observe from top-down and tilt. X-rays is a reliable guarantee of successful BGA welding,

b. Proposed inspection criteria

The inspection criteria will help X-ray inspection system confirm some typical welding problems, which is related with the use of BGA device. It includes the following factors:

(1)Poor welding

Poor welding results from the expansion of compounds in solder during the heating of BGA. BGA with poor welding may cause some problems such as ineffectiveness. The inspection criterias are as follows: the size of single poor welding should be no more than 20% of the solder ball's diameter, with no single poor welding on the surface; if many poor welding may exist, the total should be no more than 20% of the solder ball's diameter.

(2)Desoldering spots

No desoldering spots.

(3)Bridging and short-circuit.

When there is extra solder or the solder is not put on the right place, bridging and short-circuit may happen. So no bridging or short-circuit.

(4)None paraposition.

The X-ray image will show very clearly whether the BGA solder ball is aimed at the welding pad on PCB.

(5)Broken circuit and cold welding

When solder don't touch the relevant pad or the solder doesn't flow very well, there will be broken circuit or cold welding. It is absolutely not allowed.

4. BGA rework process

Most of the semiconductor device's heat-resistant temperatures are between 240°C and 600 °C. Therefore, the control of the temperature and uniformity are very important to BGA rework systems. BGA rework process as follows:

a. Printed Circuit Board and BGA preheating

Printed Circuit Board and BGA's preheating is meant to wipe off the moisture. If the moisture was little, this step can be omitted.

b. Remove BGA

If the BGA will not be reused, and the PCB can endure high temperature, we can use high temperature (shorter heating period) to remove it.

c. Clean the pad.

Pad cleaning is mainly clearing the solder paste and scaling powder remained on the surface of PCB after BGA removal. For that process, it must use standard cleaning agent. To ensure the reliability of the BGA solders, generally we cannot use the remained solder paste in the pad, and we must clear away the used solder paste, except that solder balls reform on the BGA. Because of the small size of BGA, especially CSP (or μBGA smaller), it is always

difficult to cleaning the pad, so when reworking CSP, it needs to use Rinse-free Flux if the space around CSP is very small.

d. Lay on BGA Flux Paste

Laying solder paste on the PCB has important influence on the result of BGA Rework. It is convenient to lay solder paste on the PCB by selecting mould matched with BGA. For CSP, there are three solder pastes for choice, including flux paste, clean-free and water-soluble. If we choose the flux paste, the reflow time should be longer, if choose the clean-free solder paste, reflux temperature should be lower.

(1) Mounting: The main purpose of mounting to make every BGA solder align to the PCB pad with special equipment.

(2)Hot air reflow: Hot air reflow soldering is the key to the whole BGA Rework.

①The curve of reflow soldering of BGA Rework should be similar with the original soldering one. Hot air reflow soldering curve can be divided into four zones, including preheat zone, heating zone, recirculation zone and cooling area. These four zones' temperature and time parameter can be set respectively, when it connects with the computer, these programs can be saved and transferred at any moment.

②In reflow soldering process, we must choose the right heating temperature and time of different zones; at the same time, we should notice the heating speed. Commonly, the maximal heating rate is not more than $6℃/s$ before $100℃$, and the maximal heating rate is not more than $3℃/s$ after $100℃$. In the cooling zone, the maximal cooling rate is not more than $6℃/s$, because both of the exorbitant heating rate and cooling rate may cause damage to PCB and BGA, which sometimes cannot be observed by unaided eyes. For different BGA and different solder pastes, we should choose different heating temperature and time. For example, reflux temperature of CBGA BGA should be higher than that of PBGA…choose the higher reflux temperature. For no clean solder paste, its activity is lower than non-no clean solder paste, so the soldering temperature should not be too high, and the soldering time should not be too long, so as to prevent the oxidation of solder particle.

③In hot air reflow soldering, the bottom of PCB board should be heated. There are two purposes for this kind of heating. First, avoid the warping and deformation in one-side heated PCB board; second, shorten the time of the solder paste melting. For the dimension pad of BGA rework, this kind of heating on the bottom of PCB is especially important. There are two ways of heating on the bottom of BGA rework equipment. One of them is hot air heating, and the other is infrared ray heating. The advantage of hot air heating is the homogeneous heating, which common Rework Techniques suggest to adopt this way of heating. What opposite with it is the disadvantage of infrared ray's inhomogeneous heating.

④We should choose the right hot air reflux suction nozzle. The hot air reflux nozzle is non-contact heating, which depend on the high temperature air current make every solder of joint on BGA melt synchronously. For that reason, it ensures the steady temperature circumstance in the whole of reflux process, and it protects the adjacent parts from damaging by the convective hot air's regeneration.

C. Installation

1. Place

In order to ensure the validity of BGA Rework Station, the installation should meet the following requirements.
a. Away from inflammable and explosives;
b. Away from water and other liquids;
c. Ventilated, dry place;
d. Stable and flat, free from tremor.
e. Less dust;
f. No heavy objects on the controlling box;
g. Not affected by airflow of air conditioner, heater or ventilator.
h. Leave a space of 30cm or more behind the rework station for the upper part to move and rotate.
2. Power supply:
a. Use a power supply with little fluctuations in voltage.
b. Fluctuation: 220V±10
c. Frequency fluctuation: 50Hz±3

D. Safety Cautions

1. Don't blow to the rework station directly when it is working, or there will be a negative difference from the surface of the heating board, thus some parts will be burnt out.
2. After it is started, the high temperature area should not touch any objects, or it will lead to a fire or explosion. The PCB and other parts should be put on the PCB bracket.
3. No vibration. Handle it gently.
4. Don't touch the heaters with your hands when it is working, or you will get hurt.
5. Don't use combustible spray, liquefied and flammable gas near the rework station after it is started.
6. Don't try to re-equip the machine, or there may be a fire or an electric shock.
7. There are high-pressure parts in the circuit box. Don't disassemble it.
8. If some metals fall in the rework station when it is working, turn off the power immediately. After it is cooled down, get the metal out, and clean the machine. If not, there may a smell when the machine starts working next time.
9. When the rework station's temperature rises abnormally or smokes, turn off the power and inform the service technicians to repair it. Turn off the power of the circuit box and the the machine while moving the rework station. Hold the plug when we remove the wire, or it will lead to a poor contact then the machine can't work very well.
10. Turn off the power when stop using it.
11. Don't put the rework station on the wires, or there may be a failure, a fire, or an electric shock.
12. Before you use the machine, you must read the instructions attentively.
Note: when the machine works, it will produce some smell. So ensure the comfortable, healthy and safe operation environment, please keep the air in circulation.

