



# Operation and Maintenance Manual for the TF 3000 BGA/CSP Rework System

**MANUAL NO. 5050-0482**  
**REV B-PRM**

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## Safety

The following safety precautions must be understood and followed when using or servicing PACE products.

1. **POTENTIAL SHOCK HAZARD** - Repair procedures on PACE products should be performed by Qualified Service Personnel only. Line voltage parts may be exposed when the equipment is disassembled. Service personnel must avoid contact with these parts when troubleshooting the product.
2. To prevent personnel injury, adhere to safety guidelines in accordance with OSHA and other applicable safety standards.
3. Always use PACE systems in a well ventilated area. A fume extraction system, such as those available from PACE, is highly recommended to help protect personnel from exposure to solder flux fumes.
4. Exercise proper precautions when using chemicals (e.g., solder paste or cleaning solvents). Refer to the Material Safety Data Sheet (MSDS) supplied with each chemical and adhere to all safety precautions recommended by the manufacturer.
5. The following safety precautions cover use of PACE hot air systems/hand pieces (e.g., ThermoFlo<sup>®</sup>, ThermoJet<sup>®</sup>).
  - a) Be careful when using in places where combustible materials are present.
  - b) Do not use in the presence of an explosive atmosphere.
  - c) A fire may arise if a hot air hand piece is not used with care. Do not leave the hand piece unattended when in use.
  - d) The heater assembly housing and any installed nozzle are hot when the system is being cycled and for a period of time thereafter. **DO NOT** touch the heater assembly housing, nozzle or heated air stream. Severe burns may result!

### Warning Symbols on Unit



HOT – DO NOT TOUCH



Warning, Use caution

## **Introduction:**

Thank you for purchasing the TF 3000 BGA/CSP Rework Station. As electronic devices continue to get smaller, lighter and more compact, components and printed circuit boards are also becoming smaller and the amount of available space on PCBs is continually decreasing. In order to maximize board space, area array devices have become the popular choice. Area array devices are BGAs, CSPs and “micro-BGAs”, LGAs, and Flip Chips. These devices require an optical overlay vision system to ensure proper placement and high levels of process control during installation to ensure successful installation. The TF 3000 has been specifically designed to rework these types of components and can also install and remove a variety of other SMT devices.

## **Agency Compliance**

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) This device must accept any interference received, including interference that may cause undesired operation.

The TF 3000 also complies with 98/37/EC and 89/336/EEC.

**Caution: During normal operation, the top heater, nozzle and bottom-side heater(s) will get hot. Do not contact them directly as serious injury may occur.**

## **Environmental Requirements**

Ambient Operating Temperature: 0 °C to 50 °C (32 °F to 120 °F)  
Storage Temperature: -20 °C to 75 °C (-4 °F to 170 °F)  
95% Humidity, non-condensing max.

## **Electrical Specification**

15 Amp 115 VAC, 60 Hz Max OR 8 Amp, 230 VAC, 50 Hz Max  
Fuse: .5 Amp, SloBlo 115 V System  
.5 Amp TimeBlo, 230 V System

## **Packing Contents**

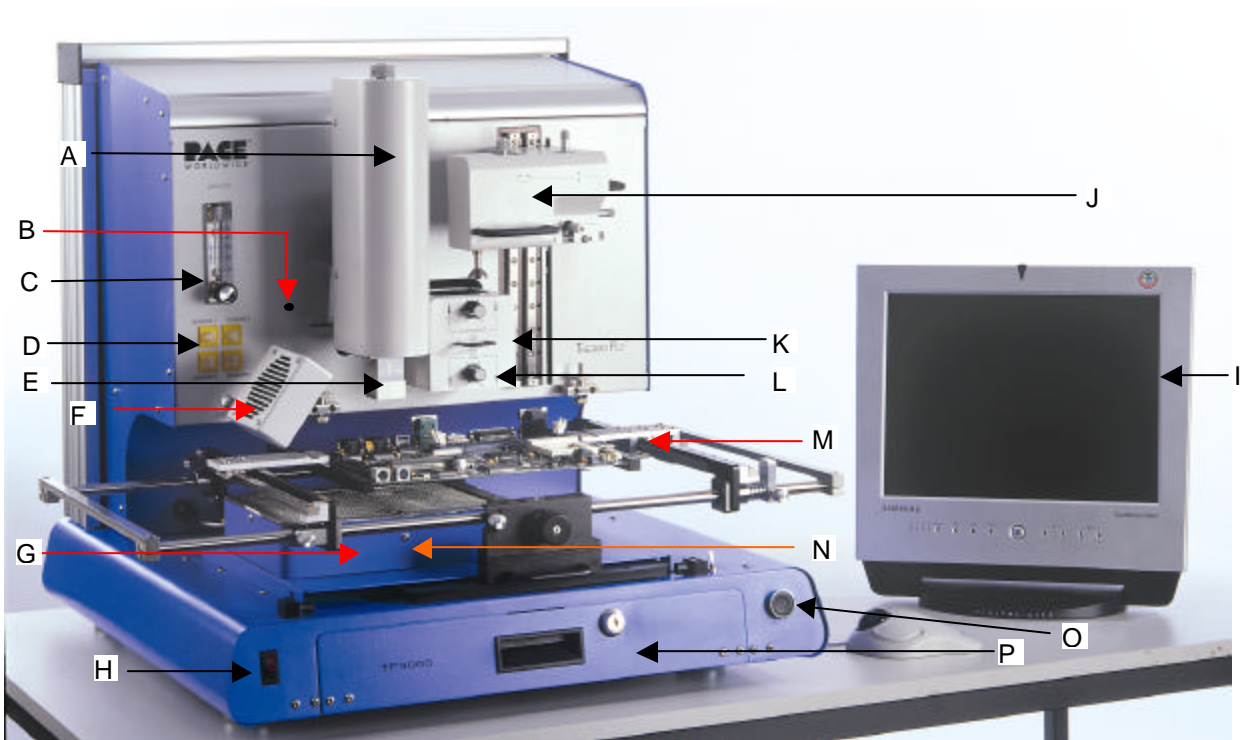
### ***TF 3000***

1. TF 3000/E or TF 3000 L/E: 1 each
2. LCD VGA Display Monitor: 1 each
3. TF 3000 Software Package: Installed on PC
4. Hand Held Vacuum Pick for removal: 1 each
5. Rubber suction cups (spare for #4): 3 each
6. Vacuum nozzle for placement head: 1 each Large, Medium, Small and extra-small sizes
7. Hex Wrench Set and Screwdriver: 1 each
8. TF 3000 Manual: 1 each on PC as pdf file
9. NET-OP manual - 1 each on PC as pdf file
10. K-Type Thermocouple: 4 each
11. LED Extension wire
12. USB Track Ball
13. PCB Supports: 1 each
14. Odd shaped PCB holders: 4 each

15. Alignment board and component: 1 each
16. Wooden shipping crate.

**The wooden shipping crate must be kept by the end user. If a TF 3000 has to be returned to PACE for any reason, it MUST be returned in the original shipping crate. PACE is not responsible for any unit not returned in its original crate. If a TF 3000 is returned for service in a different container, the customer will be charge for a new crate for return shipment.**

**Parts Identification**



**Figure 1: TF 3000 BGA/CSP Rework Station**

**Features: Please refer to Figure 1.**

- A) Reflow Head  
Contains the top-side heater and moves up and down via an electric motor that is controlled through the software. The reflow head is clutched to prevent excessive downward force from being applied.
- B) Removal Nozzle Vacuum Port  
Vacuum port to connect Nozzle Vacuum Hose for component removal
- C) Air Flow Meter  
This device is used to control and monitor the airflow.
- D) Sensor 1 thru 4 Inputs  
The sensor inputs are K-type thermo-couples. Measured temperatures are displayed through the PC Software in real time for use in making profile graphs.
- E) Nozzle  
The nozzles for the TF 3000 are easily changed. Several varieties are available. Use caution and proper hand protection when changing nozzles, as they will be hot.
- F) Cooling Fan  
The component and the PCB are cooled by the cooling fan, which can be set to activate automatically after the reflow cycle is complete.

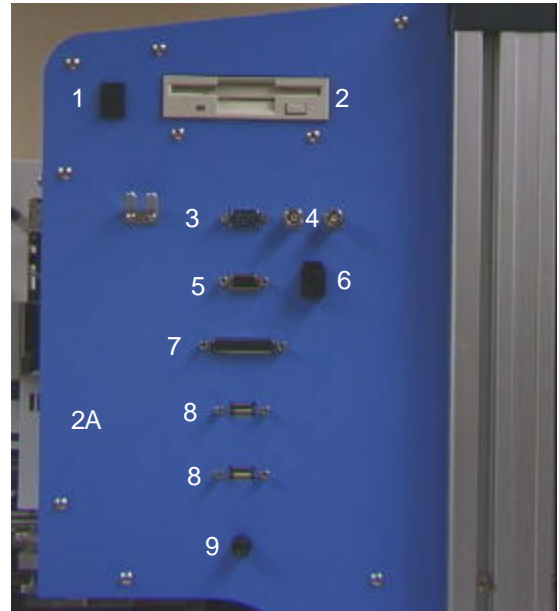
- G) Sliding Shaft Holder Supports the rail system for the board holder. It is also used to index the table from the Placement Position to the Reflow Position using the handle on the front.
- H) On/Off Switch Used to turn the system on or off. When turning off the system, always turn off the PC using the windows interface first.
- I) LCD Display Monitor Displays PC software. Shown with optional articulated arm.
- J) Alignment Head X, Y, Z and T aspects of the component position are adjusted in relation to the land pattern on the PCB through this apparatus.
- K) Optics Housing Contains the camera and beam splitter (prism). The housing is retractable and should be kept in the retracted position when not in use. The lights for the optics will turn on/off automatically when the housing is extended.
- L) Light Controls The upper (component side) and lower (PCB side) lights within the optics housing can be adjusted for intensity (overlay contrast) at this location.
- M) Board Holder The board holder is fully adjustable in both the X and Y directions. The right side of the holder is spring loaded to hold the PCB securely. Fine adjustment in the “X” direction is achieved by using the adjustment knob on the Sliding Shaft Holder and adjustment in the “Y” direction is achieved using the knob on the right rail.
- N) Bottom Side Heater Used to warm the PCB from the underside. It is an IR type of heating source.
- O) Magnetic Lock Release Disengages magnetic lock to release platform when moving from Reflow position to Placement position and vice-versa.
- P) Keyboard Tray Door The keyboard is stored behind this door. To access the keyboard, open the door and pull the tray out.

## **1 SET-UP**

### ***TF 3000 Set up***

- 1-1 Place the TF 3000/E or TF 3000 L/E on a flat and stable bench that can support at least 90 kgs (200 lbs).
- 1-2 The TF 3000 weighs 77 kg (170 lbs). To lift it, grasp the underside of the frame. The unit should be moved by two people minimum. Each person should be capable of lifting 45 Kgs (100 lbs).
- 1-3 Connect the hand-held vacuum pick to the vacuum port on the side of the TF 3000 and hang the vacuum pick on the side of the TF 3000 using the bracket provided (2A).
- 1-4 Connect the LCD display monitor to the VGA output on the side of the TF 3000. See Figure 2.

- 1. Hand Wand Vacuum Switch
- 2. 3.5" Floppy Drive
- 2A Hand Wand Bracket
- 3. VGA Output – to connect the VGA monitor
- 4. Composite Video Inputs – to connect alternative video inputs
- 5. 9 pin Serial I/O – to connect a 9 pin serial device
- 6. Modem I/O – to connect to a phone line
- 7. Printer Port – to connect to a printer
- 8. USB I/O – to connect to USB compatible devices such as the track ball provided.
- 9. Hand Wand Vacuum Connection – to connect the hand wand.



**Figure 2: Image of Side Panel**

- 1-5 Connect the TF 3000 and LCD Display Monitor power cables to the power inlet ports and then plug them into an appropriate 115 VAC, 60 Hz or 230 VAC 50 Hz power supply. The LCD Monitor can be plugged into the AC outlet on the back of the TF 3000. Do not plug any equipment requiring more than 1 amp into this outlet.

## **2 OPERATION**

### **2-1 Before Operating**

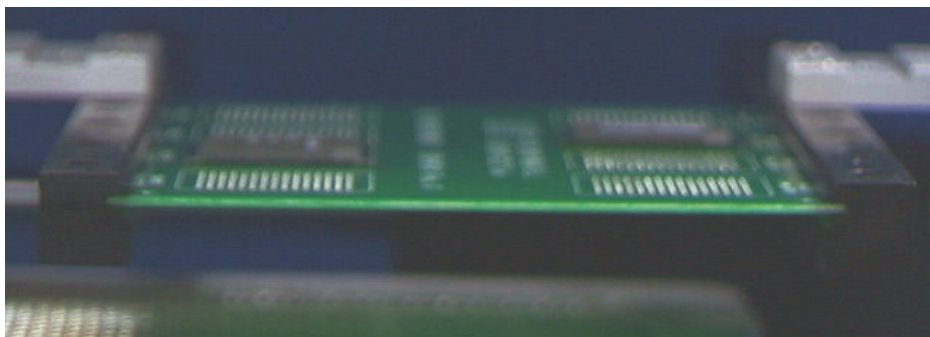
- Make sure the TF 3000 is on a stable platform
- It is recommended that the TF 3000 be turned on for at least 15 minutes before use to ensure the Bottom Side heater has reached its set temperature and stabilized. Once the bottom-side heater is at temperature it will deliver consistent heating, ensuring highly repeatable heating from operation to operation.
- It is advisable to conduct a trial operation each day to ensure all systems are operating properly. Also, it is important to verify the airflow of the unit with each profile to be run: The recommended maximum airflow is 22 l/min and the recommended minimum airflow is 15 l/min.



- Verify that the devices/parts being soldered to the PCB do not exceed the height limitations. Exceeding the limitations may interfere with the operation of the machine.
  1. The maximum height of any component or device on the top of the PCB is limited to 30 mm (1.2”).
  2. The maximum height of any component or device on the bottom of the PCB is limited to 15 mm (0.6”).

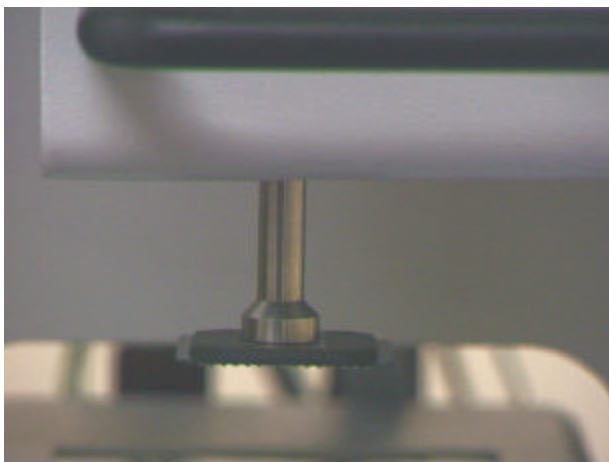
## 2-2 General Operating Procedure

1. Ensure sliding shaft holder is the placement position.
2. Insert PCB into Board Holder. See Figure 3.



**Figure 3: Board Holder and PCB**

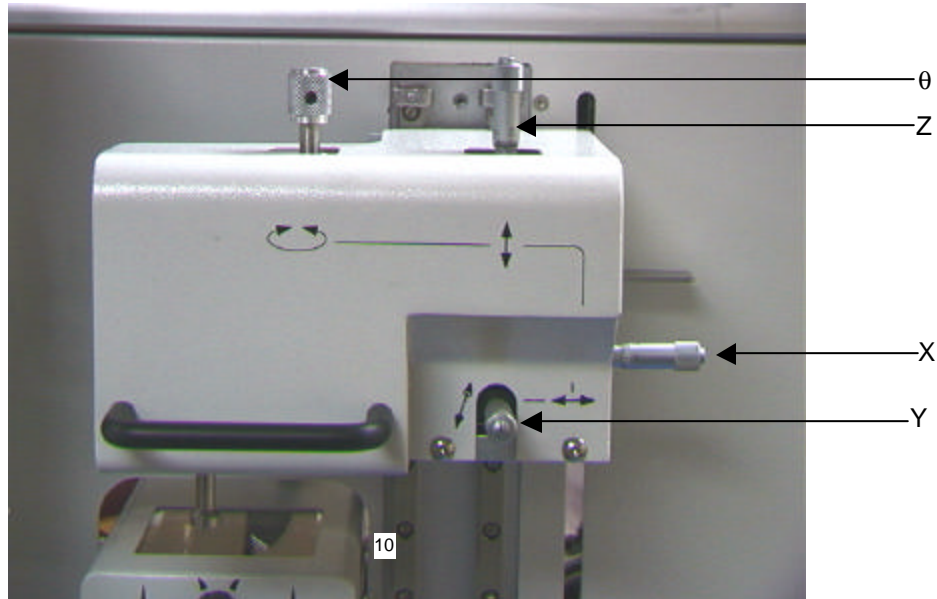
3. Activate vacuum on TF 3000 from the Alignment screen on the TF 3000 Software. Place component on vacuum nozzle on placement head. See Figure 4.



