SB^2 Laser Solder Ball Systems

Features

- Single-step solder ball placement and reflow
- Flux-free reflow with laser
- No special tooling required
- No additional reflow required
- Solder-ball diameter from 60µm to 760µm
- High solder alloy flexibility
  - Eutectic SnPb
  - High-lead SnPb
  - Lead-free SnAg, SnAgCu, etc.
  - AuSn
- In-line capability
- High throughput
- High accuracy axes system
- Automated fiducial alignment
- Ball rework and repair capability
- Optional configurations
  - 2D bump-inspection system
  - Integrated laser power sensor
  - Repair station
  - Automatic handling system
  - Reel-to-Reel (300–400mm or 35–70mm)

Solder ball placement systems within the semiconductor industry have reached a new standard for advanced and reliable solder-ball placement, reflow and rework. The high-speed SB^2 systems can achieve a ball placement up to 10 balls per second. They provide an exceptional solution for economical solder-ball placement, reflow and repair.

SB^2 systems provide reproducible solder-bumping technology for packaging optoelectronic devices, MEMS, sensors, BGA's, chip-scale packaging and flip-chips. They are available in three configurations: fully automatic (SB^2-Jet), semiautomatic (SB^2-SM) and small foot print fully automatic (SB^2-Jet LF).

An SB^2 system has the ability to singulate, to position and to reflow solder balls with diameters of 60µm to 760µm. It is designed for wafer bumping, single-chip bumping and selective solder deposition on substrates (FR4, ceramic, flex materials). The system is suitable for wafer of substrate sizes up to 300mm. They also allow a flexible method of solder ball placement on chip-scale packages (CSP) and ball-grid arrays (BGA) and can be used for 3D interconnections such as chip-on-flex, stacked 3D memory modules and HGA's.

Solder ball reflow is performed by the class 1 SB^2 laser system using an infrared wavelength. All components of the systems are integrated into a single cabinet.

PAC TECH USA
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SB^2-Jet

The SB^2-Jet is the most advanced, fully automated high-speed sequential solder-ball attach system available today. It can operate either in a fully automatic mode or in a semiautomatic mode. In automatic mode, the SB^2-Jet operates using programmed wafer coordinates. In semiautomatic mode, an operator operates the machine with "eyes-on" control. When Pac Tech's new solder-jetting process is used, the ball placement rate is up to 10 balls per second, with ball diameters ranging from 60µm to 760µm. A single cycle consists of solder-ball singulation, solder-ball placement (or solder jetting) and laser reflow.

The gantry system of the SB^2-Jet is driven by linear motors, and it is suitable for wafer or substrate sizes up to 12 inches. In a fully loaded version, the SB^2-Jet can be delivered with a vision and pattern-recognition system, an after-bump 2D inspection and an additional repair unit. The system is fully in-line capable and can be equipped with an automated substrate or wafer-handling solution such as conveyor, robot or reel-to-reel systems.

SB^2-Jet LF

The basic differences between the SB^2-Jet LF and its bigger brother, the SB^2-Jet, are the smaller footprint and the maximum wafer or substrate size of 8 inches. Especially in case of limited floor space or costly environmental aspects, using the SB^2-Jet LF has its advantages. The SB^2-LF product line is a fully automated high-speed sequential solder-ball attach system that can operate either in a fully automatic mode or in a semiautomatic mode. In automatic mode, the SB^2-Jet LF operates using programmed wafer coordinates. The ball placement rate is up to 10 balls per second, when using PacTech's new solder-jetting process. Ball diameters range from 60µm to 760µm.

The gantry system of the SB^2-Jet LF is driven by piezo linear motors. In a fully loaded version, the SB^2-Jet LF can be delivered with a vision and pattern-recognition system, an after-bump 2D inspection and an additional repair unit. The system is fully in-line capable and can be equipped with an automated substrate or wafer-handling solution, such as conveyor, robot or reel-to-reel systems.

SB^2-SM

The SB^2-SM is a semiautomatic solder-ball placement reflow and rework machine designed for small-volume manufacturing, prototyping, and research and development. Maximum throughput is 5 balls per second if the solder-jetting option is installed. The ball diameters range from 80µm to 760µm.

The axes of the system are driven by piezo linear motors and can be provided for 4-inch or 6-inch substrate capability. In manual mode, a joystick can control the axes. Visual inspection of the process is accomplished using a high-resolution five-step-zoom stereo microscope. Vision and pattern-recognition system and repair unit is optional.

