INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION

Technical specifications for Flip Chip Bonder (1 Unit)

Sr. No.	Description	Value / Range	Technical Compliance (YES / NO)	Additional Information (if any)
	Key Generic Requirements:			
a.	The tenderer must provide an installation scheme showing the physical space (footprint) of the machine(s) as well as space required for routine access and all installations including the gas lines, MFCs, and other related accessories.			
b.	The vendor should have installed similar types of systems in centrally funded technical institutes or government research labs. Purchase order (PO) and user list should be provided as supporting evidence.			
c.	The compliance sheet should be provided by the vendor. The absence of the compliance sheet may result in the cancellation of the purchase order.			
d.	For each compliance, supporting evidence such as manuals and other necessary and supporting documents needs to be provided.			
e.	The vendor should have an Indian representative which can take care of the urgent troubleshooting or any process related queries on an urgent basis.			
f.	Safety features like interlocks to prevent errors in operation, Gas leakage interlock, RF interlock, emergency shut-down options along with necessary protocols should be separately mentioned.			
	Technical Specifications (Generic):			
a.	The system must be cleanroom compatible with all the necessary support systems such as vacuum systems, cooling systems, power supply systems, computer hardware, and software provided.			
b.	The machine must be software controlled with appropriate software and hardware interlocks to protect the machine from any possible operational or non-operational failure thereby ensuring the safety of the operator as well as the machine. The system should also incorporate software support to control and monitor bonding processes, ensuring ease of use and reproducibility.			
c.	The process is required to contain all the necessary sensors and control to aid in safety monitoring, performance monitoring, automatic operation, and diagnostic of the system. A complete set of system operation and maintenance manuals must be provided.			

d.	A library of process recipes for materials that can be processed by the machine well documented by the company must also be included.		
e.	The system should be designed with an integrated or modular approach to accommodate various bonding techniques, including thermocompression and flip-chip soldering. Programmable tool heating should be included to support various bonding techniques.		
f.	The control computer system/PLC should be a state-of-the-art system with a pre-loaded operating system and the software required for running the machine. The control panel must contain all the buttons required to operate the machine.		
g.	The software must allow for configurable user groups with different access privileges. Three different modes operator, engineer, and admin should be provided for easy and safe handling of the tool.		
h.	The software must allow the user to write and edit machine recipes.		
i.	The software must provide full system monitoring and recording of full system states in log files.		
j.	The system must provide access to sample process history and security protocols.		
k.	The system must provide system fault detection and diagnosis.		
l.	The system should support multiple bonding methods, including thermocompression, adhesive, soldering, and ultrasonic bonding.		
m.	Automatic and manual control modes should be available in the software. The system should provide programmable control over all bonding parameters, such as bonding force and temperature.		
n.	The system should be configurable for various environments, including air and inert gases, with controlled flow.		
o.	The system should provide programmable control over all bonding parameters, such as bonding force and temperature.		
p.	The system should enable programmable placement and alignment capabilities for precise component positioning.		
q.	Automated and programmable alignment and placement features should be implemented for die, component, and flip chip assembly.		
r.	Controlled heating and cooling for substrates, packages, or boards with temperature ramp-up and ramp-down features.		
s.	For flip chip assembly, chips should be designed to be manually flipped and loaded, with a die flipper unit provided if needed.		
	Technical Specifications (Specific):		

	System Design: Integrated or modular approach for different bonding techniques, including thermocompression and flip-chip soldering.			
1	**Semi-automated Flip-Chip bonder, low force version:**	Micro assembly system with placement accuracy 0.5 µm, ideal for component sizes ranging from 0.03 mm x 0.03 mm to 20 mm x 20 mm. Various process modules available to upgrade the machine for supporting a multitude of bonding technologies: • Thermo-compression • Thermosonic • Ultrasonic • Soldering (AuSn, C4, Indium) • Adhesive technologies • Curing (UV, thermal) • **Mechanical assembly:** ***Consists of:*** ➢ Optical Alignment System ➢ High-resolution camera system with X-travel ➢ Zoom: manual ➢ Field of view: max 6.6 mm x 5.28 mm / min 0.54 mm x 0.43 mm ➢ Camera shifting in X: -10 mm to +10 mm ➢ Max. resolution: 1 µm ➢ Optical overlay of substrate and chip image ➢ LED illumination (diffuse / coaxial) separately controlled for component and substrate ➢ Target Finder for quickly and easily finding of the target position in the optical center ➢ Automatic Bonding Force Module ➢ Software-controlled bond force (constant values, dynamic force ramps) ➢ Force range: 0.2 N up to 30 N ➢ Tolerance: 0.2 N ➢ Positioning table ➢ Air-bearing, manual movement in all directions ➢ Micrometer screws for fine positioning in X, Y & Z ➢ Resolution of micrometer screws: X: 1µm Y: 1µm Z: 10µm ➢ Working area max.: 190 mm x 78 mm ➢ Rotatable positioning table (±2°) ➢ Suitable for various Substrate Heating Modules or substrate support plates and wafer ➢ chucks (heated or unheated) and presentations ➢ Placement arm ➢ For placement of components ➢ Support of placement tools (unheated, heated) ➢ Integrated, switchable vacuum supply ➢ Support of optional modules, such as Chip Heating Module or UV Module		