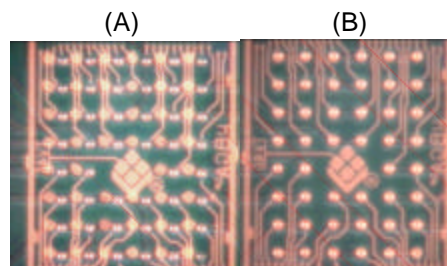
**Figure 4: Component held by Vacuum Pick**

4. Pull the optics housing out from the front of the TF 3000 using the handle. Be sure the Sliding Shaft Holder is in the Placement Position (Against the right bumper).
5. Center the land pattern in the optics display.
6. Adjust the lighting so the lands and solder balls are clear.

- Align component solder ball/lead pattern to the land pattern on the PCB using the adjustment knobs on the alignment apparatus. See Figure 5. The BGA (ball side) and the PCB pattern side are super-imposed on the computer monitor, by the optical system. See Figure 6.



**Figure 5: Placement Head**

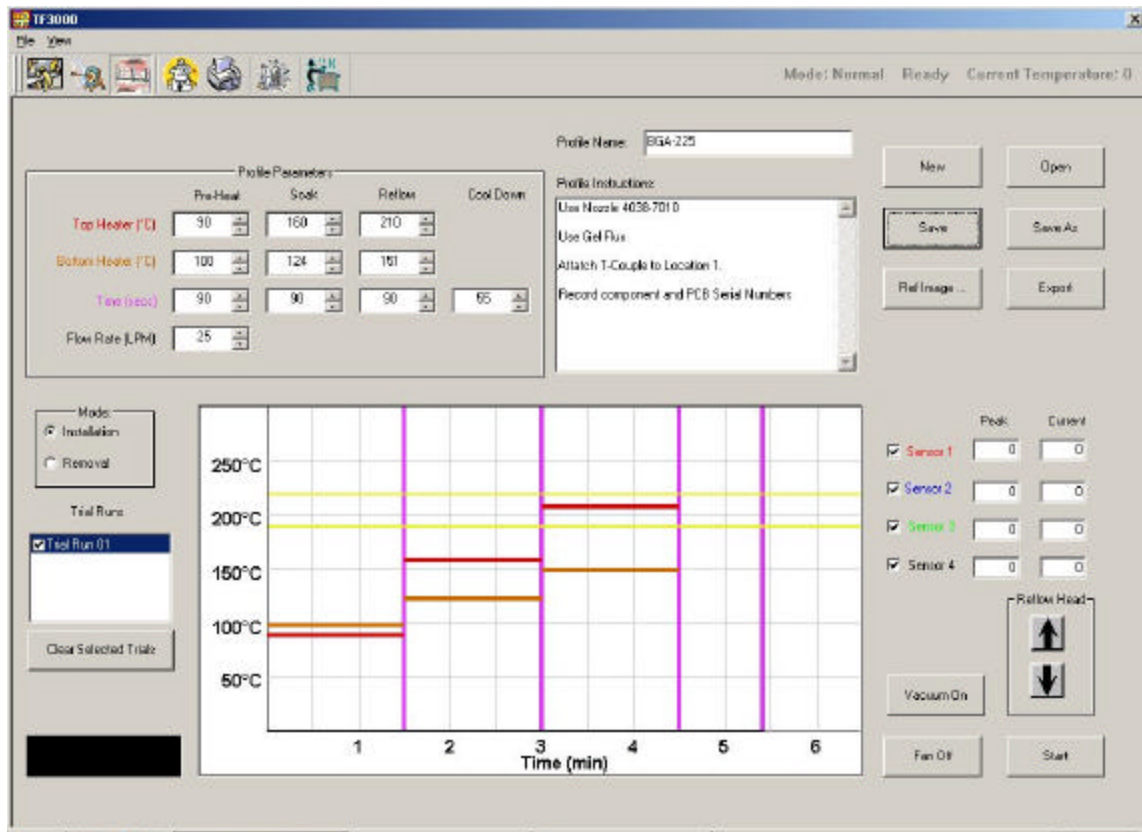


**Figure 6 - Unaligned (A) and Aligned component (B) as they would appear.**

- Push optics housing back into unit.
- Apply flux or solder paste: One of the following methods is applicable depending on the rework conditions, the specification of Device/PCB, or operator preference.
  - Dispense flux on the land pattern using a brush or flux pencil. (Most common).
  - Apply solder paste to the land pattern using a conventional stenciling technique.
  - Apply flux to the BGA, solder ball side, by means of a flux application tool. See Reference Section.
  - Print paste on the BGA, solder ball side, by using one of PACE's component stenciling tool kits. See Reference Section.

**Note:** Method B must be completed prior to insertion of PCB into board holder. Methods C and D apply flux/paste to the underside of the component, not the PCB. They should be performed before placing component with vacuum pick on TF 3000.

10. Lower the Alignment Apparatus to PCB so the component is in contact with the PCB.
11. Release component by turning off the vacuum and return alignment apparatus to the upper position.
12. Index the sliding shaft holder from the Placement Position to the Reflow Position.
13. Select the desired profile or enter time and temperature parameters for pre-heat, soak, and reflow phases. See Figure 7.



**Figure 7: Profile Development Page**

14. Lower the reflow head using the reflow head buttons (Fig 7) and start the cycle by clicking on the “Start Button” on the profile development or Operations Page.
15. Once the reflow profile has been completed, the reflow head will lift up automatically and the cooling fan will turn on for the user-selected amount of time. Airflow from the cooling fan may be directed by loosening the locking thumbscrew on the fan and rotating it around its shaft.

### 3 EXPLANATION OF EACH OPERATION

#### 3-1 Placing BCB into Board Holder - See Figure 8..

1. Center the sliding shaft (8) in the holder (9).
2. Adjust the sides of the board holder so that the distance between them is 3 mm smaller (half the width of the rail) than the width of the PCB. Secure the sides by tightening the setscrews (6 & 2)
4. The right side of the board holder is spring loaded. Insert the PCB into the support slots while holding the right side of the board holder open. When the PCB is positioned, let the right side close.

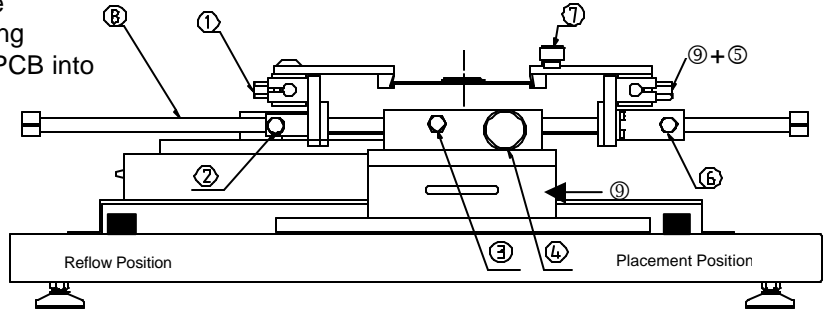


Figure 8: Board Holder and Base

#### 3-2 Component Alignment and Placement - Refer to Figures 5 and 8.

1. Set the sliding shaft holder at the Placement Position at the far right side of the base
2. Extend the optical housing by pulling the handle towards you. The LEDs will turn on automatically.
3. Center the PCB array pattern on the display. Zooming in on the array allows for easier centering
4. Tighten the setscrews (#1 & 5, Fig. 8) to secure the "Y" position of the PCB.
5. Tighten the setscrew (#3, Fig. 8) on the sliding shaft holder (#9, Fig. 8) to secure "X" position of the PCB.
6. Focus the array pattern on the PCB by focusing manually or by using the AUTO FOCUS feature. Switch the feature **off** after the array pattern has been focused.
7. Switch on the vacuum on using the "Vacuum" button on the Alignment screen in the software.
8. Place the component to be placed on the end of the vacuum nozzle. See Figure 4.
9. Adjust the lighting using the adjustment knobs (#L, Fig 1) so the image of the PCB land pattern and the image of the solder balls on the component can be seen clearly.
10. Adjust the height of the device with the height (Z-axis) adjusting screw (Fig 4) to bring solder balls/leads into focus. Failure to focus the component may result in inaccurate alignment.
11. Turn the "AUTO-FOCUS" feature on **after** the PCB and component are in focus.
12. Adjust ? aspect of the component by turning the ? adjustment knob (Fig. 5).
13. Adjust the X and Y aspects of the component by adjusting the X and Y adjustment knobs (Fig. 5).



Figure 9

14. When the component is aligned (See Figure 6), return the optics housing to its retracted position. The lights will turn off automatically.
15. Using the handle, lift the alignment apparatus upward by hand to release, then lower the apparatus slowly.

**NOTE:** The alignment apparatus can be lowered while the optics housing is extended; DO NOT hit the glass with the component or vacuum nozzle.

**NOTE:** When repeating operations using the same PCB and device, steps 4 and 11 may be eliminated. However, when changing devices, it is important to include steps 4 and 11 in the initial setup procedure.

16. Confirm that the component is in contact with the PCB. Turn off the vacuum switch using the “Vacuum” button on the Alignment screen in the software.

When repeating operations using the same PCB and device, the mechanical stop on the right side of the alignment apparatus may be set to ensure repeatability.

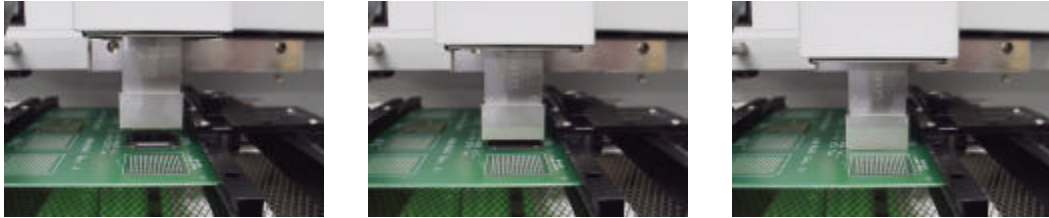
17. Return the alignment apparatus to its original position.
18. Move the sliding shaft holder to the “Reflow Position” by disengaging the magnetic lock and using the handle on the sliding shaft holder.

### 3-3 Component Reflow

- 1) Make sure that an appropriately sized nozzle is fitted to the reflow head.
- 2) Verify the sliding shaft holder is at the Reflow Position at the far left side of the base
- 3) Select a profile or enter reflow parameters. **Refer to section 4.**
- 3) From either the “Operations” or “Profile Development” screens, click on the NOZZLE DOWN button. (Figure 7) The nozzle will go down and stop automatically 5 mm (will vary with PCB thickness) above the PCB.
- 5) Visually confirm that the component position is aligned with the nozzle. Press and hold the NOZZLE DOWN button. The reflow head will lower itself, slowly. Lower the reflow head until there is no gap between the nozzle and the PCB. See Figure 10.

When repeating operations using the same PCB and device, the mechanical stop on the left side of the reflow apparatus may be set to ensure repeatability. Once set, simply lower the reflow head until the mechanical stop engages. The reflow head is fitted with a clutch that will engage if the nozzle applies pressure on the PCB or the mechanical stop. This ensures the safety of the PCB and protects the motor that drives the reflow head.

**NOTE:** In some instances the available space around a component will be insufficient to bring the nozzle into contact with the PCB. Should this occur, select a nozzle with dimensions that are similar to the component body. For reflow, position the nozzle 1 mm above the component. The time of the reflow cycle may have to be adjusted to insure satisfactory results. A thermo-couple should always be used to verify reflow conditions.



**Figure 10: Properly Positioned Nozzle in Relation to PCB**

- 6) When the nozzle is properly positioned, click the CYCLE START button. The cycle will begin. An audible alarm will sound seven (7) seconds before the end of the reflow phase.
- 7) When the reflow cycle is complete, the Reflow Head/nozzle will automatically raise and the COOLING FAN will turn on (if activated), cooling the soldered component, PCB and nozzle.
- 9) Do not remove the PCB from the board holder until the temperature of the component and PCB has reached “below solder melt” temperatures.

### **3-4 Adjusting Airflow**

- 1) The knob on the air flow meter adjusts the airflow. Make sure to match the air flow meter value with the value of “Air Flow” field on the software. The actual airflow will not be changed by the flow value displayed by the software. However, this value affects the heating so it is important to make sure the airflow regulator on the front panel of the machine matches in the airflow value in the profile.

### **3-5 Component Removal**

There are two methods for removing components from the PCB.

Method 1 - Use a removal nozzle fitted with a vacuum pick-up.

- 1) Fit a removal nozzle to the TF 3000
- 2) Connect the vacuum hose to the vacuum port on the front of the system.
- 3) Run the removal profile.
- 4) The component will be lifted off when the reflow head lifts up at the completion of the cycle.

Method 2 – Using the hand wand.

- 1) Run the removal profile.
- 2) When the audible alarm signals 7 seconds before the end of the reflow phase, turn on the vacuum pump using the switch on the right side of the TF 3000 and pick up the hand wand.
- 3) Once the reflow head raises up, remove the component by using the hand held vacuum wand.

## **4 CREATING AND SAVING PROFILES**

Please refer to Figure 7 for this section.

### **4-1 General Information**

The TF 3000 comes with two profiles already installed that should be used as baselines when developing profiles. Profile Default 1 is recommended as a starting point for area arrays larger than 21 mm square. The Default 2 profile is recommended as a starting point for area arrays 21 mm square and smaller.

### **4-2 Additional Information**

- 1) Temperature settings are as follows:
  - Top Heater Pre-heat
  - Bottom Heater Pre-heat
  
  - Top Heater Soak
  - Bottom Heater Soak
  
  - Top Heater Reflow
  - Bottom Heater Reflow
- 2) Time and temperature parameters can be changed while a reflow cycle is running from the Profile Development Screen. However, the PROFILE itself cannot be changed.
- 3) To determine a temperature, it is strongly recommended to use a thermo-couple to take temperature measurements. Profile creation is most successful when thermo-couples are used. For assistance, contact PACE or your local representative.
- 4) To ensure a successful installation the following conditions should be met in each profile.

During the PRE-HEAT phase, the PCB should experience a temperature of between 95 and 105 °C before entering into SOAK.

During the SOAK phase, the solder balls should experience a temperature between 145 to 165 °C for 30 to 60 seconds. Refer to your flux activation temperature.

During the REFLOW phase, the solder balls should experience a temperature of 190 to 220 °C for 10 to 30 seconds. Always verify the component's maximum allowable temperature with its manufacturer.

- 4) The preset default profiles are as follows: (Time (s)/Top Heater Temperature/Bottom Heater Temperature)

<b>Profile</b>	<b>Preheat</b>	<b>Soak</b>	<b>Reflow</b>	<b>AirFlow</b>
<b>Default 1 °F</b>	60/212/320	80/275/350	70/410/375	22 lpm
<b>Default 1 °C</b>	60/100/160	80/135/175	70/210/190	22 lpm
<b>Default 2 °F</b>	60/212/300	70/375/330	60/375/355	15 lpm
<b>Default 2 °C</b>	60/100/150	70/135/165	60/190/180	15 lpm

**Figure 11: Default Profile Table**



## **5 PC SOFTWARE**

TF 3000 application software comes pre-installed on the PC of the TF 3000 BGA/CSP Rework System. The software provides numerous features, which include:

- Allows password to be entered to protect existing profiles from unauthorized modification.
- View images from the Vision Overlay System (VOS).
- The ability to save images electronically.
- Real time split screen function allows for quick alignment of large components or components with numerous solder balls.
- Real time modification of profile parameters.
- Use up to 4 Thermo-Couple Sensor Inputs to monitor reflow profile.
- Time and Temperature parameters are displayed on screen.
- Incorporate work instructions for operators into profiles.
- Document operations for quality assurance.
- Integrate inspection devices.

The TF 3000 application software consists of 6 functional pages indicated by buttons across the top of the display. Click on the associated button to access the appropriate page.

## 5-1 Setup Page

The Set-Up page is accessed by clicking on the second button from the right on the toolbar within the TF 3000 application (See #1, Figure 12). The Setup page allows the TF 3000 software to be configured.