E. Introduction of Structure
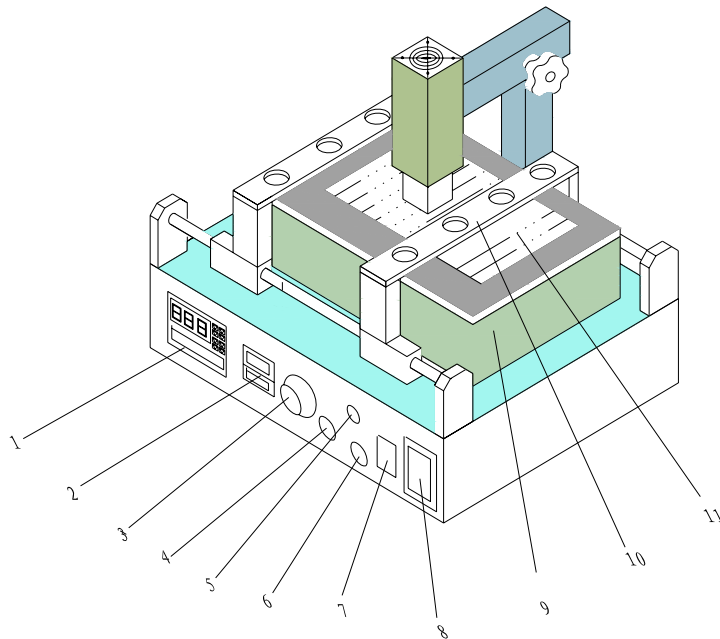
Introduction of host labels:

1. Top heater temp control	**2. Bottom heater temp control**
3. Top breeze adjust	4. Start
5. Running show	6. Stop
7. Cooling AUTO/HAND	8. Power
9. Heat box	10. PCB fixer
11. Heater	

Specification:
1. Total power：3.2 KW
2. Top heater：0.8 KW
3. Bottom heater：2.4KW
4. Power supply ：220V±10　50Hz±3
5. Dimension ：　　450×400×580㎜
6. Temperature control ：　K sensor
7. Positioning: V-groove for PCB positioning　　Max PCB size: 280×320㎜ mm
8. Weight ：　20kg

Features:

1. Choose imported high-precision materials (temperature sensor, PLC, heater) to control BGA desoldering & soldering procedures precisely.

2. Top & bottom temperature areas heat independently, And it can set up 8 rising temperature segments and 8 constant temperature segments to control. It can save 10 groups of temperature curves at the same time.

3. Choose imported high-precision thermocouple to detect the top/bottom temperature precisely.

4. Top & bottom heating can be controlled independently by the temperature graphs. A cross-flow fan cools rapidly to protect the PCB from deformation when welding.

5. This machine can be connected to a computer to be controlled more conveniently with a built-in PC serial port and a proprietary software attached to it.

6. After finishing desoldering & soldering, there is an alarming. The machine is equipped with a vacuum suction pen to facilitate the removing of BGA after desoldering.

7. For large thermal capacity of PCB or other high-temperature and lead-free welding requirements, all can be handled easily.

F. Operation Steps

1. Preheating

Preheat the BGA and PCB before repairing. The temperature in thermostat is usually set at 80℃-100℃,time 12-24 hours, to remove the moisture in PCB and BGA, and prevent burst when heating.

2.Desoldering

Put PCB on the positioning bracket, choose the appropriate hot-air reflow nozzle, set the right soldering temperature curve, and press the START button. After the procedure is over, move the hot-air nozzle away by hand, and use the vacuum suction pen to remove BGA.

3.Clean the soldering pad.

There are mainly 2 ways: one is use suction line to make it flat, the other is use the soldering iron to remove the dregs directly. It is better to remove the dregs soon after the desoldering of BGA, for the BGA has not cooled down, and the damage caused by temperature difference is less.To use some flux paste when cleaning the pad can increase the solder activity and achieve better cleaning effect. Be careful to not to destroy PCB pad! Try to use some volatile solvents.

4.Reballing

Lay the BGA Flux Paste on the BGA pad evenly with a brush. Choose corresponding steel net, and plant the soldering ball on the BGA pad with a BGA Reball Kit.

5.Soldering

Put the BGA on the bottom heating area of BGA Rework Station, and solder the balls on the pad.

6.Lay on Flux paste

Lay the BGA Flux Paste on the BGA pad evenly with a brush, no more, no less.

7.Mounting

Mount the BGA on the right place of PCB. When we place in by hand, we can make use of the silk screen borders. We can touch the surface of the pad and the balls to know whether it is placed in the right area.

8.Soldering

Put PCB with new-mounted BGA on the positioning bracket, move the hot-air nozzle to the right place, choose the appropriate hot-air reflow nozzle, set the right soldering temperature curve, and press the START button. After the procedure is over, turn on the cooling fan to cool down BGA for 30-40 seconds, and elevate the upper hot-air nozzle to be 8-10mm away from the surface of BGA. Or move away the hot-air nozzle after the START light is off, then remove PCB from the heating area.

# G. PLC (Programmable Logic Controller）

1.Top/bottom PLC

a. Panel introduction   Model: PC410 sectional type temperature controller
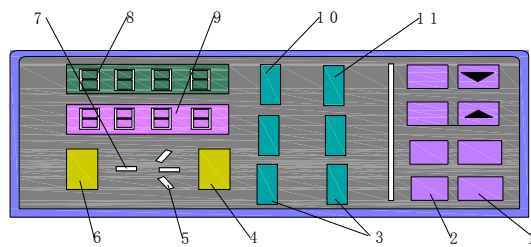
1	PAR/SET	PAR/SET switch	6	PTN	Order of temperature profile
	AUTO/HAND	AUTO/HAND switch	7	OP3	Output 3
	▲	number increase		AT RUN	PID self setting / Running show
	▼	number decrease	8	PV	The actual temperature
2	PTN ▲	Group number increase	9	SV/MV/TIME	The left time
	RUN PROG	RUN/STOP	10	SV	Setting show
	SET PROG	SET/STOP		MV	Output show
	DISP SELECT	Display Select		PV	Actual temperature show
3	OUT1 OUT2	Output 1 Output 2	11	AL1	Alarming 1
4	step	Step number		MAN	Man control show
5	PRFILE	state of profile		COM	Communicating show

b. Panel display

When we turn on the meter, the upper screen displays the basic model, the lower shows the version of the software (for the customized meter, the customer should pay special attention to the software version, to facilitate future order).

Three seconds after, the upper screen displays measurements (PV), the lower screen displays settings (SV).

The meter has two rows of LED, the upper one is used to display the measurements (PV) and various codes of parameters ;the lower one is mainly used to display setting value (SV), the output value (MV) or the remained time of running(TIME) and various parameters. When press the DISP SELECT button, the lower screen will show the items in the SV, MV, TIME order. When the meter is set as curve process controller (ctrl set to prog), TIME shows the remaining time of certain period of procedures. While the meter is set to constant temperature controller, TIME shows cent code. In some special type of instrument, TIME shows the second group measured value or special meaning of input signals.