System Configuration

All SB^2 systems are self-contained into a compact 19-inch chassis. The systems can singulate, position and reflow solder balls that have diameters ranging from 60µm to 760µm. The solder-ball bumper base is constructed of highly stable granite with isolation. SB^2 systems consist of the following elements:

- Bond head (mounted on a Z stage)
- Axis and drives with 4-inch or 6-inch chuck for the SB^2-SM system, gantry system with 8-inch or 12-inch chuck for the SB^2-Jet systems
- System control unit
- Class 1 laser system

Bond Head

For different solder ball diameters, a specific bond head is required . For the SB2-Jet and the SB2-LF bond heads for ball diameters ranging from 60µm to 760µm are available The minimum ball size for the SB2-SM is 80µm A bond head consists of the following elements:

- Solder-ball loading station
- Singulation unit
- Capillary holding for ball positioning
- Fiber-coupling unit
- Optical sensor
- Rotation motor stage
- Pressure sensor

System Control Unit

The SB^2 system-control unit fulfills all requirements for industrial PC standards. The system-control computer can be linked to a host computer, via Ethernet, to administer all data. The integration of a SECS GEM protocol is optional. The basic system-control unit configuration consists of the following:

PC Type	IBM PC compatible
Processor	Pentium IV
Memory	256-MB minimum
Hard Drive	40-GB minimum
Floppy Disk	1.44-MB, 3.5-inch
Monitor	15-inch flat screen
Input Devices	Keyboard and joystick

Laser Class 1 System

Pac Tech uses a solid-state, pulsed Nd: YAG laser that is incorporated into a standard 19-inch rack configuration. The entire system includes the power supply, cooling unit, laser cavity, and fiber-coupling unit. A red pointing-dot laser light is used as a target light to precisely locate the high-power laser spot.

The laser system, when combined into the SB^2-Jet and SB^2-SM systems safety housing, is specified as a class 1 laser product . The entire system is manufactured in accordance with IEC825 (European Standards E DIN VDE 0750, 871, 835 and 837). When the system is exported to the United States, the laser system complies with the U.S. Federal Performance Standards for class IV laser products (21 CFR 1040.10 and 1040.11).

Technical Data and Facility Requirements

	SB^2-Jet	SB^2-Jet LF	SB^2-SM
Axes (work space) Note 1			
X, Y Axes	500mm x 500mm (12-inch)	200mm x 200mm (8-inch)	100mm x 100mm or 150mm x 150mm (4-inch or 6-inch))
Z Axis	50mm	50mm	50mm
Ball Placement Rate and Reflow			
Specified	Up to 10 balls/sec.	Up to 10 balls/sec	1 ball/sec
Depending on Layout			5 balls/sec (Jet-mode, optional)
Mechanical Data			
Dimensions (L x W x H)			
mm	1,200 x 1,200 x 1,670	1,000 x 640 x 1670	1,100 x 610 x 1,600
Inches	47.25 x 47 25 x 65.75	39.37 x 25.20 x 65.75	43.31 x 24 x 63
Dimensions Reel-to-Reel			
mm	400 x 500 x 1340	400 x 500 x 1340	
Inches	881.85 x 1,102.31 x 2,954.19	881.85 x 1,102.31 x 2,954.19	
Total weight (Approx.)			
kg	1,200	500	300
Pounds (lb)	2,646	1,103	661
Floor Space (Approx.)			
mm	1,200 x 1,200	1,000 x 640	1,100 x 610
Inches	47.25 x 47.25	39.37 x 25.20	43.31 x 24
Electrical Data Note 2			
Line voltage	208V/400V Three Phase	110/230V Single Phase	110/230V Single Phase
Maximum Current	24 (400V)/32 (208V)	16(230V)/25(110V)	16(230V)/25(110V)
Frequency	50/60Hz	50/60Hz	50/60Hz
Ancillary Supply			
Vacuum-Pressure Note 3	Approx... 0.03 bar	Approx... 0.03 bar	Approx... 0.03 bar
Vacuum-Flow Rate	N/A	N/A	N/A
Vacuum-Tube Diameter	6mm/8mm ID/OD	6mm/8mm ID/OD	6mm/8mm ID/OD
Air-Pressure	7 bar. max.	7 bar. max.	7 bar max.
Air-Flow Rate	126 l/min. max.	126 l/min. max.	126 l/min. max.
Air-Tube Diameter	6mm/8mm ID/OD	6mm/8mm ID/OD	6mm/8mm ID/OD
Nitrogen-Pressure	3 bar min., 12 bar max.	3 bar min., 12 bar max.	3 bar min, 12 bar max.
Nitrogen-Flow Rate	0.75 l/min. max.	0.75 l/min. max.	0.75 l/min. max.
Nitrogen-Tube Diameter	6mm/8mm ID/OD	6mm/8mm ID/OD	6mm/8mm ID/OD
Environmental Conditions			
Temperature	20˚C ±5˚	20˚C ±5˚	20˚C ±5˚
Relative Humidity (non-condensing)	30%–80%	30%– 80%	30%–80%
Climatization Time	12 hours	12 hours	12 hours
Cleanroom Recommendations	Class 10.000 or better	Class 10.000 or better	Class 10.000 or better
Laser Specifications			
Wavelength	1,064nm	1,064nm	1,064nm
Laser Energy (max.)	5J in 10ms	5J in 10ms	4J in 10ms
Pulse Frequency	Up to 20Hz at 5J	Up to 20Hz at 5J	Up to 10Hz at 4J
Pulse Width (Cont. adjustable)	1ms–20ms	1ms–20ms	1ms–20ms
Pilot Diode Laser	2-3mW (635nm)	2-3mW (635nm)	2-3mW (635nm)
Divergence	<6mrad	<6mrad	<6mrad
Stability	±5%	±5%	±5%