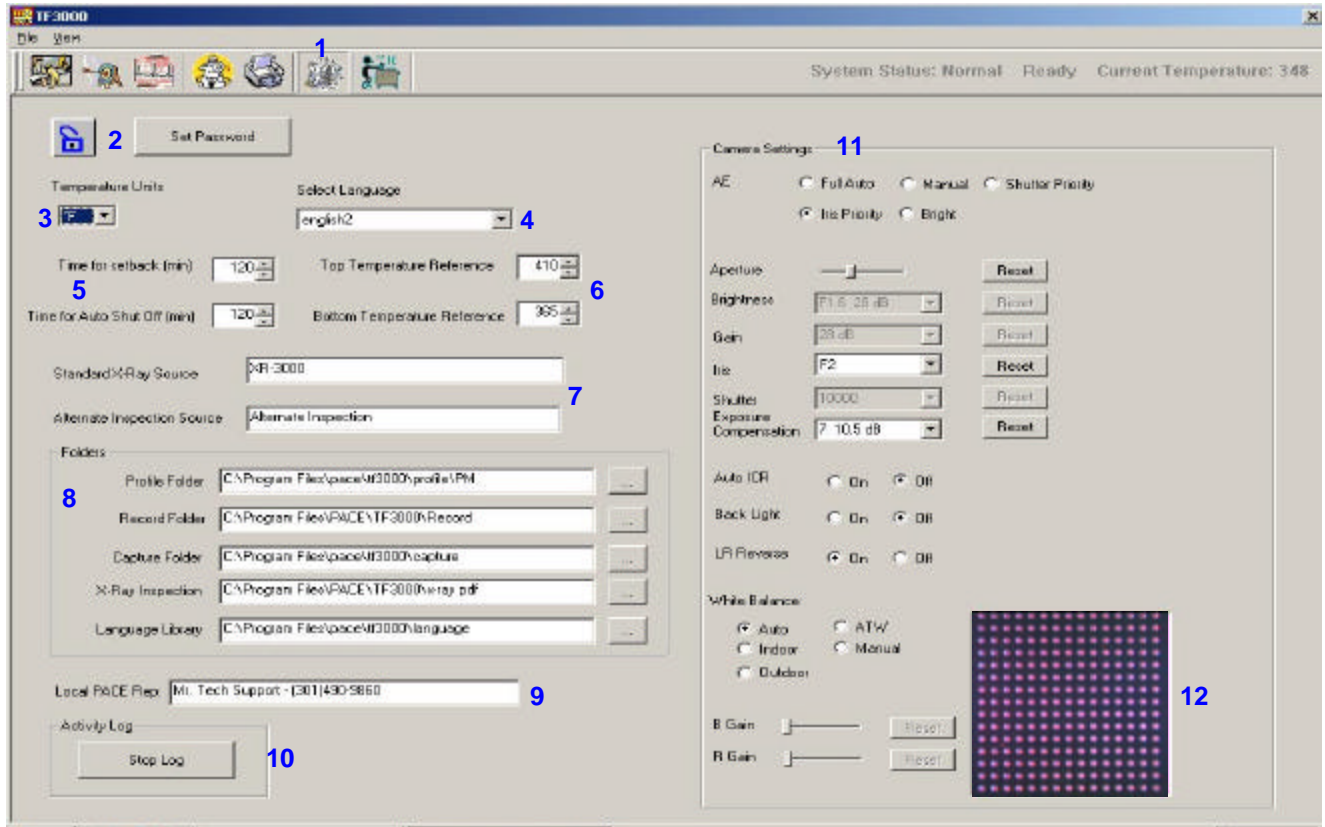


Figure 12: Setup Page

- 2 Setup Password Button – Restricts access so that profiles cannot be modified, deleted, or created by unauthorized users. Clicking this button causes a pop up box to be displayed. (See Figure 13)
- 3 Select °F or °C as a temperature scale.
- 4 Select Language – Allows for selection from 6 different languages, including English, German, French, Italian, Spanish and Swedish from a drop down menu. Languages can be customized and created using the language wizard. See Section 6.
- 5 Setback and Auto off. Enter a time for each to activate.



Figure 13

- 5-1 Setback – When the system has been idle for the defined period of time, the system will go into Setback, which will reduce the set temperature of the bottom heater by 50%.
- 5-2 Auto Off – When the system has been in setback for the defined period of time in the auto off field, the system will shut the bottom heater off.
- 6 Set Upper and Lower Temperature Limits – Provides a reference zone for reflow, typically set at 190 and 220°C. Horizontal yellow lines on the graph represents upper and lower limits.
- 7 User defined labels for the Inspection page to label the composite video inputs. For example, when using PACE's XR 3000 either of the composite video inputs could be labeled "XR 3000" or any name you wish to call it.
- 8 Folder management: Assigns access to a defined folder for:
  - 8-1 Profiles
  - 8-2 Records
  - 8-3 Captured Images
  - 8-4 Inspection Images
  - 8-5 Language Libraries

When a password is entered, this feature locks the operator into using the defined folders. For example, if you are working on a job that requires three profiles, you can create a directory that only contains the three profiles. This way, the choices an operator has to make when selecting a profile are restricted, reducing the likelihood of selecting an incorrect profile.

If records of each profile run are to be created and maintained for documentation purposes, the operator can be limited to saving them to a specific directory to keep them all together under a folder associated with a specific board run, job number, or customer name.

- 9 User defined Local PACE Representative Phone Number – Allows for entry of PACE Local Representative or PACE customer service telephone number for easy reference.
- 10 Enable/Disable activity log. When activated, this button logs all communication activity between the PC and the microprocessor in the TF 3000. This is useful when trouble shooting the unit.
- 11 Camera controls. The camera settings can be changed and changes are immediately reflected in the video display window, lower right hand corner. (#12)
- 12 Display of video from TF 3000 alignment camera so you can see the effect of the changes made to the camera settings.

## 5-2 Alignment Page

The Alignment page is accessed by clicking on the second button from the left on the toolbar within the TF 3000 application (See #16, Figure 14). This screen is used for:

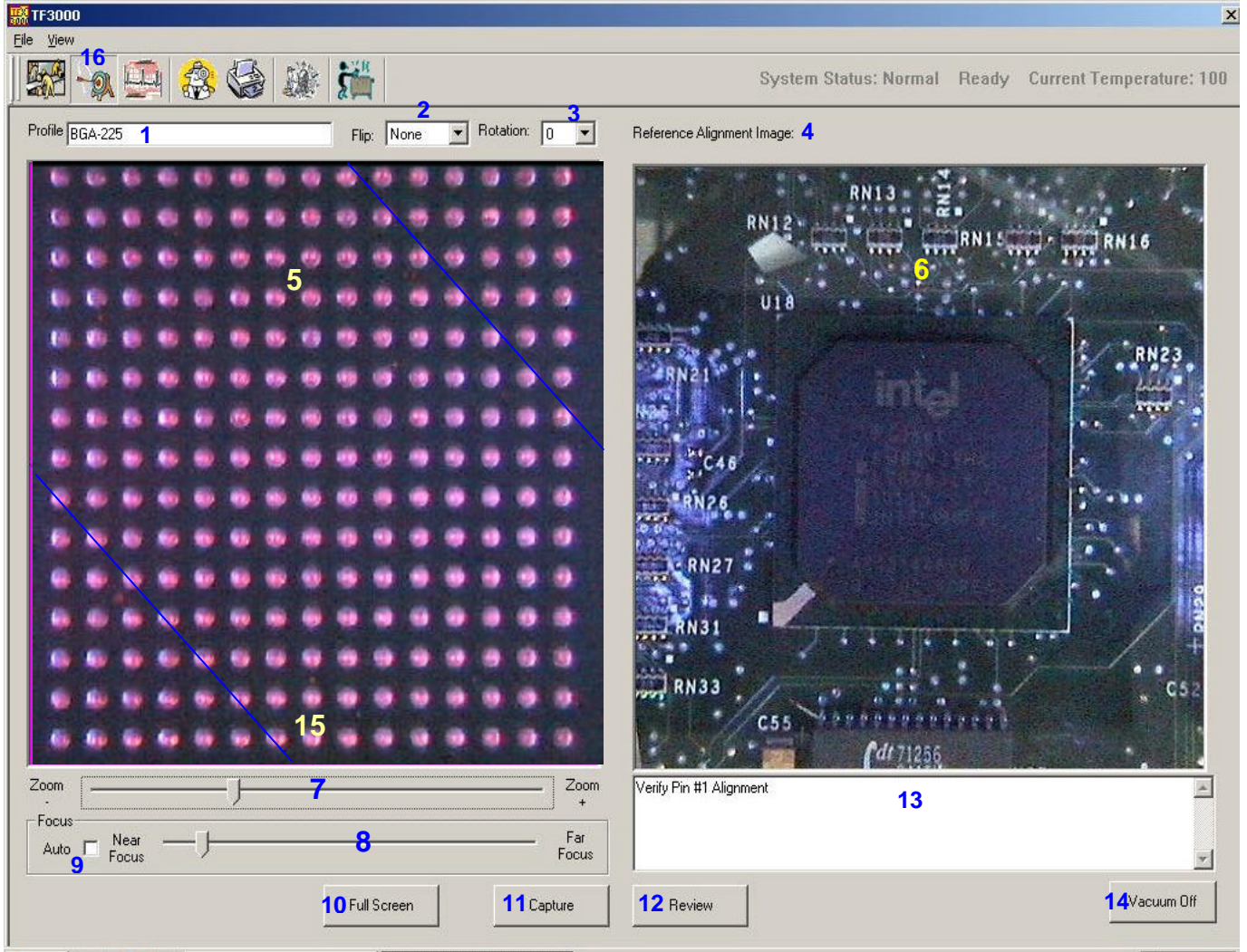


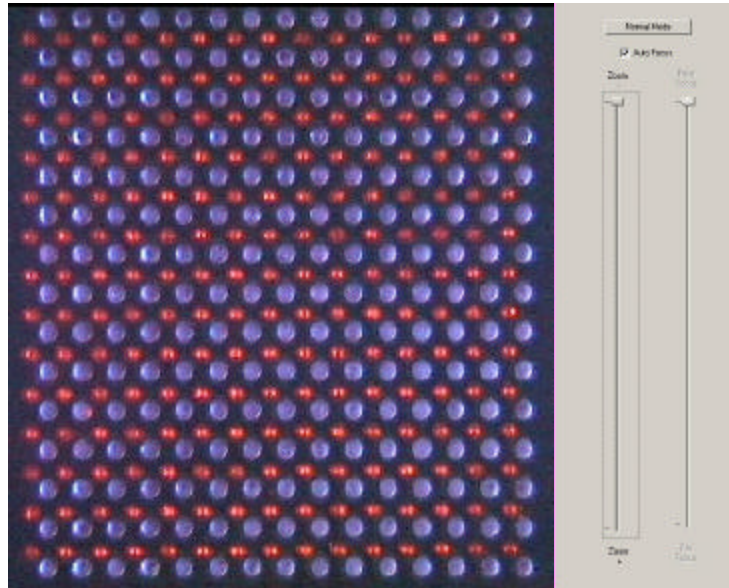
Figure 14: Alignment Page

1. Name of profile selected from Operation Page displayed here.
2. Allows for user to set Horizontal or Vertical Flip of image
3. Allows for user to set Image rotation

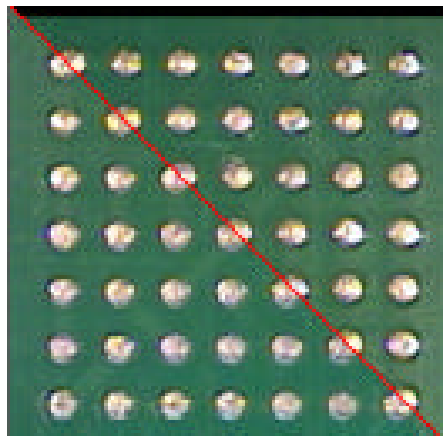
**NOTE:** Selecting any of the Video Image Flip or Video Image Rotation options may cause the displayed image to appear “jerky” or “sluggish”, due to the calculation time required to digitally flip or rotate an image.

4. Displays name of the reference image file.
5. Display pane for live video from TF 3000 alignment camera.
6. Display pane for reference image or image review
7. Zoom adjust slide bar

8. Manual focus adjust slide bar. (Auto-Focus must be disabled before slide bar can be used)
9. Auto Focus enable/disable
10. Full screen button – when activated displays video feed full screen. See Figure 15.
11. Image capture button. Captures image displayed in #5 and saves electronically.
12. Review Button – allows for review of images captured with #11. Images will be displayed in #6. When image is displayed, button will change to “Normal” which will return the user to reference alignment image or clear pane is no image is available.
13. Alignment instructions – See Reference alignment Image in Section 5-4.
14. Turn vacuum on/off to vacuum nozzle on alignment head.
15. Split screen line. Refer to Figure 16 for an example of Real Time Split Screen images. Clicking on the image between the corner and blue line will display the image in split screen mode. This means that the lower left-hand corner and the upper right-hand corner up to the diagonal lines marked “15” on Figure 14 are magnified and placed together in the display, See Figure 16. Click the split image display (Figure 16) anywhere to return to normal display mode.



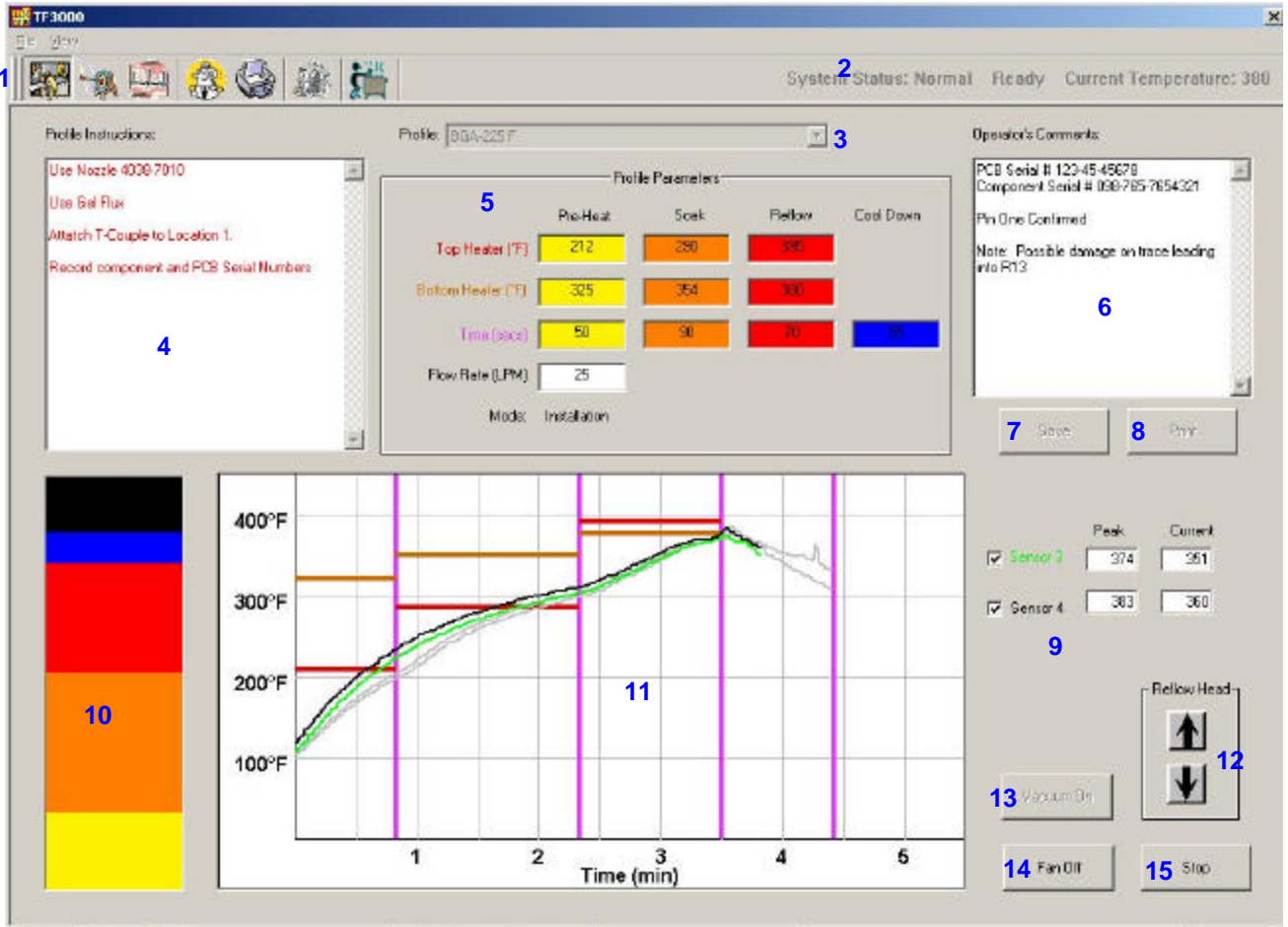
**Figure 15: Full Screen Mode not aligned  
(Component =Red, PCB=Blue)**



**Figure 16: Results from the Real Time Split Screen Feature**

### 5-3 Operations Page

The Operations page is accessed by clicking on the first button from the left on the toolbar within the TF 3000 application (See #1, Figure 17). With the exception of the optical alignment, this screen allows the operator to perform all essential operations including profile selection, documenting operations for quality assurance, and process validation.



