

**UNIVERSITY OF CALIFORNIA, MERCED**  
**SCIF CLEANROOM FACILITY**  
**STANDARD OPERATING PROCEDURE (SOP)**  
**TPT Semi-Automatic Thermosonic Wire Bonder Operation (HB10 or Equivalent)**  
**Location: SE1: 153**

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## **1. PURPOSE**

To provide a standardized and safe procedure for thermosonic wire bonding using the TPT HB10 system, ensuring reliable electrical interconnections, reproducibility, and equipment safety.

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## **2. SCOPE**

Applicable to all trained users performing wedge bonding, ball bonding, and ball bumping for microelectronic device fabrication and packaging.

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## **3. RESPONSIBILITIES**

- **Users:** Follow SOP and bonding parameters
  - **Core Staff:** Maintain system and provide training
  - **Facility:** Ensure safety, utilities, and compliance
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## **4. SYSTEM OVERVIEW**

The TPT HB10 is a semi-automatic thermosonic wire bonder that forms electrical interconnections using ultrasonic energy, force, and temperature.

Capabilities:

- Gold (Au) and Aluminum (Al) wire bonding
- Wedge bonding, ball bonding, and bump bonding
- Loop formation and programmable bonding sequences
- Precision X-Y manual stage and motorized Z-axis

👉 Bonding is achieved using ultrasonic energy (~63 kHz), force, time, and optional heat

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## 5. REQUIRED SYSTEM CONDITIONS

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### 5.1 Utilities

- AC power (110–230 V)
  - Compressed air (if applicable)
  - Heater stage operational
  - Ultrasonic generator active
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### 5.2 System Conditions

- Proper bonding tool installed (capillary or wedge)
  - Wire loaded correctly
  - Sample firmly mounted on stage
  - Stage temperature stabilized
  - Microscope aligned
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## 6. SAFETY REQUIREMENTS

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### 6.1 Hazards

- Moving bond head and stage
  - High temperature stage (up to ~250°C)
  - High voltage (EFO system)
  - Laser spotlight exposure
  - Sharp bonding tools
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### 6.2 PPE

- Cleanroom gloves
  - Safety glasses
  - Lab coat
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### 6.3 Critical Safety Rules

- Keep hands clear of bond head and stage during operation
- Do NOT touch heated stage
- Do NOT stare into laser spotlight
- Ensure proper grounding
- Power OFF before maintenance

👉 Heated stage and high-voltage EFO present burn and shock risks

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## **7. CLEANROOM PROTOCOL**

- Use clean, contamination-free samples
  - Avoid oxidation and residues on bonding pads
  - Handle wires and tools carefully
  - Maintain clean bonding environment
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## **8. DETAILED OPERATION PROCEDURE**

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### **STEP 1: SYSTEM PRE-CHECK**

- Verify:
    - o Power ON
    - o System initialized
    - o Bond head and stage functional
    - o Correct bonding tool installed
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### **STEP 2: LOAD WIRE**

- Install wire spool
  - Thread wire through guide tubes and bonding tool
  - Ensure wire properly seated in clamp
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### **STEP 3: INSTALL TOOL**

- Install wedge tool or capillary
- Ensure tool is flush with transducer
- Tighten using torque (~35 cNm recommended)

👉 Proper tool alignment is critical for bonding quality

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#### **STEP 4: LOAD SAMPLE**

- Place sample on heater stage
  - Secure using clamp/vacuum
  - Ensure flat and stable positioning
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#### **STEP 5: HEIGHT SETUP**

- Perform auto height setup
  - Define bond heights for 1st and 2nd bond
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#### **STEP 6: SET PROCESS PARAMETERS**

- Ultrasonic power
- Bonding force
- Bonding time
- Temperature (typically 80–150°C for Au)

👉 These four parameters determine bond quality

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#### **STEP 7: SELECT BONDING MODE**

- Semi-automatic (recommended)
  - Manual or automatic modes if required
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#### **STEP 8: PERFORM BONDING**

- Move to first bond location
  - Press and hold bond button → reach search height
  - Release → perform first bond
  - Move to second bond position
  - Repeat bonding sequence
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## STEP 9: LOOP FORMATION

- Adjust loop height and length
  - Ensure proper wire tension
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## STEP 10: MONITOR PROCESS

- Observe bond formation
  - Check for:
    - o Proper deformation
    - o No wire breakage
    - o Good adhesion
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## STEP 11: COMPLETE PROCESS

- Finish bonding sequence
  - Reset system if needed
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## STEP 12: SHUTDOWN

- Turn off ultrasonic
  - Turn off heater stage
  - Remove sample
  - Power down system
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## 9. TROUBLESHOOTING GUIDE

<b>Issue</b>	<b>Cause</b>	<b>Action</b>
No bond	Low US power	Increase power
Wire break	High force	Reduce force
Poor adhesion	Dirty pad	Clean sample
Pad damage	Excess force	Reduce force
Loop instability	Incorrect parameters	Adjust loop settings

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## **10. CRITICAL DOs & DON'Ts**

### **DO**

- Optimize bonding parameters
- Use clean samples and wires
- Perform parameter sweeps
- Monitor bonding quality

### **DON'T**

- Touch bond head during operation
  - Use oxidized or dirty pads
  - Apply excessive force
  - Skip height calibration
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## **11. CONTAMINATION CONTROL**

- Clean bonding pads before use
  - Avoid oxidation exposure
  - Store wires in clean conditions
  - Keep stage clean
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## **12. WASTE HANDLING**

- Dispose wire scraps properly
  - Follow SCIF waste procedures
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## **13. EMERGENCY PROCEDURES**

- Machine malfunction → Power OFF
  - Overheating → Stop and cool system
  - Electrical issue → Disconnect power
  - Tool crash → Stop immediately
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## **14. TRAINING COVERAGE**

Users are trained on:

- Wire bonding fundamentals
  - Tool installation and wire loading
  - Parameter optimization (US, force, time, temperature)
  - Loop control and bonding sequence
  - Safety procedures
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## **15. ACKNOWLEDGMENT & APPROVAL**

Director Name: \_\_\_\_\_

Director Signature: \_\_\_\_\_

Date: \_\_\_\_\_

User Name: \_\_\_\_\_

User Signature: \_\_\_\_\_

Date: \_\_\_\_\_