On the panel of the meter, there are two digital tubes display window: PTN and STEP, and four indicative lights: PROFILE, RUN etc.. These two digital tubes and four indicative lights are used to indicate the operation states of these curves. When the meter is set to curve procedures controller (ctrl set to prog), PTN is the display window of the No. of curve procedure. By pressing PTN button, we can select the curve which needs to run or be modified. When the curve is running, RUN blinks,

STEP window shows the No. of the running curve. When running on the slopes of the increase, the indicator "/" is on. When running on the platform, indicator "-" is on. While running on the slope of decline, indicator "\" is on.

When the meter is set to constant temperature controller, the two display windows: PTN and STEP, PROFILE, RUN, these four lights were off.

OUT1 is used to indicate the working state of output 1. It is on when there is output.

OUT2 is used to indicate the working state of output 2, It is on when there is output.

SV lights: when the lower screen shows setting value, SV is on.

MV lights: when the lower screen shows the output value, MV is on.

TIME lights: the lower screen shows the remained time of the operating procedures, TIME is on.

AL1 is used to indicate the working state of emergency. When the AL1 is in the state of alarm, the lights lit.

MAN is used to indicate the state of manual work. When working in manually state, MAN is on.

COM is used to indicate the state of communication. When the meter sends data, COM is on.

AT is used to indicate the PID state. When the meter is in the state of PID, AT is on.

OP3 is used to indicate the state of output 3, or used as special indicator in certain model.

c. Button operation

The meter have eight buttons, in which PTN, RUN/ PROG and SET/ PROG these three buttons are dedicated to a number of the setting of curve program parameters. When the meter is set to curve process controller (ctrl set to prog), PTN is used to set the number of curve program. SET/PROG is used to set operating parameters, RUN/PROG is used to start the program. When the equipment is set to constant temperature controller, RUN/ PROG, SET/ PROG are not working.

DISP / SELECT is the switch button. When we press DISP/ SELECT button, the lower screen shows settings value, the output value or the remained time of operation, the corresponding indicator SV, MV, TIME are on.

AUTO / HAND is the automatic / manual switch button. When switch to manual output, MAN is on

PAR is parameters setting button. ▲means value increase. ▼ means value decrease.

(1)　　settings modifying

When the meter is in a state of display, the upper screen shows actual measured value. When you use DISP / SELECT button to select the setting value of the lower screen (SV light is on), by pressing ▲ or ▼, you can modify settings.

The scope of setting value is from the minimum settings (code for the SPL) to the maximum settings (code for the SPH).

When the equipment is set to curve program controller (ctrl set to prog), for example, in running state, settings can not be modified.

(2) AUTO/HAND switch without interference

Press the AUTO / HAND button, then it can realize two-way switch without interference.

When working in manual control, the manual control indicator (MAN) is on. When we use DISP / SELECT button to select output power value in lower screen (MV is on), by pressing ▲or ▼, you can modify the value of manual dynamic output.

The maximum value of power output is the limit value for the output power (code for HPL)

If we set AUTO/HAND switch parameter (code for AH) at Auto, AUTO/HAND switch is forbidden.

No.	parameter code	Parameter name	adjusting range	explanation

If we set AUTO/HAND switch parameter (code for AH) as Hand, AUTO/HAND can be switched without interference.

(3) Adjusting parameters and modifying

When the meter is in a state of measurement (PV) display, pressing PAR button for three seconds, the meter will enter the state of parameters modifying; the upper screen shows the first parameter code; the lower screen shows the value of the parameters. Then press ▲or ▼button to modify the value of the parameter. When finished, press the button PAR, meters will show next code and the value of the parameters in order. Revised data will be saved in the memory of the instrument.

After showing the last parameter or no operation in 16 seconds, the instrument will return to the measured value (PV) display state.

（4）Code and meaning of regulation parameter

d. PID self-setting

Before the meter starts working, the best PID adjust parameters should be set, then the control precision can be ensured.

Theoretically, systems on different settings have different ideal PID parameters. Therefore, before start the PID self-setting, you should set the SV to the exact parameter that the user needs.

When the meter stay in the state of auto-control, set the PID self-setting (the code is tunE)to ON, then the PID self-setting works, and AT lamp is on.

In the PID self-setting process, when the self-setting is set to OFF, the process will stop. At the same time, the top heater's position is being adjusted, so the measured value is not vibrating. After 1.5 periods of vibration, the PID self-setting is completed. Then the AT lamp is off. The meter can calculate the best PID parameter and save it in the meter according to the vibration period and amplitude.

If the system can't give vibrate response during the PID self-setting, the PID self-setting can't finish successfully. As different systems have different response periods, the time of PID self-setting ranges from several seconds to several hours. The time is affected by the system, not the meter.

Don't change the settings during PID self-setting, because one change leads to one restart, then PID time is prolonged.

When we use meters with the function of curve procedure control, we should stop the curve procedures first, set the PID self-setting according to the above steps, then start the curve procedure control.

If we only choose PID self-setting, please set the differential time to OFF so that it is not changed when the meter is in the process of PID self-setting. In the system that doesn't allow output signals change frequently, we should choose PID self-setting.

e. Problems display

When the input sensor breaks or the input signals exceed the max range, the upper screen will show the fault code snb; when the sensor short-circuits, or the input signals is less than the min range, the upper screen will show the fault code ur.

In general, the meter works in the state of auto-control. When the meter shows Snb or ur, it shifts to start working very soon, outputting powers. Then, the power can be controlled by button ▲ and ▼,at the same time, the MAN lamp flickers. Once the problem is solved, the meter will return to the state of auto-control.

Order	Parameter code	parameter	Adjustment range	Note
1	C F	Measurement unit		Celsius or Fahrenheit
2	Prog	Curve procedure control	ldLE / Run / Hold	Stop / Start / Pause
3	SP	Basic settings	SPH-SPL	
4	TunE	PID self-setting	OFF ON	Stop PID Start PID
5	AU	First alarming value	Input signal range	
6	AL2	Second alarming value	Input signal range	
7	HyS1	First alarming D-value	1～300℃	Optional function
8	HyS2	Second alarming D-value	1～300℃	Optional function
9	ProP	Heating proposition area	1～2000℃	
10	Intt	Integral time	OFF，1～8000 s	No display when Ctrl is set at ON/OFF
11	dEr と	Differential time	OFF，1～999 s	No display when Ctrl is set at ON/OFF
12	rElc	Cooling coefi	0.1～10.0	Display when heating/cooling
13	Db	Static area coefficient	0.1～10.0	Display when heating/cooling
14	Hc と	Heating period	0.1～240.0 s	No display when Ctrl is set at ON/OFF
15	cc と	Cooling period	0.1～240.0 s	Display when heating/cooling
16	Loc	Configuration password	0～9999	

f. Software configuration (code and meaning of function parameters)

Set the configuration password as 808 (the parameter code Loc), when the meter shows PV, press button PAR and ▲ for 3 seconds to enter the menu of software configuration. The upper screen shows code of the first parameter, and then we can modify the parameter value in the state of IdLE. After the modification, press PAR again, then the code and value of the next parameter. In the meantime, the modified data is saved in the memory.