**Figure 17: Operation Page**

2. System Status Bar – Displays system status:  
 Normal  
 Ready  
 Not Ready  
 Setback  
 Auto Off

and current temperature of bottom heater. This bar is to ensure the bottom heaters are at the specified temperature and will not allow a cycle to start until the bottom heaters are within the defined tolerance. If the system has entered “Setback” or “AutoOff” modes, click the right most button on the tool bar to reset the bottom heater temperature.

3. Drop down box containing the profiles available to be selected. Click on the arrow and select the desired profile and it will be loaded.
5. Profile Instructions – Specific operator instructions for the chosen profile are displayed here. These are created during profile development and are saved with the profile.

6. Profile Parameters – Display of time and temperature parameters for the chosen profile. Values are displayed but CANNOT be changed.
7. Operator Comments - Provides a means for documenting essential information. A record is defined as information associated with a particular rework job. This information includes profile parameters, sensor input (via the graph), and operator recorded comments. A record can be saved for each new component installation. When a record is saved, the date, time and profile name are automatically stored with that record.
8. Save Record Button – Stores profile name, date & time, operator comments and graph information in “Records” folder.
9. Print Record Button – Prints the current record.
10. Sensor inputs #3 and #4. Check box to display thermocouple data. “Peak” field displays highest temperature reached during profile. “Current” field displays the current temperature measured by the thermocouple.
11. Progress Indicator – Visual indication of the profile process. Color coordinated with the phases as indicated in #5.
12. Graphing Area – Graphically displays profile parameters (time and temperature) and thermocouple data from Sensors #3 and #4.
13. Reflow head Up/Down buttons. Clicking the down arrow once brings the reflow head down to 5 mm above the PCB. Click and hold the down button for fine control. Clicking the up arrow returns the reflow head to its up position.
14. Turns the vacuum pump for the nozzle on or off.
15. Turns the cooling fan on or off.
16. Start/Stop Cycle button.

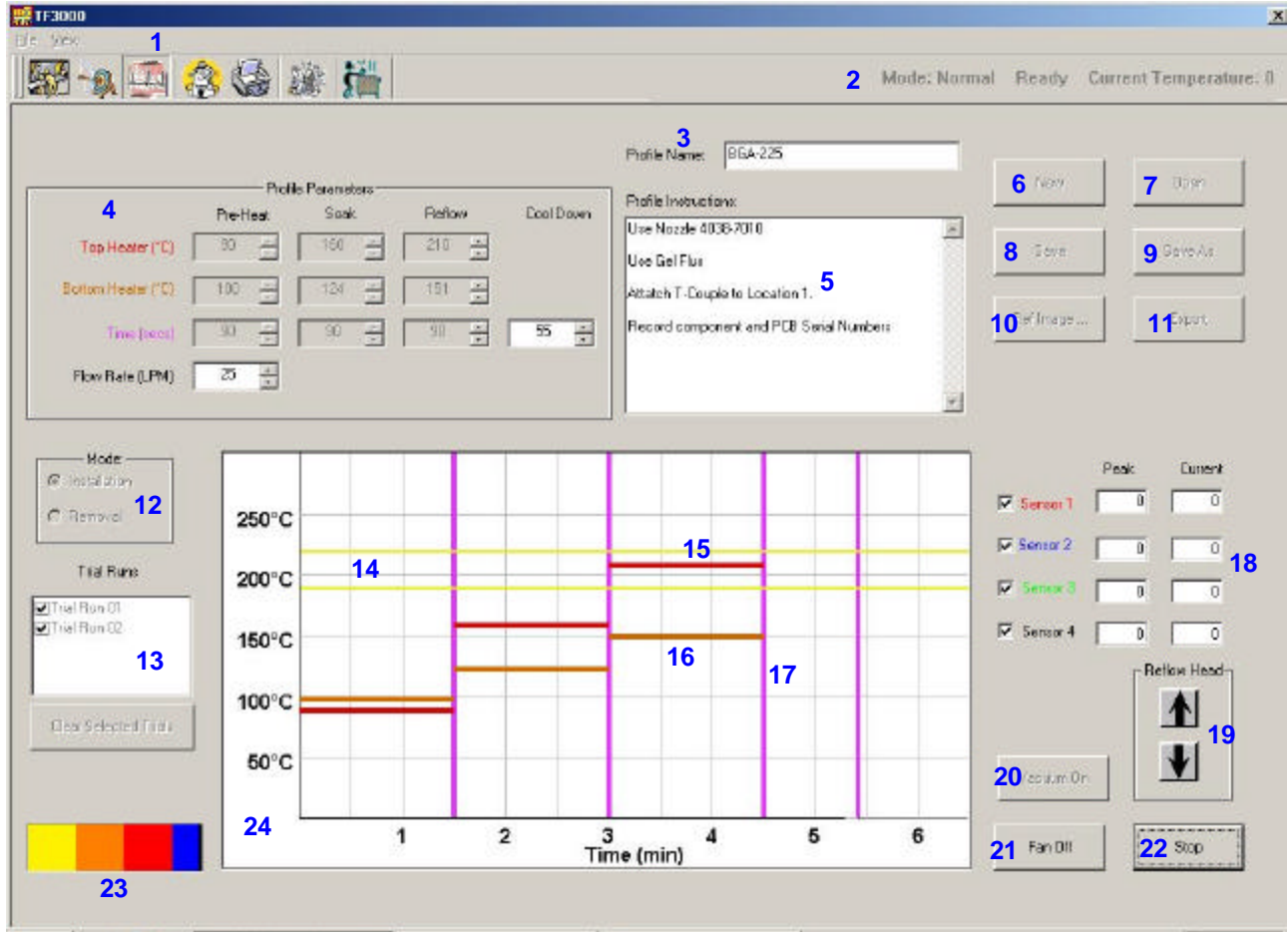
### 5-3.1 Process Control/Validation Feature

During the Profile Development phase, a temperature probe trace can be saved from Sensor #1 and #2 with a profile. To validate profile and system performance from the operation screen, a reference point near the component rework area (on an adjacent component lead for example) must be used for temperature probe placement. The location of sensor area can be stored in “Profile Instructions”. Keep in mind that data must be collected from the same Temp probe location used when developing the profile.

When an operator selects an appropriate profile, the temperature probe trace(s) will be displayed on the graph as gray lines. To validate the rework process, the operator can place one or two temperature probes or thermocouples on the designated reference point and run the profile. The check boxes next to Sensor #3 and #4 on the operations screen must be checked to display data. As the profile progresses, the temperature probe trace(s) will be displayed in green or black. The probe traces can be compared to validate a particular rework process. (See Figure 17) Some variation may exist due to differences in Temp probes, positioning, and operator error. The “shape” of the curves should be similar.

## 5-4 Profile Development Page

The Profile Development page is accessed by clicking on the third button from the left on the toolbar within the TF 3000 application (See #1, Figure 18). With the exception of the optical alignment, this screen allows an Engineer or supervisor to perform all essential functions to develop and verify a profile.



**Figure 18: Profile Development Page**

- 1) Profile Development Page Button. Clicking this button changes the software to the Profile Development Page if a Password is not entered into the system. If a password has been entered, you will be prompted to enter it before the page is displayed.
- 2) System Status Bar – Displays system status:
  - Normal
  - Ready
  - Not Ready
  - Setback
  - Auto Off

and current temperature of bottom heater. This bar is to ensure the bottom heaters are at the specified temperature and will not allow a cycle to start until the bottom heaters are within the defined tolerance. The bottom heater tolerance can be adjusted (more or less stringent) by changing the value of the bottom heater tolerance file in the TF 3000 folder using the “RegEdit” software application found in the windows directory.



To change the value, start the RegEdit software.

- a. On the left hand side, double click on "Local Machine"
  - b. Double click on Software
  - c. Double click on PACE
  - d. Double click on TF 3000
  - e. In the right hand side, double click on Btm\_Htr\_Tol
  - f. The value should always be set in "Decimal" and in F degrees.
  - g. Save changes and restart the TF 3000 software.
- 3) Name of current profile.
  - 4) Profile Parameters – Display of time and temperature parameters for the chosen profile. Values can be changes using the up and down arrows or simply click in each box, delete the text, and type a new number. The variable in the Flow Rate box does not control the airflow. The operator must verify the flow rate is set properly on the regulator on the front of the machine. This variable does affect the heat transfer of the top heater and it is important that the proper airflow be entered into this field. Generally a flow rate of 22 lpm is used for most applications. When reworking small components, a flow rate of 15 lpm is recommended.
  - 5) Instruction Box – Provides a means to store and display operator instructions applicable to the selected profile. Instructions may pertain to such items as nozzle type, type of solder paste or flux, reference position of temperature probe for process validation, and any other special needs.
  - 6) "New" Button – Clears Profile Name field and resets all profile parameter fields to the defaults. Top Heater 100 °C (212 °F): Bottom Heater 150 °C (300°C): Time 90 seconds.
  - 7) "Open" Button – Opens a profile.
  - 8) "Save Profile" Button – Saves profile parameters for the selected profile. Clicking this button will overwrite existing profile parameters for named profiles. A pop-up box will appear for new unnamed profiles.
  - 9) "Save As" Button – Saves a profile under a different name.
  - 10) "Ref Image" Button – Associates a reference image with a profile. The Alignment page should first be accessed to capture the image to be associated with the profile.

For example, capture an image of the component to be reworked while it is on the PCB to clearly identify to the operator the location and orientation of the component. To associate the reference image with the profile,

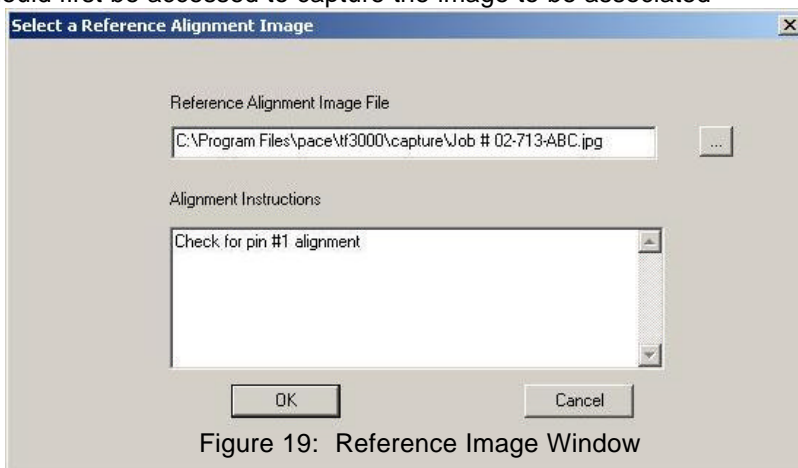


Figure 19: Reference Image Window

click on the "Ref image button and window will open. See Figure 19. Click on the box with the three dots on it and select the image to be associated with the profile. You can also enter alignment instructions that will also appear on the alignment page to remind the operator of any tasks he must complete before placing the component.

- 11) "Export" Button – Saves profile and thermocouple data in .csv format that can be opened in MS Excel.
- 12) Mode – Select Installation or Removal mode. Selecting Removal mode will turn on the vacuum pump 5 seconds before the reflow phase ends to lift the component off of the PCB.
- 13) "Trial Runs" Window – Allows for the management of trial run profiles while creating a profile. Up to three profiles can be simultaneously displayed on the graphing area at one time. This is useful for comparing runs and to view the effects in changes to the profile parameters. To display a trial run, the check box to the left of the name must be checked. If three trial runs are present and a cycle is started an error message will appear and you must delete at least one of the trials.
- 14) Reference lines – The yellow lines are for reference on the graph. Their value is set from the "Set-Up Page".
- 15) Red Lines – These lines correspond to the top heat parameters in the Profile Parameters section (#4). These lines can be clicked on and dragged up or down to increase or decrease the amount of top heat being applied. These can be used to modify profile parameters instead of using the text boxes in #4 above, or to modify the profile while one is running. All changes are reflected immediately in the profile parameters area (#4) and on the graph.
- 16) Orange Lines – These lines correspond to the bottom heat parameters in the Profile Parameters section (#4). These lines can be clicked on and dragged up or down to increase or decrease the amount of bottom heat being applied. These can be used to modify profile parameters instead of using the text boxes in #4 above, or to modify the profile while one is running. All changes are reflected immediately in the profile parameters area (#4) and on the graph.
- 17) Purple Lines – These lines correspond to the time parameters in the Profile Parameters section (#4). These lines can be clicked on and dragged left or right to increase or decrease the amount of time within each phase. These can be used to modify profile parameters instead of using the text boxes in #4 above, or to modify the profile while one is running. All changes are reflected immediately in the profile parameters area (#4) and on the graph.
- 18) Sensor inputs 1, 2, 3 and 4. Check box to display thermocouple data. The "Peak" field displays highest temperature reached during profile. The "Current" field displays the current temperature measured by the thermocouple. The thermocouple traces are colored to match the text labels for Sensor 1, Sensor 2, etc.
- 19) Reflow head Up/Down buttons. Clicking the down arrow once brings the reflow head down to 5 mm above the PCB. Click and hold the down button for fine control. Clicking the up arrow returns the reflow head to its up position.
- 20) "Vacuum" Button - Turns the vacuum pump for the nozzle on or off.
- 21) "Fan" Button - Turns the cooling fan on or off.
- 22) Start/Stop Cycle button – Starts or Stops the cycle.
- 23) Progress Indicator – Visual indication of the profile process.
  - Yellow = Preheat
  - Orange = Soak
  - Red = Reflow
  - Blue = Cool down
- 24) Graph Area – Graphically displays profile parameters (time and temperature) and sensor inputs. Right Clicking the mouse and holding the button down on any sensor trace will display the temperature at the point selected. Right clicking the mouse on any two points will give the temperature ramp rate between the two points.

#### 5-4.1 General Information concerning the Profile Development Screen

- 1) The Reflow Graph area displays a representation of the Reflow cycle profile. Time in minutes is graphed along the X-axis and temperature in degrees Celsius or Fahrenheit is plotted along the Y-axis. The time and temperature axes incorporate a dynamic scaling feature to optimize the display for extremely short or long profiles. Profile graphs can be saved with profiles to be used for process validation by operators while using the Operation screen. Profile graphs can also be stored as individual records for each rework job for quality control purposes. Solid and dotted lines are used to indicate profile parameters.

#### 5-4.2 Profile Creation

There are 2 recommended methods for developing a profile. The first, involves an actual component installation, while the second uses a previously installed package. Either method can be used to develop a reliable profile. However, there are some issues and considerations to be aware of with each.

When developing profiles through actual component installation, it is critical to make sure the thermocouples remain in contact with the solder balls throughout the entire process. Unreliable data will be collected should a thermocouple lose contact with the solder balls. If measuring the temperature on the top of the package it is best to use a preinstalled component, as the thermocouple wire will typically cause the component to not lay flat on the PCB.

When using a previously installed package, the placement of the thermocouples is important. They must be in contact with the existing solder joints. This task can be accomplished by either (1) drilling through the bottom of the PCB into a solder joint and attaching the thermocouple or by (2) sliding the thermocouple under the package. When sliding a thermo couple under a component, it is critical that the thermo couple be in contact with a solder ball. Method 2 is the most commonly used.

Information from the thermocouples will assist in determining the proper time and temperature parameters. In general, the following guidelines should be adhered to when developing profiles.

#### Ramp and Maximum Temperatures

Acceptable ramp rates and maximum temperatures should be obtained from the component manufacturer. Typical ramp rates are 2-5 °C/s (4-9 °F/s) for plastic parts and 1 °C/s (2 °F/s) for ceramic parts. It is recommended to select a maximum temperature below the manufacturer's specification to provide for a margin of safety. Typically, 20 °C below maximum specified temperature is selected.

#### Pre-Heat Phase

1. In a "step profile", the top of the PCB and package should reach a stable temperature of 95-105 °C. If plotting the temperature curve, the trace will usually level off within this temperature range.
2. If a "linear slope" is desired, pre-heat and soak phases are combined. Both the package and the PCB are warmed at a constant ramp rate (usually 2-4 °C/second) until the desired soak temperature is reached.