		➢ Integrated feed of additional media, e. g. process gas ➢ Integrated cooling air supply for additional modules ➢ Tool adjustment in Y: +3 mm to -15 mm ➢ Integrated Process Management (IPM Command), providing synchronized control of all ➢ process modules and their parameters ➢ Management of multiple independent virtual cameras and X position ➢ Prepared for controlling different Chip and Substrate Heating Modules, max. temperature ➢ 450°C, supporting ramps up to 100 K/s (heating and cooling) ➢ Bonding force control (closed loop steady values / force ramps) ➢ Control of process gas (time, flow, concentration) ➢ Object surface optimized illumination control (diffuse and coaxial separately controlled) ➢ Vacuum control ➢ Control of additional modules, e. g. Dispenser Module, Die Flip Module ➢ Protocol and documentation function (process data logging, photo) ➢ Touch option for easy handling ➢ Machine-PC and touch monitor, designed for use when wearing gloves ***Dimensions and connection data for the standard version as described above:*** ➢ Dimensions ➢ Footprint (w x d): 130 cm x 85 cm ➢ Total height: 71 cm ➢ Weight ➢ Base system, excl. system table: 120 kg ➢ Electrical connection ➢ Mains voltage: 220 V-240 V ➢ Frequency: 50 Hz / 60 Hz ➢ Power consumption base system: 1.1 kW ➢ Compressed air ➢ Nominal pressure: 6 bar ± 0.5 bar ➢ Max. flow: 100 l/min (base machine) ➢ Max. solid particle size: 40 µm ➢ Humidity: max. pressure dew point: +3°C (class 4, DIN ISO 8573-1) ➢ Max. oil content: 1 mg/m³ (class 3, DIN ISO 8573-1)		
2	**Adjustment set, 0.5 µm:**	For verification of placement accuracy and adjustment in X-Y-Theta. ***Consists of:*** • Set of glass etalons with 0.5 µm resolution • Tool for the “chip” glass etalon		
3	**Y-Camera shifting:**	Allows shifting the camera along the Y-axis in order to extend the field of view. ***Field of view shifting under:***		

		Max. magnification: +/- 0.5 mm Min. magnification: +/- 2.0 mm		
4	**Fast Chip Heating Module (w/o tool):**	For fast and process-controlled heating and cooling of components, ideal for thermo-compression, thermal curing or soldering processes. The heat is transferred to the component via direct contact. ***Consists of:*** • Control Box • Cabling and media connections for heated tools ***Specification:*** ➢ Power: 300 W ➢ Temperature ramps 1 K/s – 20 K/s for heating ➢ Controlled cooling via compressed air or nitrogen ➢ For chip sizes up to approx. 30 mm x 30 mm ➢ Vacuum support for component handling		
5	**Heated Pick & Place Tool:**	Component-specific, heatable pick & place tool for chips up to 15x15mm² with flat tooltip. • 300 W heating power or more • Fits to chip heating module FB6. • With or without gimbal		
6	**Washer Set, 6x12, consists of: 2x 0.05, 2x 0.1, 2x 0.2, 2x 0.3, 2x 0.5, 2x 1.0**			
7	**Bonding Force extension 400N, surcharge:**	Provides high-precision and reproducible bonding forces for assembly and bonding processes. Extends the force range for high force applications like thermo-compression or ACA bonding. ***Secondary force range, incl. additional force sensor:*** • 30 – 400N • Tolerance: 4N • PC-controlled in combination with the IPM software • Closed loop force control • Can be combined with low force module		
8	**Process Video Module:**	For in-situ process observation using USB camera. Automatic switching between alignment camera and process camera when the placement arm moves up/down. • Field of view / horizontal direction: 1.35 mm - 16 mm • Inclination angle: 12° or better • Left-side mounted		
9	**Substrate Heating Module 100x100, with gas cooling:**	For process-controlled heating and cooling of substrates. Ideal for soldering processes, thermo-compression and as a		