If no operation within 16 seconds after display of the last parameter, the meter returns to the state of PV.

After the configuration, we should set the password as some other numbers besides 808, to protect the data from unconsciously modification of the operator.

g. Code and meaning of function parameters:

Order	Code	Parameter	Range of adjustment	Note
1	SPH	MAX	Measuring range of input signals	350
2	SPL	MIN	Measuring range of input signals	0
3	HPL	Maximum output	0.0～100.0	100
4	Snbp	Breakdown output	0.0～100.0	0
5	DFS と	Input error correction	-19.99～99.99	
6	C—F	Measuring unit	c（Celsius） F（Fahrenheit）	No display when Sn is of liner-input
7	Sn	Output signals	J と C [R と C E と C r と c s と c b と c と と c r と d cu cu L1n L1m PrE PrE	J Sensor K Sensor E Sensor R Sensor S Sensor B Sensor T Sensor Pt100 platinum resistor Pt100 platinum resistor (with decimal) Cu50 copper resistor Cu50 copper resistor (with decimal) Linear input Linear input (with decimal) Distant transmission pressure resistance signal Distant transmission pressure resistance signal(with decimal)
8	Rddr	Local address	0--99	

9	bRud	Communication baud rate	600 1200 2400 4800 9600 19.2KB		
10	Ctrl	Regulation	On.of PLd rSP Prog	Switch（ON/OFF） PID Heating speed control Curve procedure control	
11	SPll	Heating speed	0.01～99.99	When the screen shows rSP（℃/min）	
12	Op1	Main output	と P 0-20 4-20	Output of time proportion 0-20mA output 4-20mA output	
13	OP1	Second output (cooling)	FRn olL H20 0.05 RL02 on	Wind cooling Oil cooling Water cooling Compressor cooling Second alarming output Action (suction)	
14	RL01	First alarming（AL1）	LoRL HdR LdR ndRo Pout	Under bottom-line alarming Over top deviation-line alarming Under bottom deviation-line alarming Within deviation alarming Out-of deviation alarming Curve procedure over alarming	When the OP2 is the second alarming, AL02 display on the screen.
15	RL02	Second alarming（AL2）			
16	R—H	Automatic/Manual	Auto Hand	No auto/hand shift Auto allowed/hand shift	
17	Prt	Time unit of curve procedures	Nln Sec	Min Sec	
18	Rct	Way of control	rEu Dlr	Positive control Negative control	
19	H,L	Max range of linear input	-1999～9999	Only when the input signal is linear input,it will display L1n or PrE.	
20	LOL	Min range of linear input	-1999～9999		
21	FIL	Digital filtering syatem	P1 - 16 -		
22	Proc	linear input progamming check	P2		

h. Program configuration notes

Basic parameters: Sn, Ctrl, OP1, OP2

Sn, Ctrl, OP1, OP2 are the basic four parameters. They have great impact on other parameters. Therefore, we should set these four basic parameters first, according to the specific requirements.

Output parameters: OP1, OP2, Hct.Cct

When setting OP1 and OP2, be sure to choose the right output module. If the output module is a relay, logic level module or SCR zero module, then OP1 should be set at Time proportion output. If we choose circuit output module, the OP1 should be set at 4-20mA or 4-20mA output.

When we choose time proportion output, we should set Hc,t.cc,t. If we choose SSR(solid-state relay) or SCR zero module, the action period can be set at 2s; if we choose relay to output, the action period should be no less than 20s.

Regulation parameter: ProP.ln と, と,dEr, と,rEL.C

ProP, ln と と,dEr と, rEL.C are the four regulation parameters, directly affecting control precision.

Only if the system is heating or cooling, rEL.C displays.

In the process of PID self-setting, the system can only set ProP, ln と と and dEr と. The cooling parameter rEL.C should be set by hand.

If the adjust method is set at positioning adjustment, ProP is the difference of positioning adjustment.

When Pbd is set at C-F, the unit of ProP is Celsius or Fahrenheit; when Pbd is set at Pct, the unit of ProP is %, and then the heating area equals ProP multiplied by the heating proportion coefficient PH-L. The greater the cooling coefficient, the greater the cooling output power. The cooling output power equals the temperature difference divided by heating proportion,then mutiplied by cooling coefficient.

Control mode parameter Rc と

When Rc と is set at rEu, the control mode is reverse-acting control. It means that as the input signal of the meter increases, the adjustment output decreases. For example, in heating control system, when the temperature rises, the output heating power should decrease, so we choose reverse-acting control.

When Rc と is set at rEu, the control mode is positive-acting control. It means that as the input signal of the meter increases, the adjustment output increases. For example, in heating control system, when the temperature rises, the output heating power should increase, so we choose positive-acting control.

2. Lower Thermostat

a. panel introduction   model: REX-C10   Segmental Temperature Controller

`
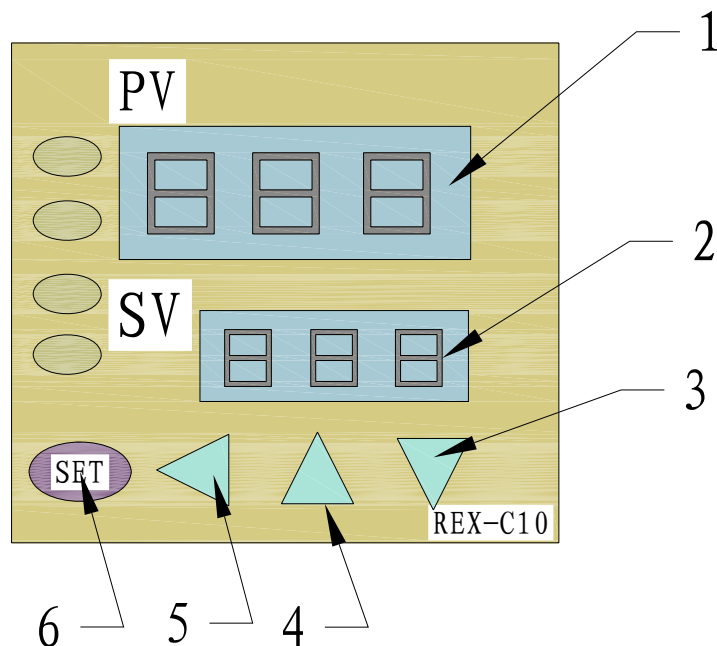
(1). PV:The actual temperature   (2). SV: setting temperature

Switching positions	H	M	S
time rannge	1M～99H99M	1S～99M99S	0.01S～99.99S

(3). Setting figures increase   (4). Setting figures decrease

(5). Setting shift   (6). SET: process set

Note: DH48S showing time is the range of electrical continuing (set by using the coding switch of panel)

b. Explanation of the setting characters

    The following characters will show up one by one by pressing SET button every time. According to different functions, some characters in the instruments you choose may not exist.

c. About PID

(1). Why choose PDI instrument

    In most occasions when the request of temperature control is stricter, we adopt PID process to control. Different temperature control target have different best ratio (P), differential time (I), and integration time (D) parameters. For traditional PID meters, the identification of these parameters mentioned above is operated by experienced process control experts. Otherwise, it's likely that the entire system is out of control for the mismatch of the parameters which bring trouble to most users. To this series of meter,after starting the function, can simulate experts to conduct a search then make the whole set the best parameters automatically according to control object, then get to the best controlling effect.