## Soak Phase

The soak phase is a crucial part of the reflow process. During this period, the flux activates and drives off volatiles and excess flux. A temperature of 145-165 °C (determined by the activation temperature of the flux used) should be maintained for approximately 20-40 seconds. This allows for uniform ramping across the entire package and PCB during reflow.

## Reflow Phase

During this phase, the solder balls reach solder melt and form a joint between the package and the lands. It is critical for all areas of the array to reach solder melt together and all solder balls remain in a liquid state for at least 10-20 seconds.

Generally, plastic packages should not be exposed to temperatures higher than 220 °C. Always consult the device specifications for maximum temperature recommendations. As a rule of thumb, a safe “maximum temperature” is the maximum temp specified by the manufacturer minus 20°C. Lower temperatures and shorter times are common in CSPs and FCs. **The lowest temperatures possible should always be used to ensure safety of the device and PCB.**

## Cool Down Phase

The cool down phase is necessary to bring the temperature of the package, solder joints and PCB under the package below solder melt temperatures. Cooling should be controlled. A good reference is to use the same cool down rate as for ramp up. The cooling fan on the TF 3000 will remain on for a minimum of 30 seconds from the start of the cool down cycle. Some types of components (like CBGAs) should be allowed to cool without external assistance from the cooling fan. When installing these packages, turn the fan away from the PCB so the air doesn't blow on it.

## General

Using one of the two baseline profiles will provide a good starting point for profile development. The reflow graph provides an excellent tool for monitoring profile parameters and fine tuning or perfecting the profile development process.

When adjusting profile parameters “on-the-fly”, all changes are reflected immediately on the profile development screen and graph.

## 5-5 Inspection Page

The Inspection page is accessed by clicking on the fourth button from the left on the toolbar within the TF 3000 application (#1, Figure 20). This page allows for the integration of the inspection function within the TF 3000 software. Up to two pieces of inspection equipment that have a composite video output can be connected to the TF 3000. Examples of inspection equipment are X-Ray inspection equipment and microscope inspection devices. These are connected through the panel on the right side of the TF 3000.

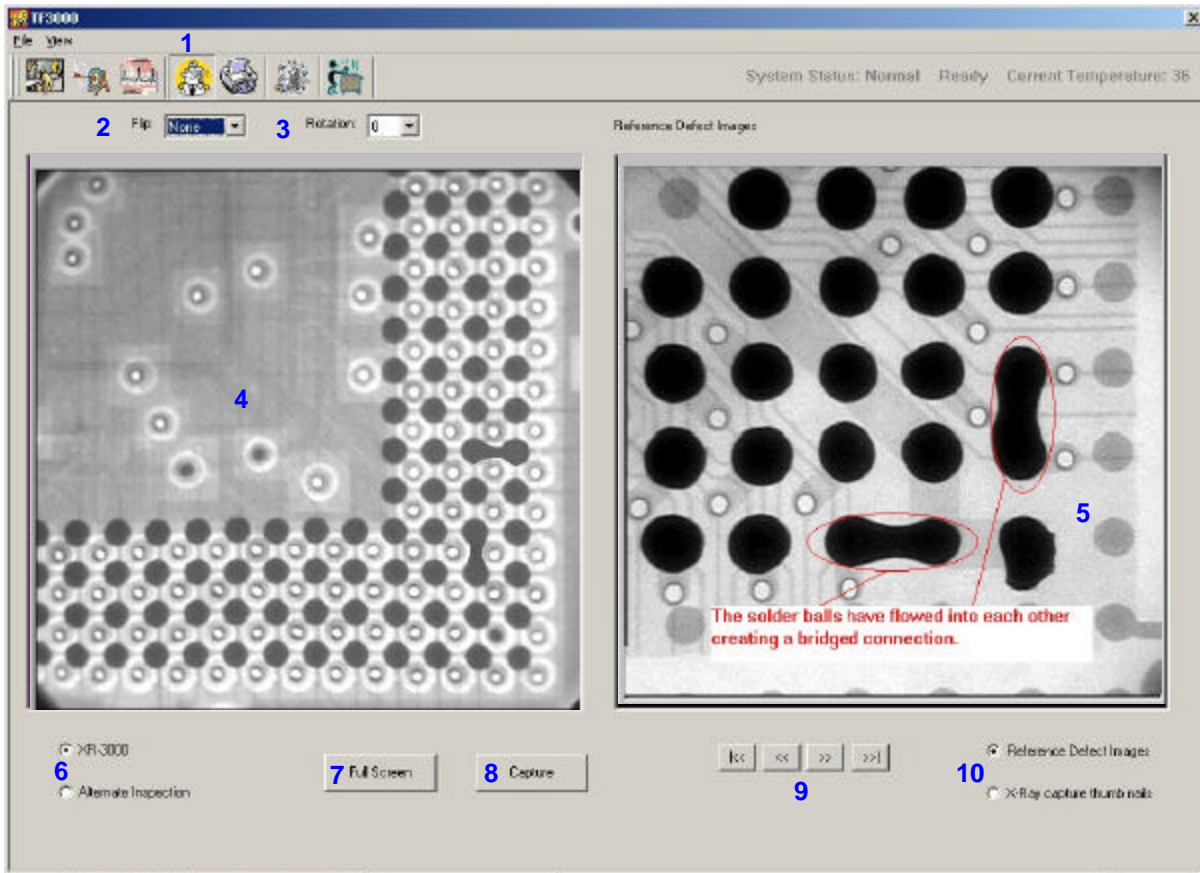


Figure 20: Inspection Page

2. Flip Field – Flips the image displayed in pane 4 horizontally or vertically.
3. Rotate Field – Rotates the image displayed in pane 4 in 90 degree increments.
4. Display pane for image from either composite video input.
5. Reference image library display pane.
6. Video input Display selection. These radio buttons allow the video/image from either composite video input to be displayed. They can be named by the specific source of the image in the “Set-Up” Page.
7. Full Screen Button – Changes display mode from Figure 20 to full screen. See Figure 21. To return to normal display mode, click the “Normal Mode” Button.

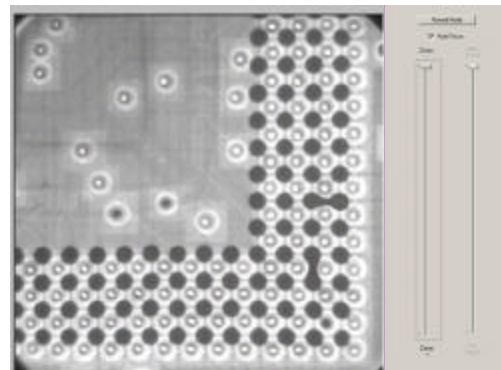
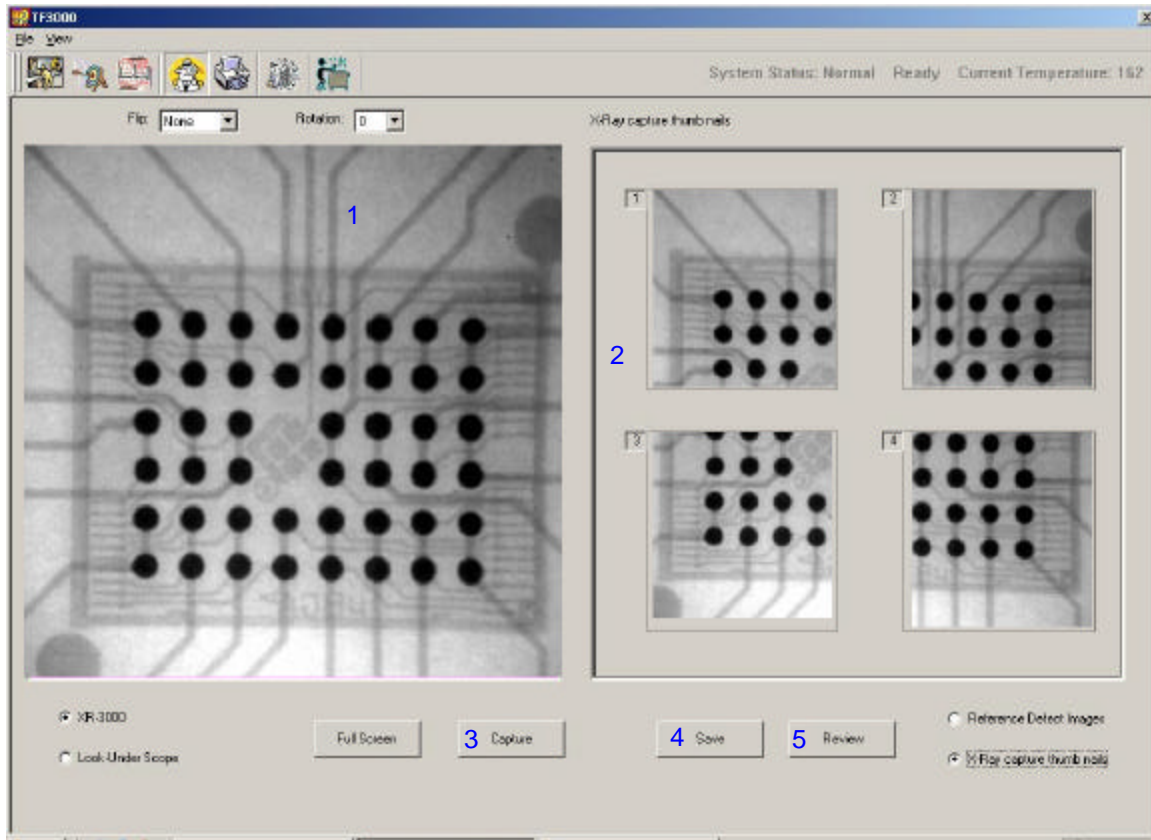


Figure 21: Full Screen Display Mode

8. Capture/Review Button - The Review and Capture Buttons operate the same as in Alignment View.
9. The Arrow Buttons scroll between images stored in the reference library. **To Add a Reference Image:** Any captured image may be added to the Reference Image Folder under the TF 3000 Software directory.
10. Radio Buttons allow the user to change from Reference Defect Image mode to Thumbnail mode. See Section 6-5.1.

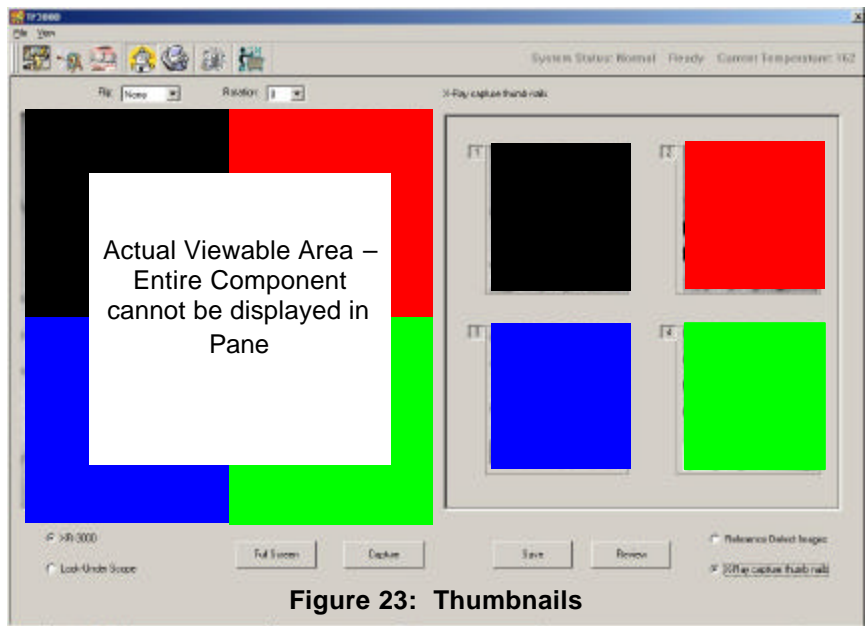
### 6-5.1 Inspection Thumbnail Mode

To enter Thumbnail mode, click on the radio button labeled “Thumbnails” (#10 Figure 20). The display will change to resemble Figure 22.



**Figure 22: Inspection Thumbnail Mode.**

The Thumbnail mode allows for images that are too large to appear in the viewing pane (#1) to be viewed in parts. See Figure 23. This creates a composite image where the entire component or desired viewing area may be reviewed. Additionally, the thumbnail panes may be loaded with images identifying defects, potential problem areas, or areas that may indicate further evaluation is required. To load images into the thumbnail frames, simply display the desired image on the display pane (#1, Figure 22), then click the Capture Button. The images will be transferred to the Thumbnail Pane (#2, Figure 22) in sequential order, i.e. Thumbnail 1, Thumbnail 2, Thumbnail 3, and



**Figure 23: Thumbnails**

Thumbnail 4. The thumbnail panes can also be selected individually if a different fill order is desired by right clicking on the thumbnail pane to be filled first and selecting "Capture" from the pop-up menu. Thumbnails can be copied over by recapturing an image or by right clicking on a thumbnail pane and selecting an option from the pop-up menu. The choices on the pop-up menu are: Capture, Delete thumbnail, and Delete all thumbnails.

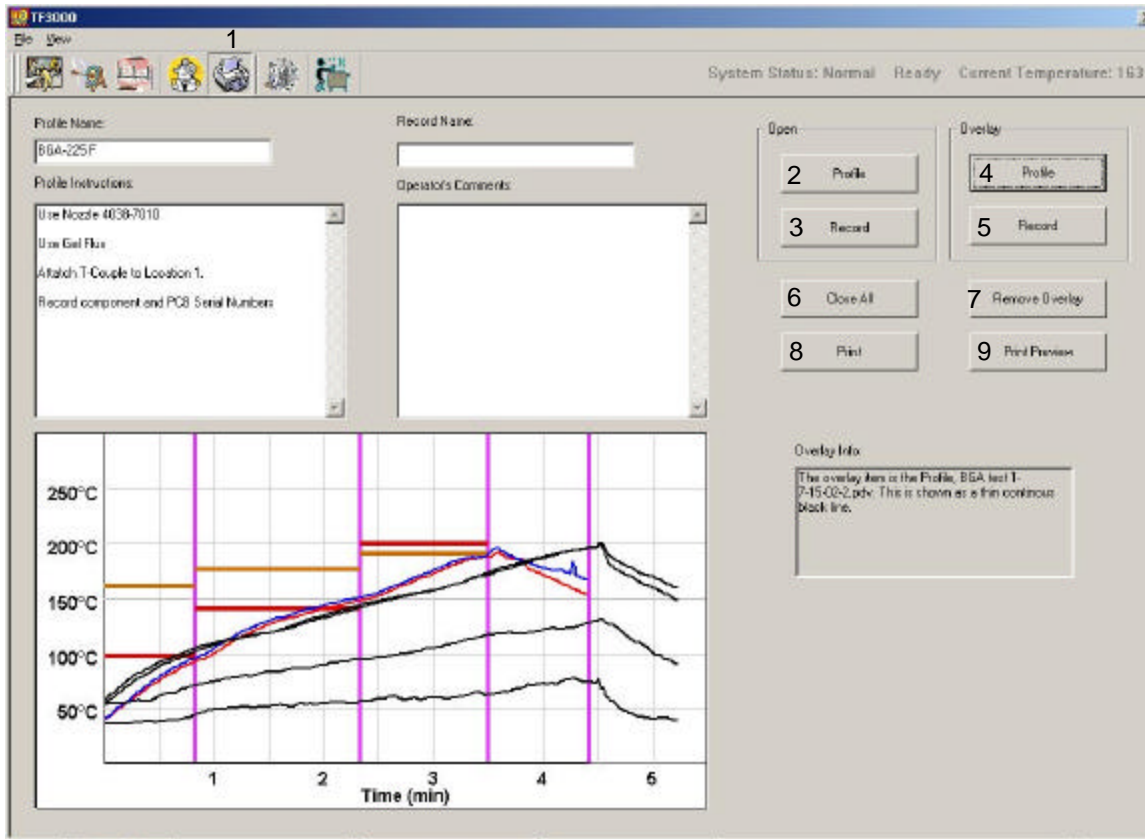
This screen can also be used to create reports such as defect or failure analysis reports. To add comments associated with each thumbnail, double click on the thumbnail and a text box will appear where text can be entered. When finished with adding comments, click on the "SAVE" Button (#4, Figure 22) and the report and images will be saved as an Adobe Acrobat file that can be emailed, printed, stored, or saved to disk for future reference.

The Review button (#5, Figure 22) is used to review the PDF files that are saved from this mode.



## 5-6 Print/Review Page

The Inspection page is accessed by clicking on the third button from the right on the toolbar within the TF 3000 application (#1, Figure 24). This Screen allows the operator to recall and view saved profiles and operator records and output them to a specified printer.