Notes:
1. The resolution for all systems is 1µm with a repetition accuracy of 3µm.
2 All systems are delivered with a transformer in order to meet the specific needs of the customer..
3. An optional vacuum ejector can be used to create the vacuum. This will require compressed air.

Specifications for Pattern Recognition and 2D Ball Inspection Software Used with SB² Solder Ball Placement Equipment

System Requirements	Microsoft Windows 2000 Pentium IVPC	
Video Input/Output	CCIR video input Strobed camera support Near real-time video display over PC bus	
Speed 5-inch 6-inch 8-inch 12-inch	Macrolens 2X 2 min. 3 min. 5 min. 11 min.	Macrolens 1X 0.50 min. 0.75 min. 1.25 min. 2.75 min.
Accuracy and Repeatability	Up to 5µm	
Ball Diameter Range SB²-Jet SB²-Jet LF SB²-SM	 60µm up to 760µm 60µm up to 760µm 80µm up to 760µm	
Device Types	Flip-chip, CSP, BGA, HGA	
Ball Patterns Supported	All patterns, including non-symmetrical and arbitrary	
Tolerance Measurements	Ball size Ball position Ball pitch Ball absence Ball shape Extra or misplaced ball Solder bridges	
Results Reporting	Overall device data Individual ball data	
Calibration	Calibration not necessary Focus optimization	
Optics	Integrated lighting and optics	
User I/F	Standard Windows-based GUI Optional user definable GUI	
Communications I/O	Serial and digital I/O (TTL)	
Substrate/Wafer Handling	Manual (optional automatic handling system available)	

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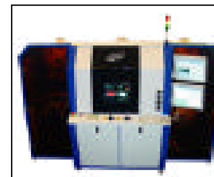
Other Equipment Available from Pac Tech

PacLine A50 - 300i

The PacLine A50 - 300i is a fully-automatic, self-contained, electro-less Ni/Au bumping system designed to provide a maximum throughput of 600,000 wafers per year. Its modular design allows for multiple batch processing of wafers ranging in size from 4- to 12-inch. This is the latest in production wafer bumping equipment from Pac Tech, it features include the following:

- Wafer sizes : 4, 5, 6, 8, and 12-inch
- Throughput of 150 8-inch wafers per hour
- Parallel throughput
  - 50 wafers 200mm (8-inch)
  - 25 wafers 300mm (12-inch)
- In-line bath control and replenishment
- Robotic handling of wafer carriers
- Quality control software available for process and bath control, SPC, process data storage, and more
- SECS GEM interface

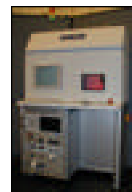
LAPLACE



The LAPLACE is a high-speed laser flip-chip placer. With up to 3,000 chip placements per hour, the LAPLACE is ideally suited for flip-chip attach including underfill and reflow on flex and rigid-substrates. High system flexibility allows the system to be used for applications like smart cards and smart labels, and also for high-precession assembly for ultrafine-pitch devices like LCD drivers.

- Flip-chip placement, solder reflow, and underfill curing in one step
- Fluxfree reflow with laser
- No additional curing or reflow required
- Suitable for flip-chip soldering and adhesive joining (ACA, NCP, ICA)
- Substrate materials include: PI, PVC, PE Polyester, paper-based, low-cost substrates
- In-line capability
- Reel-to-Reel system available

LS²-300



The LS²-300 is a new innovative laser scanning system for wafer backside marking.

- 4-inch to 12-inch wafer sizes
- High throughput
- Simultaneous quality control during process
- Low capital cost
- Axis accuracy and repeatability: 4µm
- Laser wavelength: 1,064 nm or 532nm
- Pixel diameter: 40µm/pixel
- Speed: 10µsec/pixel