(2). Usage of PID

    ①Press SET, come to the second set area, then get into the "PID set conditions" according to operational processes, set "AT" at "01". Then press "SET" button for 5 seconds, the

meter will exit from set condition. At that time, AT indicator light blinks. At the vicinity of setting point or after three periods of PID control (setting time varies according to different objects), PID is over. "AT" go out, P.I.D parameters which have been set before will be kept in the meter automatically.

②If we need to examine P.I.D parameters after setting, we can do it in the second setting area.

③In the process of PID, keeping the continuity of power is necessary. We should minimize interference, otherwise, restart PID.

④There may be some differences between two parameters of PID starting in the process of warming and starting on control point. Generally, we choose the latter.

⑤ On some great interference occasion, repeatedly setting may be used to exam the rationality of parameters. Then we can define, choose and revise.

Notes: ①In a state of setting, PV window shows setting character; SV window shows current settings.

②If we want to get into the second setting area from normal control state, press SET button for more than 5 seconds.

③If we want to get out of the second setting area to normal control state, there are two ways to choose: First, press SET button for 5 second or more; second, press any functional button of the meter at least 30 seconds. There are a little bit differences between these two ways: the parameters you set or corrected with the first method is inefficient in the second setting area.

④ In the second setting state, when AT=1, press SET button 5 seconds or more, the system will get out of the second state and get into PID state automatically. At that time, AT is on.

⑤In a working state of PID, press SAT button, the system will get into setting state form PID state. If you want to return to PID state, set AT to 1 again, then press SET button 5 seconds.

⑥To protect the parameters from being revised, you can set the value of LOK to 01 or 02, then get out.

H. Curve Program Controller

1. Parameter set of curve program.
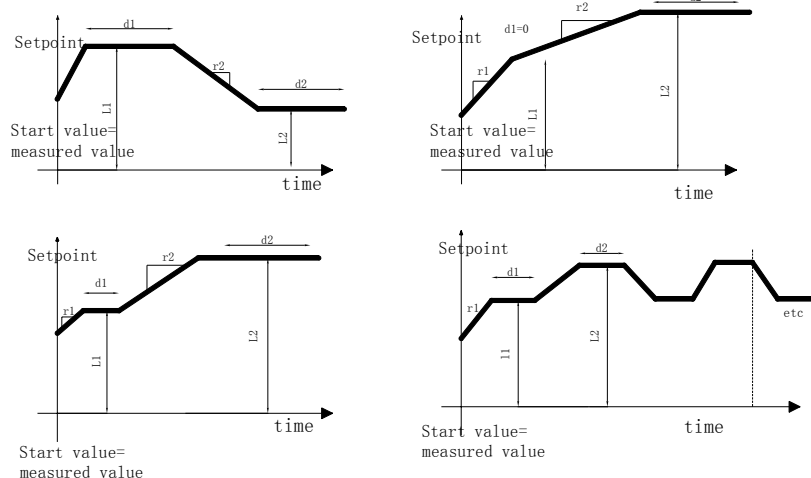
a. Pn0：saved curve program（0～4groups）;

r1:the slope of Curve 1；End;StEP;0.01～99.9°C/min;

Set the slope at End：When the curve program goes to this section, it stops.

Set the slope at StEP：when the curve program goes to this section，the program skip this section and goes to next flat section.

L1: the aim of the flat section. Range: the entire measuring range of input signals, limited by SPH and SPL. The procedure will skip this section. One curve has several slops and flat sections. So we should set every parameter correctly according to specific requirements.

b. Adjustment (the parameter code is Ctrl)

When the meter shows PV/SV, press PAR and ↓ for 3s, the meter can enter the menu of curve program menu, the upper screen display the code of the first parameter, and the bottom one display the value of parameter. Then we can change the value by ↑and ↓. After the modification, press PAR again and the next parameter and its value display. At the mean time, the modified data has been saved in the memory.

If no operation within 16s after display of the last parameter, the meter will return to PV/SV.

c. The working state of curve procedure working

（1）idIE

When the meter stops, it is used as a thermostatic controller. We can set is at SP, which will display in the lower screen. When the meter finishes the curve control procedure, it will go into the stop state (idIE).

（2）**RUN**

When the meter runs, it modifies SV according to the set curve to let PV change as the curve program goes on thus control the heating process.

（3）**HOLD**

When the meter pauses, the timer also stops. SV remains the same, then the time of curve program is prolonged.

d. Display when during curve procedure

(1)display of RAMP

When the meter displays ldIE, the RAMP is off.

When the meter displays RUN, the RAMP is on.

When the meter displays HOLD or Hb, the RAMP blinks.

Note: When the CTrl is set at rSP, and the curve goes through the slope, the RAMP is on.

(2)display while running

When the meter displays RUN, Hb or HOLD, press PAR. The lower screen display the code r1,d1,r2,d2,……Hb and the code of display code.

(3)Display of remaining time

When the meter is on flat section d1or d2, the value displayed under the parameter code is the remaining time, not the total running time.

(4)display of setting

When the meter is in the state of run ，Hold or Hb, the lower screen shows the running setting instead of the basic setting. The basic setting displays under the SP parameter code.

When the meter is in the state of ldIE, the lower screen displays the basic setting.

2. Modification of parameters when the curve procedure runs.

a. When the meter runs, we can't modify the curve program parameter LC，r1, L1, d1, r2, L2.d2…… But other parameters can be modified and saved.

b. When the meter pauses, the modification of LC，r1,L1,d1,r2,L2.d2……is valid only in this running, and not saved. Other parameters all can the modified and saved.