**Figure 24: Print/Review Page**

- 1) Open Profile Button – Loads saved profile from disk and displays it on screen.
- 2) Open Record Button – Loads saved operator record and displays it in Record Comment.
- 3) Overlay Profile Button – Inserts a previously saved profile on screen to compare the currently viewed profile to.
- 4) Overlay Record Button – Inserts previously saved record on screen to compare currently viewed record to.
- 5) Close All Button – Clears all opened and overlaid Profiles and Records.
- 6) Remove Overlay Button – Removed the overlay from the graph area.
- 7) Print Button – Brings up Print Screen to select printer to output displayed record or profile.
- 8) Print Preview Button – Opens Print Preview Screen.

## 6 Language File Creation and Modification

The TF 3000 comes standard with the software in 6 languages: English, German, Spanish, Italian, Swedish and French. To change languages please refer to the set-up page section in Chapter 6. The TF 3000 also comes with a piece of software that allows for the modification of existing language files or for the creation of new language files. To modify the language files, open the “Language File Editor” located on the desktop, under the TF 3000 icon.

As the default language, English will always be displayed in the first column.

If you wish to modify an existing language file, follow the procedure below:

1. Under the “FILE” menu, “LOAD” the language you wish to modify. The file will be loaded into the second column of the language editor. This is the language file that will be used as a reference file and cannot be modified.
2. Next, under the “FILE” menu, “OPEN” the language file. The file will be opened in the third column of the language editor. This is the column you will actually modify. It is normal to “open” a language file, then “load” the same one. This is done so there is an uncorrupted set of data to use as a reference.
3. Next, place the cursor into the cell you wish to modify and make your changes.
4. The modified file must then be saved in the language folder. The standard language files cannot be overwritten, so any modified file must be saved under another name. For example, if the “English” file has been modified, the new file would have to be named something other than “English”. This is to maintain the original set of language files incase they are needed for reference purpose.
5. Saved files will appear in the language selection menu on the set-up page of the TF 3000 software.

To create a “New” language follow the procedure below:

1. Under the “FILE” menu, “LOAD” the language you wish to modify. The file will be loaded into the second column of the language editor. This is the language file that will be used as a reference file and cannot be modified.
2. Next, under the “FILE” menu, select “New” and the new language file will be opened in the third column of the language editor. This is the column you will actually create.
3. Next, place the cursor into the first cell in the new column. Type the reference text in whatever language you are creating and go on to the next cell.
4. The new file must then be saved in the language folder. The standard language files cannot be overwritten, so any new file must be saved under another name. This is to maintain the original set of language files incase they are needed for reference purpose.
5. Saved files will appear in the language selection menu on the set-up page of the TF 3000 software.

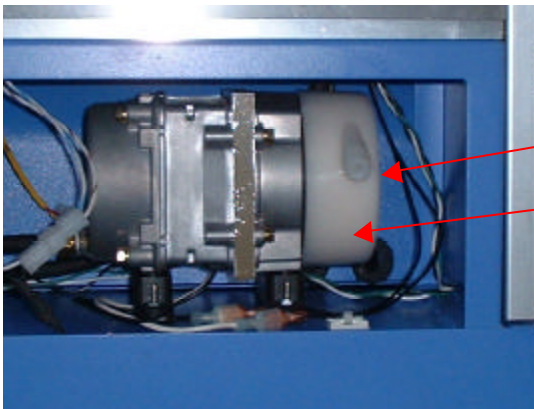
## 7 Maintenance

The TF 3000 is designed to operate with a minimum level of maintenance. However, replacement of some parts will be required from time to time. Please follow the maintenance instructions below when replacing parts. If there are any questions, contact PACE.

**CAUTION:**     **Disconnect the main power supply and computer cables, if applicable, BEFORE opening the TF 3000/E or TF 3000 L/E, BEFORE replacing any component and BEFORE performing ANY routine maintenance.**

### 8-1     Cleaning the Blower Filter (See Figure 25)

Clean the filter every three (3) months.



- 1) Open the cover on the back of the TF 3000.
- 2) Identify the Blower pump, mounted on the base of the machine.
- 3) Loosen the screw fitted to the end of the filter housing.
- 4) Remove the housing, then the filter.
- 5) Clean the filter using warm water.
- 6) Make sure the filter is dry before re-assembly.

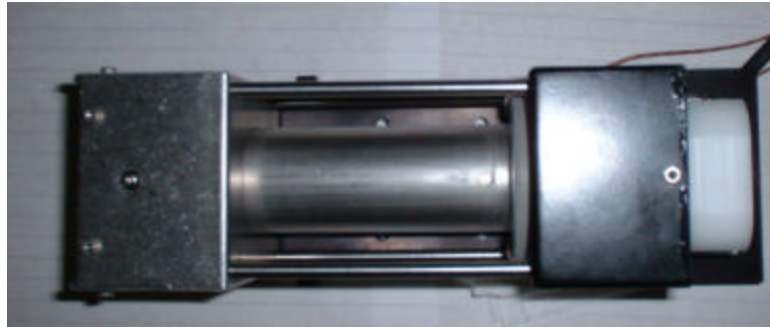
**Figure 25: Blower Filter Access**

### 8-2     Replacing the Top Heater

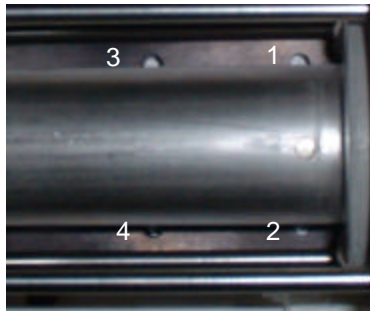
Please refer to Figure 26 and Figure 27 for heater replacement.

- 1) Disconnect the TF 3000 from **ALL** power supplies.
- 2) Remove the protective cover from the reflow head by removing two screws from each side of the cover.
- 3) Open the back panel and disconnect electrical connections AS and HS.
- 4) Feed the wires through the front panel. (you will have to remove several wire ties.)
- 5) Remove the white cap on the heater assembly
- 6) Remove the electrical connections under the cap.
- 7) Remove the wire ties holding the air hose onto the connection on the back of the reflow head assembly and remove the hose.
- 8) Remove all four screws shown in Figure 27 and the heater assembly can be removed.
- 9) Be careful not to lose the steel ball bearing positioned behind the reflow head.
- 10) Fix the replacement reflow head assembly to the support arm using the 4 screws removed in #8 above. Make sure the steel ball bearing has been replaced as well.
- 11) Reconnect the Air hose and thermocouples.
- 12) Reconnect the electrical connections
- 13) Reinstall the white cap.

- 14) Install the replacement wire ties that came with the heater assembly in the same locations as the removed ones.
- 15) Realign the reflow head. See section 9-4.
- 16) Replace protective cover.



**Figure 26: Replacement Heater Assembly**



**Figure 27: Heater Assembly Attachment Screw locations**

### 8-3 Identification of Electrical Connections.

<b><i>Label</i></b>	<b><i>Description</i></b>
HVJ5	High Voltage Board J5 - Blower
BLOW	Blower connector
COM1	Computer COM port 1
J3	Main PCB J3 - RS232 control
PH	Pre-Heater AC power connection
HVJ4	High Voltage Board J4 - PH
MH	Main Heater AC power connection
HVJ3	High Voltage Board J3 - MH
J5	Main PCB J5 - LED control
J2	Main PCB J2 - HV control
HVJ1	High Voltage J1 - Input control
J10	Main PCB J10 - Camera Interface
CIJ2	Camera Interface Board J2 connector
FG	Frame Grabber Card

J11	Main PCB J11- Frame Grabber
CIJ1	Camera Interface Board J1 connector
V1	Video 1
V2	Video 2
AS	Air Stream Temperature Sensor
HS	Heater Core Temperature Sensor
PH	Pre-Heater Sensor
E1	External TC1
E2	External TC2
E3	External TC3
E4	External TC4
J1	Main PCB J1 connector- TC Input
J4	Main PCB J4 connector- Sensor Input
J8	Main PCB J8 connector- LED control
J7	Main PCB J7 connector- DC control
MP	Magnet Power
VS	Vacuum Solenoid Power
HM	Heater Head Motor
FAN	Fan Power
V+, V-	Vacuum Power
PV	Pick Vacuum
PVSW	Pick Vacuum Switch
XFMR	Transformer Secondary Power Output
J2	Main PCB J2 connector – AC input
NS	Nitrogen Solenoid
CIJ3	Camera Interface Board J3 connector

## 9 Alignment & Calibration

All PACE TF 3000 BGA/CSP Rework Systems are factory aligned and calibrated prior to shipment. Due to adverse shipping and handling conditions, it may be necessary to perform one or more of the following alignment and calibration procedures prior to use. Proper alignment and calibration of system components should also be performed on a semi-annual basis to ensure peak performance.

### 9-1 Board to Optics Alignment

This alignment should be performed when the land pattern on the PCB appears skewed on the video display.

- 1) Position testing PCB in Board Holder.
- 2) Pull the optics housing out from the front of the TF 3000 using the handle.
- 3) Zoom in so the lands on the PCB fill the screen.
- 4) Observe land pattern. If land pattern is skewed, proceed to step 5. See figure 22. If land pattern appears aligned, omit steps 5-7.
- 5) Loosen 8 setscrews found on both sides of the board holder.
- 6) Shift the board holder by hand until the image is no longer skewed.
- 7) Retighten setscrews, alternating from one side of the board holder to the other, until all 8 setscrews are tight.

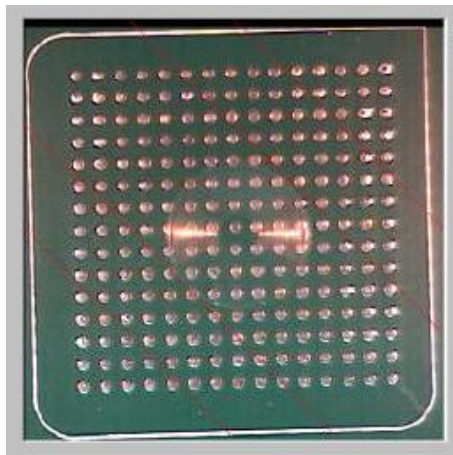


Figure 28: Skewed Land pattern

### 9-2 Sliding Shaft Holder Alignment (Indexing)

This alignment will correct X aspect errors when indexing the sliding shaft holder from the placement position to the reflow position and vice versa.

**NOTE:** A reference point must be established for this procedure. The reflow position will serve as a reference point for this alignment calibration.

- 1) Position testing PCB in the board holder.
- 2) Set the sliding shaft holder at the reflow position flush against the left indexing tab.
- 3) Lower reflow heater nozzle to approximately 1/16" above a PCB component.
- 4) Visually center component in the "X" direction under nozzle using the adjustment knob on the sliding shaft holder.

- 5) Using the handle on the sliding shaft holder, index the table from the reflow position to the placement position.
- 6) Pull the optics housing out from the front of the TF 3000P using the handle.
- 7) Zoom in so the lands on the PCB fill the screen.
- 8) The land pattern should be centered on the display horizontally (X direction). If centered, omit steps 9-16. Otherwise, proceed to step 9.
- 9) Loosen center set screw on top of right indexing tab. See Figure 29.
- 10) Depending on the direction and amount of offset in the X plane, tighten or loosen the large rubber stopper on the side of right indexing tab.

**Note:** Tightening the rubber stopper will shift the displayed image to the right. Loosening the same rubber stopper will shift the image to the left.

- 11) Return sliding shaft holder to the placement position.
- 12) Observe proper centering of land pattern on video display. If centered, proceed to step 16. Otherwise, repeat steps 9-14 until proper centering is achieved.
- 13) Tighten center set screw on top of right indexing tab.

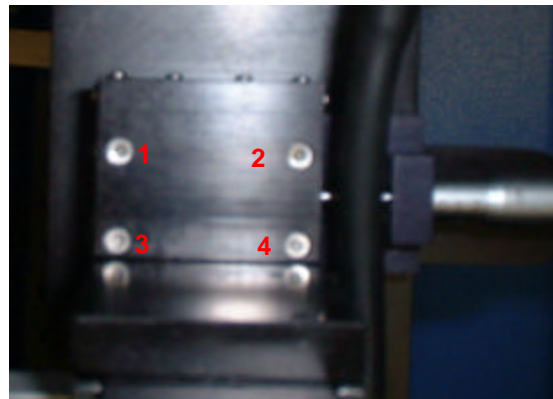


**Figure 29: Top and Side View of Indexing Tab**

### 9-3 Vacuum Nozzle Planarity

The Vacuum Pick nozzle must land flush on the PCB component in order to achieve planarity and adequate suction. Performing the following procedure can rectify problems in vacuum nozzle planarity.

- 1) Remove the cover on the Alignment Apparatus by removing the 4 bolts on the cover.
- 2) Place a PCB on the board holder and install the large vacuum nozzle.
- 3) Lower the alignment apparatus to the PCB.
- 4) Observe the relationship of the vacuum nozzle to the PCB. If the nozzle is not planar to the PCB adjustment must be made. To adjust the planarity of the vacuum nozzle, use the four adjustment screws shown in figure 30.



**Figure 30: Four vacuum nozzle planarity adjustment screws (Looking down on assembly)**

### 9-3.1 X Correction Refer to Figure 30

- 1) If adjustment is required in the “X” direction, follow the procedure below.
- 2) If the right side of the vacuum nozzle is higher than the left side, loosen screws 1 and 3 and tighten screws 2 and 4.
- 3) If the left side of the vacuum nozzle is higher than the back side, loosen screws 2 and 4 and tighten screws 1 and 3.
- 4) Replace the cover.

### 9-3.2 Y Correction Refer to Figure 30

- 1) If adjustment is required in the “Y” direction, follow the procedure below.
- 2) If the front side of the vacuum nozzle is higher than the back side, loosen screws 1 and 2 and tighten screws 3 and 4.
- 3) If the back side of the vacuum nozzle is higher than the front side, loosen screws 3 and 4 and tighten screws 1 and 2.
- 4) Replace the cover.

## 9-4 Reflow Head Planarity Alignment

When lowered and properly aligned, the nozzle on the reflow head should land flush with the PCB. Errors in reflow head planarity (both Y and skew aspects) can be corrected by performing the following alignment. Before proceeding with any adjustments, **DISCONNECT THE ELECTRICAL POWER AND MAKE SURE THE REFLOW HEAD IS COOL AS ELECTRROCUTION OR BURN INJURY MAY OCCUR.** Place a test PCB into the board holder and lower the reflow head to the PCB. Observe the relationship between the nozzle and the test PCB.

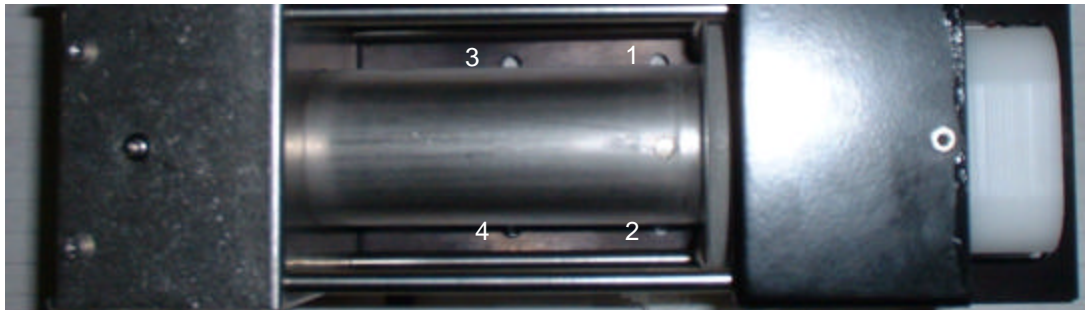


Figure 31: Four Reflow Head Assembly adjustment/replacement screws

**NOTE:** Allow ample time for cooling before handling the reflow head.

### 9-4.1 Y Correction Refer to Figure 31

- 1) If adjustment is required in the “Y” direction (back to front), follow the procedure below.
- 2) Remove the 2 screws on the right and 2 screws on the left side of the reflow head that secure the cover on the reflow head.
- 3) If the front side of the Reflow head is higher than the back side, loosen screws 1 and 2 and tighten screws 3 and 4.
- 4) If the back side of the vacuum nozzle is higher than the front side, loosen screws 3 and 4 and tighten screws 1 and 2.
- 5) Replace the cover.



#### **9-4.2 Skew Correction Refer to Figure 31.**

- 1) If the reflow head is skewed (twisted in relation to the PCB), follow the procedure below.
- 2) Remove the 2 screws on the right and 2 screws on the left side of the reflow head that secure the cover on the reflow head.
- 3) If the reflow head is skewed to the right, loosen screws 1 and 3 and tighten screws 2 and 4.
- 4) If the reflow head is skewed to the left, loosen screws 2 and 4 and tighten screws 1 and 3.
- 5) Replace the cover.

