Simple Ball Mounter for BGA/CSP

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The use of BGA and CSP chips has become widespread. And the number of chips (packages) with a large number of balls has increased: 300 - 600 pins with BGA chips and 100 - 300 pins with CSP chips.
This has also brought about increases in the cost of BGA and CSP chips. And the number of cases in which usable chips removed during reworking have had new balls mounted and been reused has increased.
Thus, the following introduces a simple ball mounter that can recycle balls removed during BGA/CSP chip reworking and perform small-scale ball mounting.

1. Simple BGA/CSP Ball Mounter

It is considered that there are four situations in which solder balls are mounted on small quantities of BGA and CSP chips (packages), as follows:

1) When performing operational tests on chips during BGA and CSP chip development and testing.
2) During operational analysis and tests on defective chips by quality control departments.
3) When performing solder leakage tests on packages.
4) When remounting balls in reworked chips.

There are several methods of mounting balls in BGA and CSP chips. In mass production, all of the balls are mounted at one time using vacuum suction. Development departments and quality control departments mount the balls one at a time using tweezers, which requires considerable diligence and care.
The vacuum suction method requires extensive equipment and is expensive; therefore, it is not suitable for small-scale ball mounting. Thus, a small, inexpensive and easily operated device was developed.
In the conventional method used for small-scale ball mounting, flux or cream solder is printed on the surface of the chip. A ball mounting screen is placed over that and then the balls are mounted.
In the newly developed method, an aerosol type flux is sprayed on the chip surface instead of printing a flux or cream solder coating. This greatly simplifies the printing process as well as the small-scale mounting of balls on BGA and CSP chips.

2. Simple Ball Mounter Construction and Basic Sequence

* Construction
Simple Ball Mounter (BM-11 Series)
Specifications

Chip size	6mm x 6mm - 50mm x 50mm
Number of pins	30 - 3000
Pitch	0.5mm - 1.5mm
Ball diameter	0.30mm - 0.89mm
Ball solder	183 - 290 degrees C

Construction
(A) Ball-mounting screen
(B) Chip (package) holder
(C) Ball presser
(D) Spray type flux

(A) The ball-mounting screen consists of an aluminum or steel frame and a stainless steel screen. The diameters of the balls mounted range from 0.30mm to 0.89mm and a screen thickness of 0.13mm, 0.15mm or 0.20mm is used, depending on the ball diameter.
There are four standard screen sizes ranging from 40mm x 40mm to 70mm - 70mm.

(B) Two different chip (package) holders are used. One is made of aluminum and the other of magnesium. The one to be used depends on the application and the cost. Basically, reflow soldering is used for each holder so magnesium with its low heat capacity is used for large chips.
These holders also differ according to the chip shape; therefore, special holders are required for chips of different shapes even though the number of balls may be the same.
There are four types of holders, with external dimensions ranging from 50mm x 50mm to 80mm x 80mm, and there are two thicknesses: 2mm and 3mm.
(C) A ball presser is used to lightly press the balls into the openings of the ball-mounting screen from the top. Smaller diameter and lighter balls tend to float in the screen openings due to the effects of static electricity. Lightly pressing from the top makes the balls stay more securely on the chip surface.
(D) The spray type flux is applied by spraying the flux over the entire surface of each chip terminal. Thus, the normal process of printing flux or cream solder is reduced to a matter of 1 - 2 sec.

* Basic Sequence

Small-scale ball mounting and re-balling for BGA and CSP involves the following three processes.

1) Cleaning of old solder from the chip surface (for re-balling) and coating flux or cream solder.
2) Mounting the flux-coated chip on the chip holder and placing the ball-mounting screen over the chip. The appropriate balls are placed on the screen and the balls drop into the screen openings and are mounted.
3) The ball-mounting screen is removed and a reflow device performs reflow soldering for each holder.