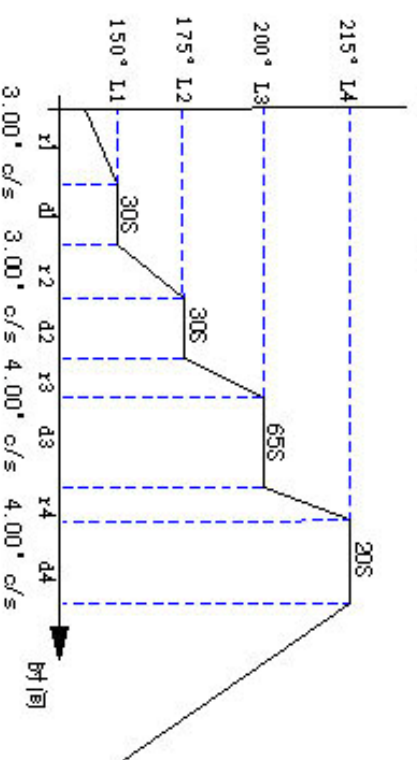c. When the meter stops, LC，r1, L1, d1, r2, L2.d2……and other parameters can be modified and saved.

d. What to do if there is a power-off while the meter is working? At this moment, the meter will record and save the current parameter and running state. Once the power is on, the meter will continue the program from this point, instead of restart from the beginning.

e. What to do when the curve program is over? Then the meter will deal with it according to the settings of (P, End). When P.End is set at OFF, the meter stops outputting and the programme is over.
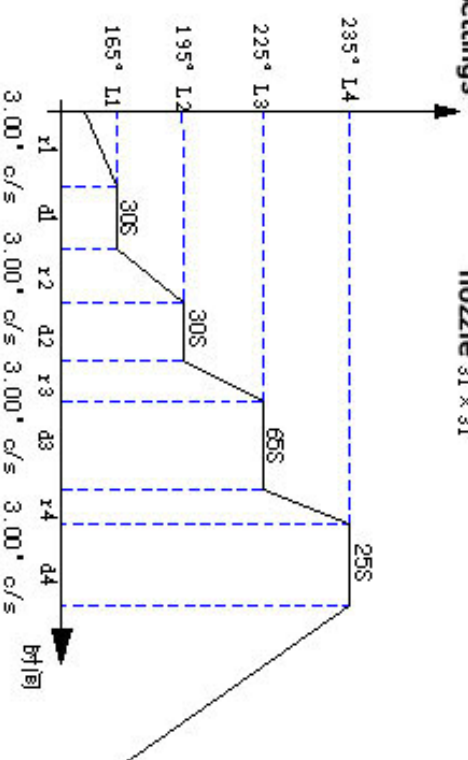
The following chart only for reference：

settings   nozzle 18×18
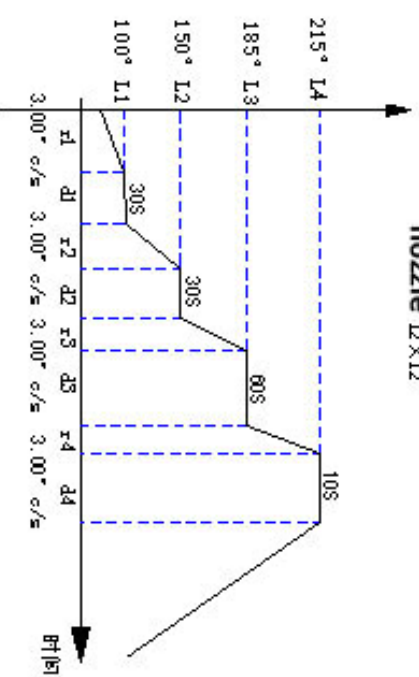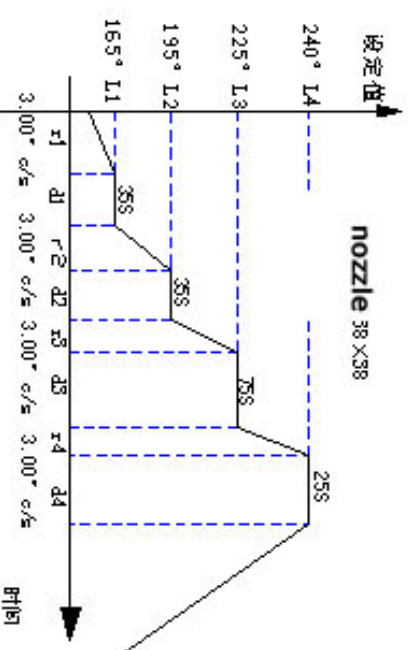
215° L4
200° L3
175° L2
150° L1

r1 d1 r2 d2 r3 d3 r4 d4
3.00" c/s 3.00" c/s 4.00" c/s 4.00" c/s

30S
30S
65S
20S

时间

settings   nozzle 31×31

235° L4
225° L3
195° L2
165° L1

r1 d1 r2 d2 r3 d3 r4 d4
3.00" c/s 3.00" c/s 3.00" c/s 3.00" c/s

30S
30S
65S
25S

时间

设定值   nozzle 12×12

215° L4
185° L3
150° L2
100° L1

r1 d1 r2 d2 r3 d3 r4 d4
3.00" c/s 3.00" c/s 3.00" c/s 3.00" c/s

30S
30S
60S
10S

时间

设定值   nozzle 38×38

240° L4
225° L3
195° L2
165° L1

r1 d1 r2 d2 r3 d3 r4 d4
3.00" c/s 3.00" c/s 3.00" c/s 3.00" c/s

35S
35S
75S
25S

时间

I. Related information

1. How to deal with the Voids produced by the lead BGA in lead-free soldering?

As the development of the lead-free technology, more and more SMT processing enterprises come across the problem of Voids in production.

Many companies try to avoid using lead BGA in lead-free soldering technology. Because the melting point of lead soldering balls is lower than lead-free tin paste. The tin balls melt first and surround the tin paste, so that the flux in the paste can't volatilize, and form bubbles inside. If there is via on the soldering pad, there may be more bubbles.
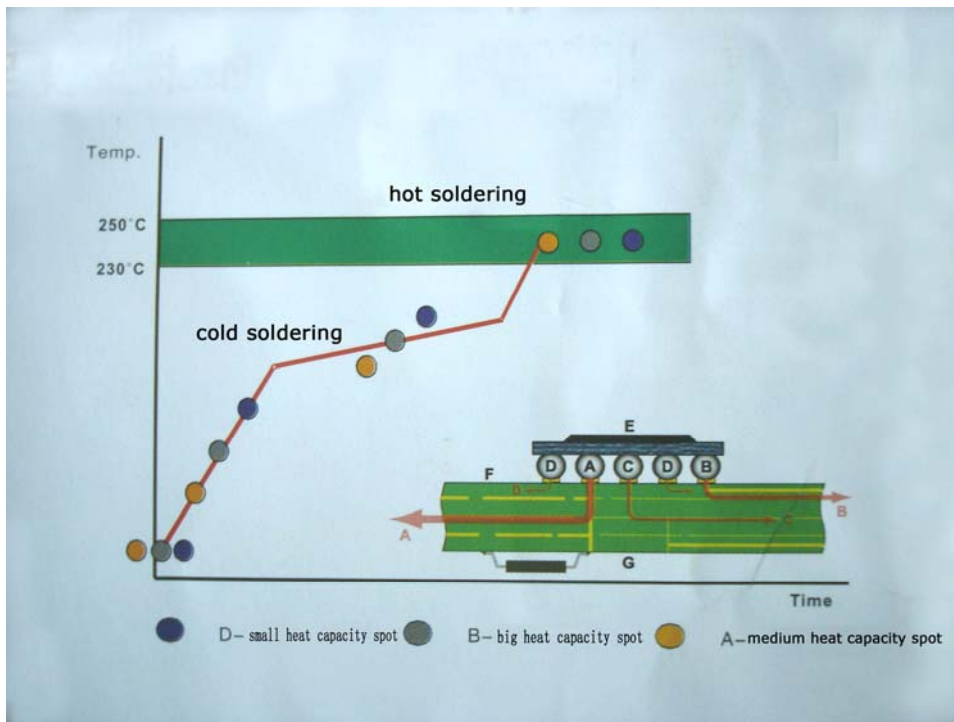
Steps of desoldering and replacing BGA/CSP with lead-free desoldering materials:
Set the temperature curve;
Desoldering the broken parts;
Clean and preparation for the repair work;
Remount the reworked parts with flux paste.
Detection of reflow soldering.
a. Requirement of devices in reworking