## 10 Specifications

PC	Pentium III, 850 MHz minimum 256 MB Ram 10 GB Hard Drive 8 MB Video Ram High Resolution Video Capture Card 89mm (3.5") Floppy Disk Drive 2 USB Ports 1 Serial Port 1 Parallell Port Keyboard Mouse
Operating System	Windows XP Professional
Video Display	380mm (15") LCD Display
Heaters	
Top Heater:	Convective (air or N2), 1600 Watts
TF 3000 Pre-Heater:	IR, 400 Watts (200 Watts x 2), 220mm x 155mm (8.6" x 6.1")
TF 3000L Pre-Heater:	
Large Area Heater	900 Watts, 305mm x 610 mm (12" x 24")
Localized Heater	IR, 120 Watts, 65mm x 100mm (2.5" x 4")
Component Size:	65mm x 65mm (2.6" x 2.6") maximum
PCB Size:	
TF 3000	460mm x 500mm (18" x 20")
TF 3000L	500mm x 500mm (20" x 24")
Air Flow:	Self-contained, manual adjust, 22 SLPM maximum
N2 Option	Standard
Resolution on Optics Adjustment:	25 $\mu$ meters (0.001")
Positioning Accuracy (Z travel):	$\pm$ 25 $\mu$ meters (0.001")
Vacuum:	-800 mbar
Power Requirements:	115 VAC, 60 Hz or 230 VAC, 50 Hz 2.3 kW maximum (3 kW for L version)
Optics:	High resolution, Vision Overlay System 126 X Magnification
Video inputs:	2 Composite Video (external) 1 "S" Video (Internal for alignment optics)
Temperature Setting Range:	
Top Heater:	50° to 500°C (106° to 932°F)
Pre-Heater:	50° to 220°C (106° to 430°F)
Dimensions:	635m H x 641mm W x 660mm D (25" H x 25.5" W x 26" D )
Weight:	
TF 3000, 115 VAC:	78 kg (170 pounds)
TF 3000E, 230 VAC	85 kg (185 pounds)
TF 3000L, 115 VAC	88 kg (195 pounds)
TF 3000LE, 230 VAC	95 kg (210 pounds)
Board Supports	Included
Optical Alignment Kit	Included

## 11. Accessory Items

### 11-1. Instructions for using the Board Supports

When performing rework on larger PCBs, the use of board supports may be required to keep the PCB level at all times. The PCB Supports can be left in place for all operations. To adjust them, simply loosen or tighten the screws to raise or lower the support pins so they make contact with the underside of the PCB or components on the bottom of the PCB. (See Figure 35)

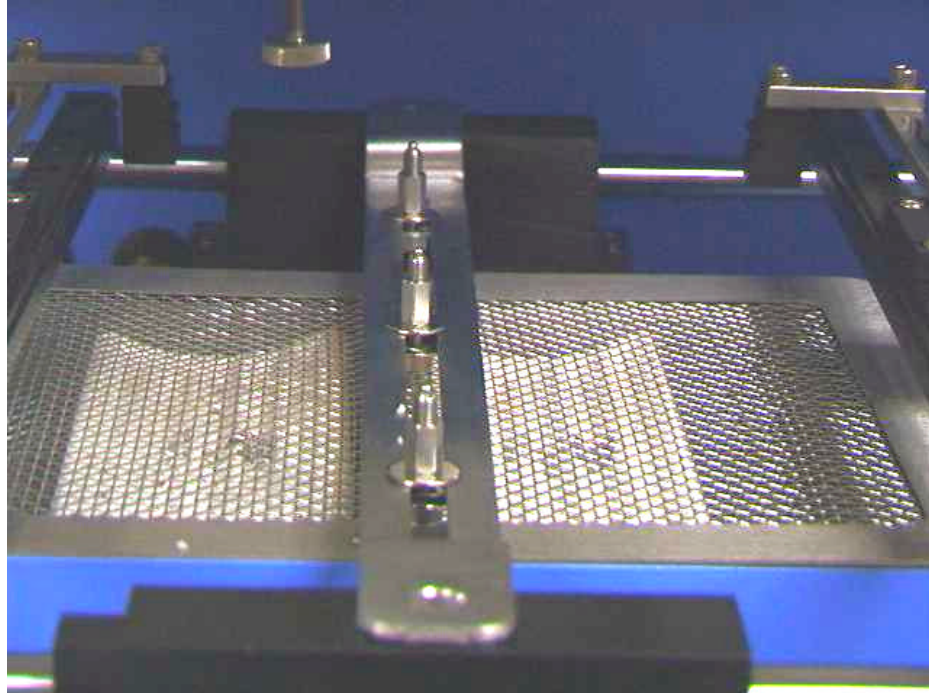


Figure 32: PCB Supports

### 11-2. Instructions for using the Nitrogen/Compressed Air Bi-pass

The TF 3000 is completely self-contained. However, it can also be used with compressed air or compressed Nitrogen. To use the system with Compressed gas, you must provide a clean, dry gas supply to the press fit bulkhead fitting on the left side of the unit (#1, Figure 33). Then turn the key on the locking switch button (#2, Figure 33) to activate. The system will utilize the compressed gas supply instead of the internal blower pump.

**DO NOT ENGAGE THE N<sub>2</sub> SWITCH UNLESS A COMPRESSED GAS SUPPLY IS CONNECTED AND TURNED ON. ENGAGING THE SWITCH WITHOUT THE PROPER GAS SUPPLY MAY CAUSE THE TOP HEATER AND CONTROL SENSOR TO OVERHEAT AND EVENTUALLY FAIL, REQUIRING REPLACEMENT.**

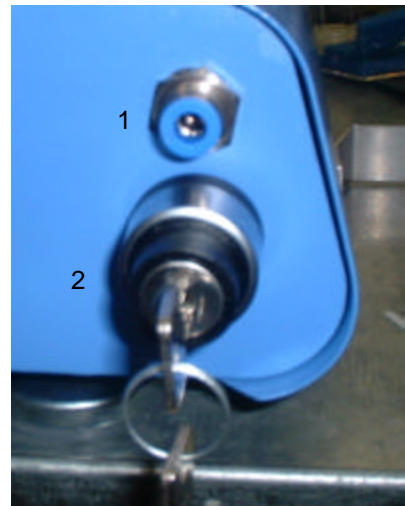


Figure 33: Compressed Gas Panel

### 11-3 Spares and Accessory Items

1121-0841-P 1	Micro Vacuum Nozzle
1159-0271-P5	FUSE
1159-0272-P5	FUSE
1199-0006-P 1	TF3000 Software
1199-0007-P 1	NET OPS Software
1272-0005-P 1	Hand Held Vacuum Pick, TF3000
1321-0694-P 1	Board Support
1321-0695-P 1	Odd Shaped PCB Holder (ea)
1321-0696-P 1	LED Monitor Articulated Arm
1334-0021-P 1	Hand Wand Vacuum Pump
1334-0031-P 1	Gear Motor
1340-0174-P 4	Set of 4 K-Type Thermo-couples
1348-0614-P 1	Main Vacuum Pump
1360-0320-p1	Blower Pump 230 VAC
1360-0368-p1	Blower Pump 120 VAC
3008-0142-P 1	PC Cables Set
4018-0100-P 1	Alignment PCB
6000-0223-P 1	Reflow head Assembly, 120 VAC
6000-0224-P 1	Reflow head Assembly, 230 VAC
6016-0033	HEX KEY SET
6020-0154-P 1	Main PCB
6020-0155-P 1	High Voltage PCB
6993-0202-P 1	Suction Cup, 5 each
6993-0203-P 1	Vacuum Nozzle Kit (4 nozzles)
6993-0218	Flux Applicator Tool
7015-0010-P 1	LCD Monitor

### 11-4 TF 3000 Nozzles

<b>MAXIMUM COMPONENT SIZE</b>	<b>NOZZLE DIMENSIONS</b>	<b>Standard NOZZLE P/N</b>	<b>Optional NOZZLE P/N</b>
5mm x 5mm (0.19" x 0.19")	8mm x 8mm (0.31" x 0.31")	4038-7001	
6mm x 6mm (0.24" x 0.24")	9mm x 9mm (0.35" x 0.35")	4038-7042	
6mm x 8mm (0.24" x 0.31")	9mm x 11mm (0.35" x 0.43")	4038-7002	
7.3mm x 7mm (0.29" x 0.28")	10.3mm x 10mm (0.40" x 0.40")	4038-7040	
8mm x 8mm (0.31" x 0.31")	11mm x 11mm (0.43" x 0.43")	4038-7041	
8.1mm x 8.1mm (0.31" x 0.31")	11.1mm x 11.1mm (0.43" x 0.43")	4038-7055	
8.2mm x 12.7mm (0.32" x 0.50")	11.2mm x 15.7mm (0.44" x 0.62")	4038-7003	
9mm x 9mm (0.35" x 0.35")	12mm x 12mm (0.47" x 0.47")	4038-7004	
10mm x 10mm (0.39" x 0.39")	13mm x 13mm (0.51" x 0.51")	4038-7005	
11.4mm x 5.1mm (0.49" x 0.20")	14.4mm x 8.1mm (0.56" x 0.31")	4038-7050	
13mm x 10mm (0.51" x 0.40")	16mm x 13mm (0.63" x 0.51")	4038-7039	
13mm x 13mm (0.51" x 0.51")	16mm x 16mm (0.63" x 0.63")	4038-7006	
14mm x 22mm (0.55" x 0.87")	17mm x 25mm (0.67" x 0.99")	4038-7021	4038-8021
15mm x 15mm (0.59" x 0.59")	18mm x 18mm (0.71" x 0.71")	4038-7007	4038-8007
15.34mm x 12.7mm (0.60" x 0.50")	18.34mm x 15.7mm (0.72" x 0.61")	4038-7063	
15.6mm x 5.1mm (0.61" x 0.20")	18.6mm x 8.1mm (0.73" x 0.31")	4038-7062	
16.5mm x 8mm (0.65" x 0.31")	19.5mm x 11mm (0.77" x 0.43")	4038-7027	4038-8027
17mm x 11mm (0.67" x 0.43")	20mm x 14mm (0.79" x 0.55")	4038-7052	
17mm x 17mm (0.67" x 0.67")	20mm x 20mm (0.79" x 0.79")	4038-7008	4038-8008
19mm x 19mm (0.75" x 0.75")	22mm x 22mm (0.87" x 0.87")	4038-7026	4038-8026

20mm x 8mm (0.79" x 0.31")	23mm x 11mm (0.90" x 0.43")	4038-7058	
20mm x 20mm (0.79" x 0.79")	23mm x 23mm (0.90" x 0.90")	4038-7061	
21mm x 12.75mm (0.83" x 0.50")	24mm x 15.75mm (0.94" x 0.62")	4038-7060	
21mm x 25mm (0.83" x 0.98")	23mm x 28mm (0.91" x 1.1")	4038-7029	4038-8029
22mm x 22mm (0.86" x 0.86")	25mm x 25mm (0.98" x 0.98")	4038-7057	
23mm x 23mm (0.90" x 0.90")	26mm x 26mm (1.02" x 1.02")	4038-7009	4038-8009
25mm x 25mm (0.98" x 0.98")	28mm x 28mm (1.1" x 1.1")	4038-7025	4038-8025
27mm x 27mm (1.06" x 1.06")	30mm x 30mm (1.18" x 1.18")	4038-7010	4038-8010
28mm x 16mm (1.1" x 0.63")	31mm x 19mm (1.22" x 0.75")	4038-7038	4038-8038
28mm x 28mm (1.1" x 1.1")	31mm x 31mm (1.22" x 1.22")	4038-7048	
28.5mm x 17mm (1.12" x 0.67")	31.5mm x 20mm (1.12" x 0.79")	4038-7059	
29mm x 29mm (1.14" x 1.14")	32mm x 32mm (1.26" x 1.26")	4038-7030	4038-8030
30mm x 30mm (1.18" x 1.18")	33mm x 33mm (1.3" x 1.3")	4038-7044	
31mm x 31mm (1.22" x 1.22")	33mm x 33mm (1.3" x 1.3")	4038-7031	4038-8031
32mm x 17mm (1.26" x 0.67")	35mm x 20mm (1.37" x 0.79")	4038-7053	
32.5mm x 23mm (1.28" x 0.90")	35.5mm x 26mm (1.40" x 1.02")	4038-7051	
32.5mm x 25mm (1.28" x 0.98")	35.5mm x 28mm (1.40" x 1.1")	4038-7056	
33mm x 33mm (1.29" x 1.29")	36mm x 36mm (1.42" x 1.42")	4038-7028	4038-8028
35mm x 35mm (1.37" x 1.37")	38mm x 38mm (1.5" x 1.5")	4038-7011	4038-8011
38.1mm x 25.8mm (1.50" x 1.01")	41.1mm x 28.8mm (1.61" x 1.13")	4038-7066	
40mm x 40mm (1.57" x 1.57")	43mm x 43mm (1.7" x 1.7")	4038-7024	4038-8024
41mm x 41mm (1.61" x 1.61")	43mm x 43mm (1.7" x 1.7")	4038-7047	
42mm x 42mm (1.65" x 1.65")	45mm x 45mm (1.77" x 1.77")	4038-7032	4038-8032
42.5mm x 32.5mm (1.67" x 1.40")	45.5mm x 35.5mm (1.80" x 1.39")	4038-7054	
43mm x 43mm (1.7" x 1.7")	46mm x 46mm (1.81" x 1.81")	4038-7045	
44mm x 33mm (1.73" x 1.29")	47mm x 36mm (1.85" x 1.41")	4038-7064	
44mm x 44mm (1.73" x 1.73")	47mm x 47mm (1.85" x 1.85")	4038-7043	
44.5mm x 44.5mm (1.75" x 1.75")	47.5mm x 47.5mm (1.87" x 1.87")	4038-7012	4038-8012
46mm x 46mm (1.81" x 1.81")	49mm x 49mm (1.93" x 1.93")	4038-7046	
48mm x 48mm (1.89" x 1.89")	51mm x 51mm (2" x 2")	4038-7049	
50mm x 50mm (1.97" x 1.97")	53mm x 53mm (2.1" x 2.1")	4038-7022	
56mm x 17mm (2.2" x 0.67")	59mm x 20mm (2.32" x 0.79")	4038-7037	
60mm x 60mm (2.36" x 2.36")	63mm x 63mm (2.5" x 2.5")	4038-7023	
Connector, 16mm x 13mm (0.63" x .51")	19mm x 16mm (0.75" x 0.63")	4038-7033	4038-8033
Connector, 19mm x 8mm (0.75" x 0.31")	22mm x 11mm (0.87" x 0.43")	4038-7036	4038-8036
Connector, 27mm x 13mm (1.06" x 0.51")	30mm x 16mm (1.18" x 0.63")	4038-7034	4038-8034
Connector, 30mm x 12mm (1.18" x 0.47")	33mm x 15mm (1.3" x 0.59")	4038-7035	4038-8035
LQFP 9mm x 9mm (0.35" x 0.35")	12mm x 12mm (0.47" x 0.47")	4038-7016	
LQFP 12mm x 12mm (0.47" x 0.47")	15mm x 15mm (0.59" x 0.59")	4038-7017	
LQFP 14mm x 14mm (0.55" x 0.55")	17mm x 17mm (0.67" x 0.67")	4038-7020	4038-8020
LQFP 16mm x 16mm (0.63" x 0.63")	19mm x 19mm (0.75" x 0.75")	4038-7014	4038-8014
LQFP 16mm x 22mm (0.63" x 0.87")	19mm x 25mm (0.75" x 0.99")	4038-7019	4038-8019
LQFP 22mm x 22mm (0.87" x 0.87")	25mm x 25mm (0.98" x 0.98")	4038-7013	4038-8013
LQFP 26mm x 26mm (1.02" x 1.02")	29mm x 29mm (1.14" x 1.14")	4038-7018	4038-8018
LQFP 30mm x 30mm (1.18" x 1.18")	33mm x 33mm (1.29" x 1.29")	4038-7015	4038-8015

## 11-5 Component Stenciling Tool Kits and Stencils (Purchased Separately)

Component Stenciling Tool, 35mm x 35mm - 4	7016-0006
Component Stenciling Tool, 35mm x 35mm - 2	7016-0030
Stencil, 35mm x 35mm x 388	1035-0388-P1
Stencil, 35mm x 35mm x 456	1035-0456-P1
Stencil, 35mm x 35mm x 313	1035-0313-P1
Stencil, 35mm x 35mm x 352	1035-0352-P1
Stencil, 35mm x 35mm x 480	1035-0480-P1
Stencil, 35mm x 35mm x 580	1035-0580-P1
Component Stenciling Tool, 27mm x 27mm - 4	7016-0007
Component Stenciling Tool, 27mm x 27mm - 2	7016-0029
Stencil, 27mm x 27mm x 352	1027-0352-P1
Stencil, 27mm x 27mm x 316	1027-0316-P1
Stencil, 27mm x 27mm x 225	1027-0225-P1
Stencil, 27mm x 27mm x 256	1027-0256-P1
Stencil, 27mm x 27mm x 272	1027-0272-P1
Stencil, 27mm x 27mm x 292	1027-0292-P1