		support for ultrasonic and thermal curing adhesive processes. ***Consists of:*** • Heating plate 100 x 100 mm² • Support for 2" or 4" Waffle packs and gel packs (VR) • Control Box *Specifications:* • Power: 1200 W or more • Closed loop heating and cooling • Profiles controlled with the software • Max. temperature: 400 °C / 2 min • Stand-by temperature range: 40-100 °C • Temperature ramps: 0,03 K/s - 3 K/s for heating • Controlled cooling via compressed air or nitrogen • Standard vacuum structure for substrate clamping (two squares, 30 mm x 30 mm and 60 • mm x 60 mm in the center of the plate, separately switchable) • For bond forces up to 500 N • Prepared for process gas support with flow control		
10	**Dispenser Module, front-mounted:**	Mechanical support for high-precision dispensing of liquid and pasty media. • Manual positioning • Fine adjustment in X, Y and Z • Prepared for using with dispense controller for automatic dispensing • Support of 3 or 5 cm³ cartridges		
11	**Dipping tray with squeegee:**	For defined material filling (flux, adhesive, paste) with dipping. For using with holder or support 2" / 4" packs. ***Consists of:*** • Dipping tray with 3 depressions, width of 15 mm each • Available depths: 100/200/300 micron or 25/50/75 micron • Squeegee		
12	**Shiftable UV light support, front-mounted**			
13	**Dispenser Module incl. shiftable UV light**			
14	**Formic Acid Module Support:**	For reducing oxide layers on metals and alloys (e.g. solder materials such as Indium) and for building a process gas atmosphere around the joint during the bonding process with Formic Acid enriched Nitrogen. ***Consists of:***		

		• Quick replacement of acid bottle with lock bracket • Acid proof design for all lines and connectors • Process gas enclosure for heating plates with: • Frame and size according to the heated area of the heating plate and / or substrate size • height variable through the use of adapter frames • Cover with component specific opening, 3 standard sizes • Active exhaust for safe removal of noxious driven by compressed air ***Characterization:*** • Fill level control • Flow control of Nitrogen gas via software • Gas flow min / max: 0…4 Nl/min • Control of mixing ratio of Nitrogen and enriched process gas from 0 – 100% • Integration into software and status indication via LED • Profile control via software • Includes exhaust module for safe removal of toxic gas and vapor, adjustable, powered by compressed air.		
15	**Bonding Technologies:** Support for thermocompression, adhesive, soldering, and ultrasonic bonding methods.			
16	**Dimensions: T**o fit within standard laboratory spaces.	Compact dimensions of 150 cm x 85 cm x 85 cm or less		
	After Installation Process Demonstration:			
a.	The vendor must demonstrate the bonding process on-site, showcasing the machine's capability in handling different components like flip chips, bare dies, and MEMS structures. o Cu-Cu bonding with alignment demonstration with ~ ±0.5 µm. This is to be performed with Si chip with Cu pillars bonded to a receiver Si substrate with Cu pillar. o Flip Chip bond with solder bumps. This is to be performed with Si chip with bumps flip-chip bonded to: a) a receiver Si substrate with bumps, b) a receiver FR4 substrate with bumps.			

b.	Process stability and repeatability should be verified through trial runs, meeting specified placement accuracy and bond strength criteria.		
c.	Demonstration should include process setup, alignment, bonding, and in-situ inspection capabilities. The demonstration should include emergency shutdown and start up procedure.		
	Packaging and Shipment:		
a.	The FCB system should be securely packed to prevent damage during transit, with all fragile components adequately cushioned.		
b.	The packaging should include necessary documentation, installation manuals, and a list of included components.		
	Acceptance Criteria:		
a.	**Site Acceptance Test (SAT):** • The system must undergo SAT at the IITB site, replicating the factory acceptance test parameters with following o Pick the dies/samples from Gel pack o Flip-chip (FC) SnAg bump bump bonding with 500 nm alignment accuracy, demonstrated with a Si chip with bumps (200 µm diameter) bonded to following two receiver substrates: ▪ a) a receiver Si substrate with solder bumps (200 µm diameter) ▪ b) FR4 PCB or equivalent FR4 substrate with solder bumps (200 µm diameter) o Cu-Cu thermo-compression bonding with 500 nm alignment accuracy while bonding. This demonstration is to be done by bonding a Si chip with Cu pillar bonded to a receiver Si substrate with Cu pillars. o The accuracy can be investigated using SEM		
b.	**Installation and Qualification:** Installation and on-site qualification of the system by the OEM.		
c.	**Training:** On-site operational training for two engineers, covering system operation, maintenance, and process control.		
d.	**Performance Verification:** The system should demonstrate compliance with all specified parameters, including placement accuracy, bonding force, and process stability.		
e.	**Warranty:** One-year standard warranty		
	Application Details:		
	The application for the system is given below. However, that is not added to the acceptance criterion but such a capability will be considered advantageous for the tendering. • The Flip Chip Bonder is intended for die placement with high-accuracy of 0.5 microns with bonding force range 0.1N to 400 N and bonding for 2D, 2.5D and 3D packaging applications.		