Repairing method of BGA/CSP is convection, not radiation, so soldering iron is not the ideal choice. In normal reworking of BGA, it is difficult to use IR, because the ceramic heater can't cool down very quickly, thus it is difficult to control the time of higher reflow temperature. However, the convection can control strictly, and it is conductive to a better & repeatable temperature curve, and the components will not be over-heated, and the time of higher reflow temperature will not prolong too much.

The standard reflow consists of 3 temperature areas: preheating area, insulation area and reflow area. After reflow, it is the process that PCB cools down to less than 100℃. The soldering process is more important in lead-free assembly. Lead-free process calls for temperature as high as 235℃, but BGA/CSP is sensitive to high temperature. Then the wrong temperature rising will burn the components.

Semi-auto reflow retrieval system can save many temperature curves. It is important to know

the use of temperature curves. An precise temperature is the key point in the production which can ensure that all the welding points heat and reach the peak temperature together. The starting point of the production parameter is the actual temperature of PCB. The technician can adjust the heating area parameter of the machine to achieve the expected temperature curve of PCB through the analysis of material temperature.

The convection rework station which can save many temperature curves is directed by the approximate situation of PCB heating. The more precise method is to connect a K sensor to the PCB to detect the temperature. What's more, the final form of process control is to detect the welding points in the process, or to detect the reflow points. Look at the following picture:
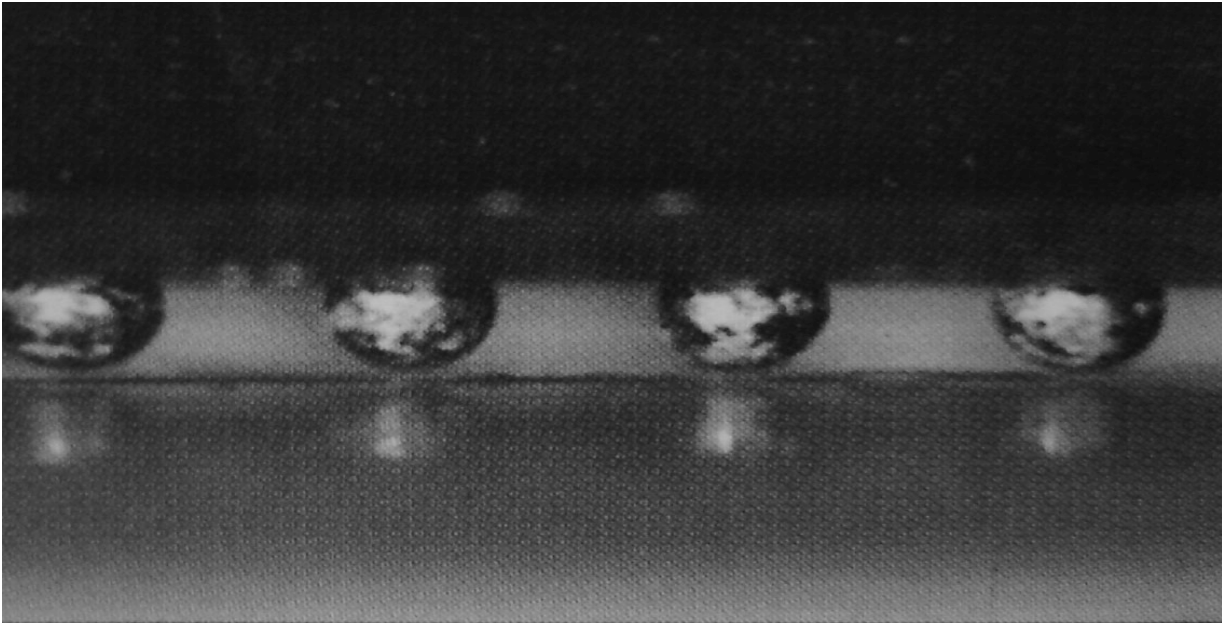
Infrared reflow oven and repair sets are not new to the world. However, because the physical effect is limited, infrared ray has lost some market. When the heat radiation distribute evenly, objects in different colors absorb and reflect heat radiation unevenly.

The purchase decision of Array Package Rework Station should start from the reliable technology. It is important to control the process. ZM-R580B is easy to operate and very useful in the soldering of SMD, TH and plastic. It can make the most profit out of the least investment.

a. Compatibility of components.

Lead-free soldering is more and more popular. Eutectic solder ball in still the standard choice in USA. Components manufacturers consider the using of lead-free balls as the standard.

b. Setting of temperature difference.

The temperature difference on the surface of components is a must factor to be considered in quality rework and assembly. Increment of 10℃ can be accepted. Temperature difference of component from top to bottom is another important factor.

c. Control of temperature curve

To avoid brittle rupture in welding points, the temperature should be better controlled, especially the heating of PCB bottom. Heating board can't change the temperature in a short time, so it can't be used in lead-free solder process.

2. Setting and adjustment of temperature curve

Setting of temperature curve is the first and most important step of BGA rework.

Compared with reflow temperature curve, the control of temperature in rework process is more strict, because in normal reflow oven, the temperature loss id nearly zero. But in the rework process, the PCB is usually exposed in the air, we heat the components respectively. In this way, there is much loss of temperature. But we loss can't be made up only by heating. The reasons are as follows: one is that over heating will damage the components. The other is that the uneven heating will lead to deformation of PCB. Therefore, choosing a right temperature curve is the key to BGA rework. What's more, different PCB has different material, thickness and heat dispersion. The corresponding BGA also has different sensitivity to temperature. To achieve the best rework effect, we should set a special curve for each component on PCB.

To get a more precise temperature curve, it is necessary to use a sensor. Generally, we put the sensor on the center of the BGA pad. But it is hard for the sensor to go through the space between balls and reach the center part. What's more, nobody can ensure that the data is from the balls or the space. Another method is to dig a hole at the center of the BGA pad from the back of PCB. Extend the sensor into the hole and fix it to the back of the PCB, then the sensor can touch the pad and the thermal conductivity can be ensured. Nowadays most manufacturers adopt this method.