Stencil, 27mm x 27mm x 324	1027-0324-P1
Stencil, 27mm x 27mm x 328	1027-0328-P1
Stencil, 27mm x 27mm x 336	1027-0336-P1
Stencil, 27mm x 27mm x 676	1027-0676-P1
Stencil, 27mm x 27mm x 672	1027-0672-P1
Component Stenciling Tool, 23mm x 23mm - 2	7016-0008
Component Stenciling Tool, 23mm x 23mm - 4	7016-0013
Stencil, 23mm x 23mm x 169	1023-0169-P1
Stencil, 23mm x 23mm x 192	1023-0192-P1
Stencil, 23mm x 23mm x 288	1023-0288-P1
Stencil, 23mm x 23mm x 324	1023-0324-P1
Stencil, 23mm x 23mm x 208	1023-0208-P1
Stencil, 23mm x 23mm x 256	1023-0256-P1
Stencil, 23mm x 23mm x 484	1023-0484-P1
Component Stenciling Tool, 17mm x 17mm - 2	7016-0009
Component Stenciling Tool, 17mm x 17mm - 4	7016-0012
Stencil, 17mm x 17mm x 208	1017-0208-P1
Stencil, 17mm x 17mm x 256	1017-0256-P1
Component Stenciling Tool, 15mm x 15mm - 2	7016-0010
Component Stenciling Tool, 15mm x 15mm - 1	7016-0023
Stencil, 15mm x 15mm x 156	1015-0156-P1
Stencil, 15mm x 15mm x 160	1015-0160-P1
Stencil, 15mm x 15mm x 196	1015-0196-P1
Component Stenciling Tool, 13mm x 13mm - 2	7016-0011
Stencil, 13mm x 13mm x 144	1013-0144-P1
Component Stenciling Tool, 13mm x 10mm	7016-0027
Stencil, 13mm x 13mm x 64	1013-0064-P1
Component Stenciling Tool, 12mm x 12mm CSP	7016-0014
Stencil, 12mm x 12mm x 144	1012-0144-P1
Stencil, 12mm x 12mm x 160	1012-0160-P1
Component Stenciling Tool, 11mm x 8mm CSP	7016-0015
Stencil, 11mm x 8mm x 69	1011-0069-P1
Stencil, 11mm x 8mm x 72	1011-0072-P1
Stencil, 11mm x 8mm x 88	1011-0088-P1
Component Stenciling Tool, 40mm x 40mm	7016-0016
Component Stenciling Tool, 40mm x 40mm	7016-0025
Stencil, 40mm x 40mm x 432	1040-0432-P1
Stencil, 40mm x 40mm x 503	1040-0503-P1
Stencil, 40mm x 40mm x 520	1040-0520-P1
Stencil, 40mm x 40mm x 596	1040-0596-P1
Stencil, 40mm x 40mm x 680	1040-0680-P1
Component Stenciling Tool, 25mm x 25mm - 2	7016-0017
Component Stenciling Tool, 25mm x 25mm - 4	7016-0020
Stencil, 25mm x 25mm x 357	1025-0357-P1
Stencil, 25mm x 25mm x 360	1025-0360-P1
Stencil, 25mm x 25mm x 413	1025-0413-P1
Component Stenciling Tool, 19mm x 19mm	7016-0018
Component Stenciling Tool, 19mm x 19mm Socket	7016-0026
Stencil, 19mm x 19mm x 52	1023-0052-P1
Stencil, 19mm x 19mm x 163	1023-0163-P1
Stencil, 19mm x 19mm x 225	1023-0256-P1
Stencil, 19mm x 19mm x 289	1023-0289-P1
Component Stenciling Tool, 16.5mm x 8mm CSP	7016-0019
Stencil, 16.5mm x 8mm x 52	1016-0052-P1
Component Stenciling Tool, 33mm x 33mm - 4	7016-0021
Stencil, 33mm x 33mm x 503	1033-0503-P1
Component Stenciling Tool, 22mm x 14mm	7016-0022
Stencil, 14mm x 22mm x 119	1014-0119-P1
Component Stenciling Tool, 4mm x 4mm LCC w/ Pedestal Top	7016-0024
Stencil, 4mm x 4mm x 16	1004-0016-P1
Stencil, 4mm x 4mm x 20	1004-0020-P1
Stencil, 4mm x 4mm x 24	1004-0024-P1
Stencil, 4mm x 4mm x 28	1004-0028-P1
Component Stenciling Tool, 31mm x 31mm - 2	7016-0028

Component Stenciling Tool, 31mm x 31mm - 4	7016-0032
Stencil, 31mm x 31mm x 304	1031-0304-P1
Stencil, 31mm x 31mm x 316	1031-0316-P1
Stencil, 31mm x 31mm x 329	1031-0329-P1
Component Stenciling Tool, 8mm x 10mm	7016-0031
Stencil, 8mm x 10mm x 48	1008-0048-P1
Component Stenciling Tool, PLCC 28	7016-0033
Stencil, PLCC 28	1012-0028
Component Stenciling Tool, 9mm x 9mm	7016-0034
Stencil, 9mm x 9mm x 56	1009-0056-P1
Stencil, 9mm x 9mm x 64	1009-0064-P1
Component Stenciling Tool, 24mm x 24mm - 4	7016-0035
Stencil, 24mm x 24mm x 241	1024-0241-P1
Component Stenciling Tool, 6mm x 6mm	7016-0036
Stencil, 6mm x 6mm x 40	1006-0040-P1
Component Stenciling Tool, 7mm x 7mm	7016-0038
Stencil, 7mm x 7mm x 32	1007-0032-P1
Stencil, 7mm x 7mm x 48	1007-0048-P1
Stencil, 7mm x 7mm x 49	1007-0049-P1
Stencil, 7mm x 7mm x 113	1007-0113-P1
Component Stenciling Tool, 45mm x 45mm	7016-0037
Stencil, 45mm x 45mm x 600	1045-0600-P1
Stencil, 45mm x 45mm x 731	1045-0731-P1
Component Stenciling Tool, 11.4mm x 5.1mm	7016-0039
Stencil, 11.4mm x 5.1mm x 22	1011-0022-P1
Component Stenciling Tool, 16mm x 16mm	7016-0040
Stencil, 16mm x 16mm x 209	1016-0209-P1
Component Stenciling Tool, 42.5mm x 32.5mm	7016-0041
Stencil, 42.5mm x 32.5mm x 824	1042-0824-P1
Component Stenciling Tool, 32.5mm x 25mm	7016-0042
Stencil, 32.5mm x 25mm x 474	1032-0474-P1
Component Stenciling Tool, 5mm x 4mm	7016-0043-P1
Stencil, 5mm x 4mm x 24	1005-0024-P1
Component Stenciling Tool, 32.5mm x 32.5mm – 4	7016-0044
Stencil, 32.5mm x 32.5mm x 624	1032-0624-P1
Stencil, 32.5mm x 32.5mm x 937	1032-0937-P1
Component Stenciling Tool, 8mm x 8mm	7016-0045
Stencil, 8mm x 8mm x 64	1008-0064-P1
Component Stenciling Tool, 37.5mm x 37.5mm	7016-0046
Component Stenciling Tool, 15mm x 13mm	7016-0049
Stencil, 15mm x 13mm x 165	1015-0165-P1
Component Stenciling Tool, 5mm x 5mm	7016-0050
Stencil, 5mm x 5mm x 32	1005-0032-P1
Component Stenciling Tool, 15mm x 15mm	7016-0051
Stencil, 15mm x 15mm x 148	1015-0148-P1
Component Stenciling Tool, 6mm x 5mm	7016-0052
Stencil, 6mm x 5mm x 32	1006-0032-P1
Component Stenciling Tool, 10mm x 10mm	7016-0053
Stencil, 10mm x 10mm x 64LCC	1010-0064-P1
Stencil, 10mm x 10mm x 128	1010-0128-P1
Stencil, 10mm x 10mm x 151	1010-0151-P1
Component Stenciling Tool, 21mm x 21mm	7016-0055
Stencil, 21mm x 21mm x 156	1021-0156-P1
Component Stenciling Tool, 14mm x 8mm	7016-0056
Stencil, 14mm x 8mm x 63	1014-0063-P1
Component Stenciling Tool, 16mm x 8mm	7016-0057
Stencil, 16mm x 8mm x 60	1016-0060-P1
Component Stenciling Tool, 42.5mm x 42.5mm	7016-0058
Stencil, 42.5mm x 42.5mm x 560	1042-0560-P1

## 11-6 Component Reballing Kits

Kit, Reballer BGA 36	4017-0001-P1
Kit, Reballer BGA 40	4017-0002-P1
Kit, Reballer FPBGA 44	4017-0003-P1
Kit, Reballer UBGA 46-33MB	4017-0004-P1
Kit, Reballer UBGA 46-16MB	4017-0005-P1
Kit, Reballer BGA 48	4017-0008-P1
Kit, Reballer UBGA 62	4017-0009-P1
Kit, Reballer FPBGA 64	4017-0010-P1
Kit, Reballer FPBGA 69	4017-0011-P1
Kit, Reballer BGA 69	4017-0012-P1
Kit, Reballer FPBGA 72	4017-0013-P1
Kit, Reballer LFPBGA 84	4017-0014-P1
Kit, Reballer BGA 100	4017-0015-P1
Kit, Reballer BGA 108	4017-0016-P1
Kit, Reballer BGA 119	4017-0017-P1
Kit, Reballer BGA 131	4017-0018-P1
Kit, Reballer BGA 144	4017-0019-P1
Kit, Reballer UBGA 144	4017-0021-P1
Kit, Reballer BGA 168	4017-0022-P1
Kit, Reballer BGA 169	4017-0023-P1
Kit, Reballer BGA 180	4017-0024-P1
Kit, Reballer TBGA 192	4017-0025-P1
Kit, Reballer BGA 192	4017-0026-P1
Kit, Reballer CBGA 196	4017-0027-P1
Kit, Reballer UBGA 196	4017-0028-P1
Kit, Reballer BGA 208	4017-0029-P1
Kit, Reballer BGA 216	4017-0030-P1
Kit, Reballer BGA 217	4017-0031-P1
Kit, Reballer BGA 225	4017-0033-P1
Kit, Reballer BGA 255	4017-0034-P1
Kit, Reballer SBGA 256	4017-0035-P1
Kit, Reballer TBGA 256	4017-0036-P1
Kit, Reballer CBGA 256	4017-0037-P1
Kit, Reballer UBGA 256	4017-0038-P1
Kit, Reballer BGA 256	4017-0039-P1
Kit, Reballer BGA 257	4017-0040-P1
Kit, Reballer PBGA 272	4017-0041-P1
Kit, Reballer BGA 272	4017-0042-P1
Kit, Reballer BGA 292	4017-0043-P1
Kit, Reballer BGA 304	4017-0044-P1
Kit, Reballer BGA 313	4017-0046-P1
Kit, Reballer BGA 320	4017-0047-P1
Kit, Reballer TFBGA 324	4017-0048-P1
Kit, Reballer BGA 325	4017-0049-P1
Kit, Reballer BGA 348	4017-0050-P1
Kit, Reballer BGA 352	4017-0051-P1
Kit, Reballer SPBGA 352	4017-0052-P1
Kit, Reballer SBGA 352	4017-0053-P1
Kit, Reballer TBGA 352	4017-0054-P1
Kit, Reballer BGA 356	4017-0055-P1
Kit, Reballer PBGA 357	4017-0056-P1
Kit, Reballer CBGA 360	4017-0058-P1
Kit, Reballer BGA 388	4017-0059-P1
Kit, Reballer BGA 400	4017-0060-P1
Kit, Reballer BGA 404	4017-0061-P1
Kit, Reballer BGA 421	4017-0062-P1
Kit, Reballer BGA 428	4017-0063-P1
Kit, Reballer PBGA 432	4017-0064-P1
Kit, Reballer BGA 452	4017-0066-P1
Kit, Reballer BGA 456	4017-0067-P1
Kit, Reballer TBGA 480	4017-0068-P1
Kit, Reballer BGA 480	4017-0069-P1



Kit, Reballer BGA 492	4017-0070-P1
Kit, Reballer TBGA 500	4017-0071-P1
Kit, Reballer BGA 548	4017-0072-P1
Kit, Reballer BGA 553	4017-0073-P1
Kit, Reballer BGA 560	4017-0074-P1
Kit, Reballer SBGA 560	4017-0075-P1
Kit, Reballer BGA 564	4017-0076-P1
Kit, Reballer CBGA 575	4017-0077-P1
Kit, Reballer PBGA 600	4017-0078-P1
Kit, Reballer SBGA 600	4017-0079-P1
Kit, Reballer TBGA 696	4017-0080-P1
Kit, Reballer BGA 100	4017-0081-P1
Kit, Reballer LFBGA 100	4017-0082-P1
Kit, Reballer TFBGA 48	4017-0083-P1
Kit, Reballer BGA 233	4017-0084-P1
Kit, Reballer TFBGA 64	4017-0085-P1
Kit, Reballer BGA 177	4017-0086-P1
Kit, Reballer BGA 169/2	4017-0087-P1
Kit, Reballer LFBGA 80	4017-0088-P1
Kit, Reballer TFBGA 48	4017-0089-P1
Kit, Reballer TFBGA 64	4017-0090-P1
Kit, Reballer LFBGA 64	4017-0091-P1
Kit, Reballer LFBGA 144	4017-0092-P1
Kit, Reballer LFBGA 132	4017-0093-P1
Kit, Reballer TFBGA 168	4017-0094-P1
Kit, Reballer TFBGA 100	4017-0095-P1
Kit, Reballer LFBGA 120	4017-0096-P1
Kit, Reballer TFBGA 320	4017-0097-P1
Kit, Reballer BGA 241	4017-0098-P1
Kit, Reballer BGA 113	4017-0099-P1
Kit, Reballer BGA 153	4017-0100-P1
Kit, Reballer SBGA 652	4017-0101-P1
Solder Spheres, 25,000 spheres, .020 diameter	6993-0231-P1
Solder Spheres, 10,000 spheres, .025 diameter	6993-0232-P1
Solder Spheres, 10,000 spheres, .030 diameter	6993-0233-P1

**12. Service & Warranty**

Please contact PACE or your local distributor for service and repair.

**LIMITED WARRANTY**

Seller warrants to the first user that products manufactured by it and supplied hereunder are free of defects in materials and workmanship for a period of three (3) years from the date of receipt by such user. Blowers and motor pumps (which wear out during normal use) are warranted for a period of one (1) year.

This warranty does not cover wear and tear under normal use, repair or replacement required as a result of misuse, improper application, mishandling or improper storage. Consumable items such as tips, heaters, filters, etc. which wear out under normal use are excluded. Failure to perform recommended routine maintenance, alterations or repairs made other than in accordance with Seller's directions, or removal or alteration of identification plates in any way will void this warranty. This warranty is available only to the first user, but the exclusions and limitations herein apply to all persons and entities.

SELLER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Seller will, at its option, repair or replace any defective products at its facility or other location approved by it at no charge to user, or provide parts without charge for installation by the user in the field at user's expense and risk. User will be responsible for all costs of shipping equipment to Seller or other location for warranty service.

EXCEPT FOR THE REMEDY ABOVE DESCRIBED, UNLESS OTHERWISE REQUIRED BY APPLICABLE LAW, SELLER WILL HAVE NO OTHER OBLIGATION WITH REGARD TO ANY BREACH OF WARRANTY OR OTHER CLAIM WITH RESPECT TO THE PRODUCTS, OR LIABILITY FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, OR INCIDENTAL LOSS OR DAMAGE CAUSED BY OR OCCURRING IN CONNECTION WITH ANY OF THE PRODUCTS.

Warranty service may be obtained by contacting the appropriate PACE Company or local Authorized PACE distributor as set forth below to determine if return of any item is required, or if repairs can be made by the user in the field.

Defective products may not be returned to PACE without a Service Authorization ("SA") Number.

Any warranty or other claim with respect to the products must be made in writing delivered to PACE (or local Authorized PACE distributor for Buyers outside the USA and the United Kingdom) within a reasonable time of the expiration date of this warranty with sufficient evidence of purchase and date of receipt, otherwise user's rights under this warranty shall be deemed waived.

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