3. Operational Procedure

The procedure used for operation is as follows. For re-balling, the old solder must first be cleaned off.
1) Spray aerosol type flux on the surface of the terminals of the chip (package) for 1 - 2 sec.
It is also possible to use chips printed with flux or cream solder.
2) Mount a flux-coated chip in the holder.
3) Correctly place the ball-mounting screen at the prescribed position above the holder.
Thus, positioning the chip and screen, and the gap between the chip and screen are maintaining correctly.
Place as approximately a number of solder balls as the number of chip pins on top of the screen.
4) Grip the chip holder and screen frame with both hands and shake so that balls drop into all of the holes.
5) Shift the left over balls to the for side of the screen and press lightly on the balls in the holes with the ball presser.
6) Using the far side of the screen as a fulcrum, use a lever to slowly remove the screen from the holder.
7) Insert each holder into the reflow device and solder the balls.
When the compact nitrogen reflow device RF-110N2 is used, set the temperature to 220 degrees C and solder for approximately 2 minutes with a oxygen concentration of 1000ppm.

4. Conclusion

The main point of this system is the use of aerosol type flux. Synthetic resin non-washing type flux FZ-135 (Sunhayato) is used but a flux with a higher viscosity is preferable.
In Japan, there are still differences of opinion concerning the reliability of re-balled chips; therefore, there is more use for ball mounting for BGA and CSP chip prototyping and quality assurance than for re-balling applications.
The use of re-balling is widespread in the United States, Taiwan, etc., but in Japan, use is limited to chips costing several tens of thousands of yen and widespread use is still in the future. In the four months since this simple ball mounter was introduced, there have been approximately 30 types but this should expand to approximately 80 types within the year. And we hope that the standard types will cover almost all demand.

* Simple Ball Mounter Configuration

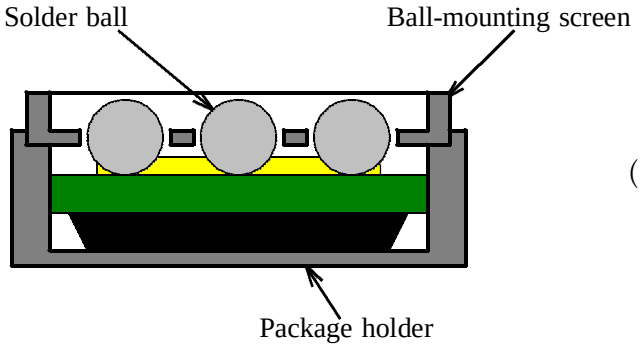
* Specifications

Ball-mounting screen

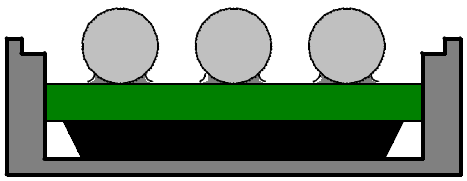
Stencil	Material	: SUS304
	Size	: 40mm x 40mm - 70mm x 70mm
Frame	Material	: aluminum (or steel)
Package holder	Material	: magnesium (or aluminum)
	Size	: 50mm x 50mm - 80mm x 80mm

* Basic Re-ball Sequence

（1） Remove all old solder remaining on the chip and coat with flux.



（2） Place the ball-mounting screen on the package holder and place solder balls on top.



（3） Heat each package holder in the reflow device （RF-110N2） to solder the balls.

* BGA, CSP Re-balling Method

1. Spray flux onto the package.

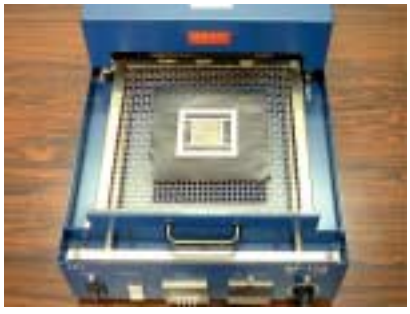
2. Place the package in the package holder.

3. Place the ball-mounting screen on top of the package holder and place a slightly excessive number of balls on top of the screen.

4. Shake the package holder and screen together so the balls drop into the holes in the screen.

5. Move the surplus balls to the rear and then use the ball presser to lightly press the balls in the holes.

6. Using the back of the screen as a fulcrum, use a lever to remove the screen.



7. For each chip holder, use the reflow device to melt the solder balls and fasten to the package.