3. Use of flux paste.

Generally, before mounting a new BGA, the paste should be laid on the pad with a special micro mesh. But for those common devices such as PBGA or MBGA, the paste can be laid on the pad directly, and the soldering can be finished by the melting of soldering balls. Of course, for CBGA, a mesh and soldering paste are necessary, because the melting point of soldering balls on CBGA is much higher than common paste, such as Sn63 and pb27.

4. Removal of residual soldering tin and mounting of BGA

Besides the temperature curve, the removal of remained soldering tin and mounting of BGA are of great importance in BGA rework. Generally, people don't realize it. But in practice, it often leads to failure in BGA rework.

We usually use copper tin-absorption line to remove the residual tin. In the rework process, the pad is likely to be destroyed by the wrong operation of the technician, thus the total process of BGA rework becomes a failure. Therefore, we should pay more attention. Here are 2 tips: one is to remove the residual tin within a short time after desoldering BGA. Because at that time PCB has not cooled down completely and the temperature difference cause less damage to the pad; the other tip is to use some flux when removing the residual soldering tin, which can improve the activity of tin. Never move the copper tin-absorption line under the great pressure of soldering iron. The remounting of BGA calls for the "fine finish" of tin removal. Thus it ought to be operated by some experienced technicians.

5. Use of nozzle

Every hot-air heating rework station need a suitable nozzle. It is better to use a nozzle which is 2-5mm bigger than the component, then the component is entirely

covered by the nozzle, and BGA can be heated evenly.

。
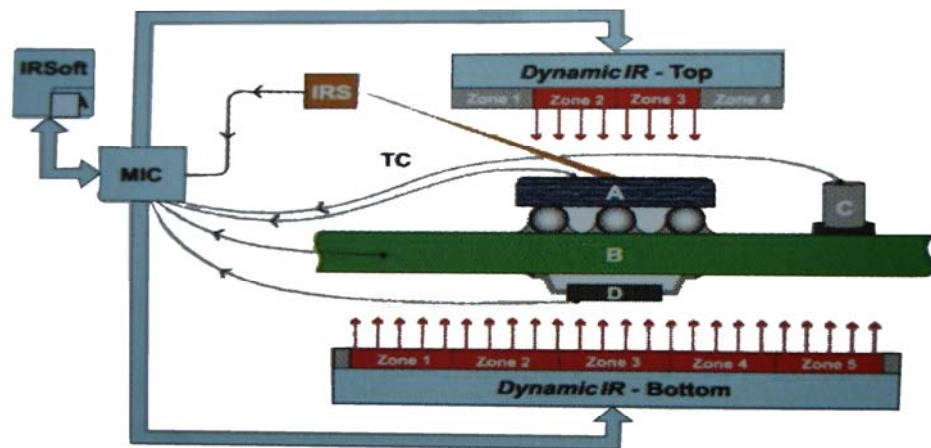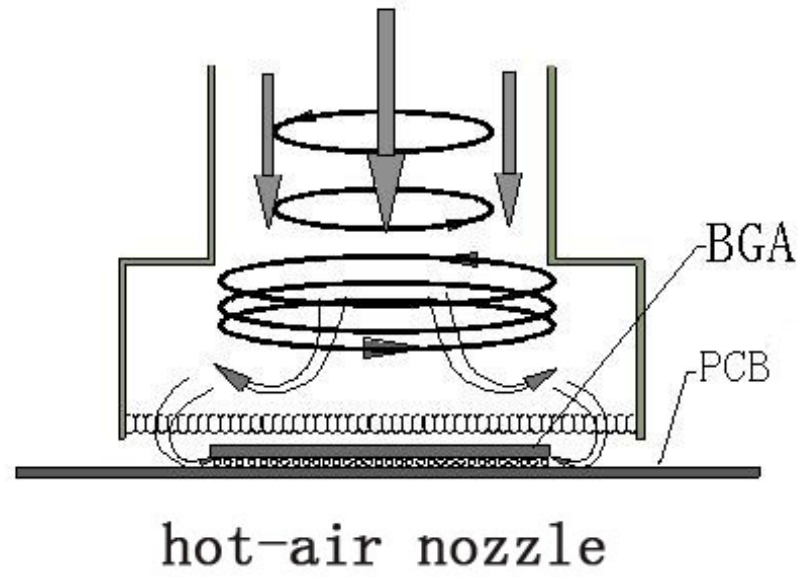
hot-air nozzle

J. Tips for operation

1. After turn on the head power switch, check whether the upper hot-air nozzle gives out cool breeze. If not, never start the machine, or the upper heater may be burnt.

2. Set different temperature curves for different BGA. The temperature should not be higher than 250℃. In lead-free soldering, it can be set according to the soldering temperature curve of BGA soldering balls.

3. When desoldering BGA, turn the cooling fan to auto. After the temperature curve goes over, the buzzer alarms automatically. Then remove BGA form PCB quickly with a vacuum suction pen and take PCB away from the positioning bracket.

4. When desoldering BGA, turn the cooling fan to auto. After the temperature curve goes over, the buzzer alarms automatically. The cooling fan begins to cool BGA and the lower heating area. The hot-air nozzle gives out cold breeze at the same time. The upper main heater arises to 8-10mm from the surface of BGA and pauses for 30-40s. Or after the working light is off, move the main heater away and take PCB away from the positioning bracket.

5. Before soldering BGA, check the PCB pad and BGA balls one by one. After soldering, check the appearance one by one again. If there is some problem, stop assembling and check the temperature. Continue after adjust it well. Or the BGA and PCB may be destroyed.

6. Clean the surface of the machine regularly, especially the infrared heating board. Don't leave dirt plot on the board to prevent it from radiating, or the soldering may be a failure and the life of infrared heater will be significantly shortened. (If the infrared heater is destroyed due to this reason, our company will not change it for free.)

7. When we use the optical place system, we must turn the self-lock (heating head and nozzle) switch to auto, or the heating head and nozzle can not rotate freely.

Those who are not trained by our company mustn't modify the parameters or disassembly the control box.

Conclusion

In the productive area of electronic products, especially the computer and communicative electronics areas, the components to miniaturization, multifuctionize and greenize. Different kinds of packaging technology emerge, while BGA/CSP is the mainstream.

To meet the fast-increasing demand of BGA circuit assembly, the manufacture companies need to choose safer, faster and more convenient assembly and rework technology.

Appendix:　packing list

Order	Name	Specification	Unit	NO.	Note
1	BGA Rework Station	ZM-R380C	Set	1	(electric cabinet)
3	Install program	Software	Set	1	
5	Vacuum sucker		PCS	2	
6	Hot-air nozzle		PCS	3	
7	Temperature sensor		PCS	1	
8	Data access		PCS	1	
9	Power cable		PCS	1	
10	Instruction book	ZM-R380C	copy	1	