



**TF-1800  
&  
TF-2800**

**BGA Rework Station**

**MANUAL NO. 5050-0588  
Revised 2/27/2023, for software version 2.03**

## **TABLE OF CONTENTS**

Safety .....	1
Specifications.....	1
Packing Lists.....	2
Hardware Overview and Identification .....	4
Set up .....	5
Software Overview .....	6
The Profiler Screen (Production Mode) .....	6
The Profiler Screen (Developer Mode) .....	8
The Component Alignment Screen .....	10
The Setup Screen .....	12
The Debug Screen.....	14
Operation .....	16
General Overview .....	16
Procedure .....	17
Production Mode .....	17
Developer Mode .....	18
Small Components.....	20
Maintenance.....	21
Replacement & Spare Parts .....	22
Warranty .....	23

<b>WARNING</b>
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Read the safety & setup information sections in this manual before installing and using your new rework system.
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## Safety

1. Do not touch heaters or heater accessories during operation.
2. After powering down the system, be sure to let everything cool off before touching.
3. Make sure there is adequate ventilation or use fume extraction equipment.
4. Do not operate near combustible vapors.
5. Do not leave the equipment unattended while it is on.
6. Do not open the rear access door without first disconnecting the main power cable.

## Specifications

Top Heater	300 Watt Inductive-Convection Heater with a temp. range of 100°-328°C (212°-624°F), and max. airflow 20 SLPM
Vacuum	Approx. 25 in/Hg at vacuum pick; 4 in/Hg at accessory port
Optics	1080p color camera with a dichroic image splitting prism
Positioning Accuracy (Z travel)	Precision stepper motor with .0011" (28µm) accuracy
Video	Up to 240x zoom, Quad-Field imaging and image capture.
Component Nest	Maximum: 65x65mm (2.5" sq) Minimum: 1mm square

Part number	TF-1800	8007-0574 for 120V, 50/60hz, dedicated 20-amp supply required (1600-watt max.)
		8007-0575 for 230v, 50hz, dedicated 10-amp supply required (1600-watt max.)
Size	TF-1800	737mm (29") <b>H</b> x 686mm (27") <b>W</b> x 737mm (29") <b>D</b>
Weight	TF-1800	45kg (100lbs)
Preheater	TF-1800	1000 Watt Medium/Long wave infrared with a temp. range of 100°-221°C (212°-430°F). 1.5" of height adjustment.
PC Board Size	TF-1800	Maximum 12" x 12"; No minimum

Part number	TF-2800	8007-0582 for 120V, 50/60hz, dedicated 20-amp supply required (2200-watt max.)
		8007-0583 for 230V, 50hz, dedicated 10-amp supply required (2200-watt max.)
Size	TF-2800	737mm (29") <b>H</b> x 1188mm (44") <b>W</b> x 965mm (38") <b>D</b>
Weight	TF-2800	90kg (200lbs)
Preheater	TF-2800	1900-Watt total Medium/Long wave IR with a temp. range of 100°-221°C (212°-430°F) for center element and 100°-150°C (212°-302°F) for auxiliary elements around edge. 1.5" of height adjustment.
PC Board Size	TF-2800	Maximum 24" x 24"; No minimum

## Packing Lists

**8007-0574 TF 1800, 120 VAC**

**8007-0575 TF 1800, 230 VAC**

Part Id	Description	Qty	UM
1107-0037	PC MONITOR, 24" Widescreen, LCD	1	EA
1107-0041	Keyboard, Computer, Wireless	1	EA
1274-0059‡	Silicone Rubber Cord, 1/2" dia. (reusable cushion)	1.4	IN
1332-0134*	POWER CORD, DOM DETACHED	1	EA
1332-0093†	POWER CORD,DETACHABLE,230V	2	EA
1332-0280†	Power Cord, Type G, to C13, 230V, Fused	2	EA
1332-0287†	AC Adapter, Type G to Type A/B (US)	1	EA
1332-0288†	AC Adapter, Type E/F to Type A/B (US)	1	EA
3008-0383	Cable, HDMI to HDMI, Male to Male, 1M	1	EA
5005-0164‡	BANDING, CUT-TO-LENGTH, 1/2" WIDE, BLACK	86	IN
5005-0165‡	BUCKLE, REUSABLE, 1/2" BAND WIDTH, BLACK	1	EA
5005-0170‡	SHIPPING CRATE, TF1800/IR3100	1	EA
6020-0257	COMPUTER, INTEL NUC613SYH loaded build	1	EA
6993-0306	IR/TF Monitor Arm Kit	1	EA
7008-0324*	TF1800 machine, 120v	1	EA
7008-0325†	TF1800 machine, 230v	1	EA
7950-0158	TF1800 PACKOUT	1	EA
Part Id	Description	Qty	UM
1001-0001	STENCIL,COMPONENTS,LEADS	1	EA
1100-0100	PACE MousePad, 9-2014	1	EA
1100-0231	TOOL,NOZZLE/CHIP ASSY	1	EA
1100-0303	NOZZLE CHANGE PAD	1	EA
1132-0070	TOOL, 3/32" BALL_END SCREWDRIVER	1	EA
1132-0071	TOOL, 5/64" BALL END SCREWDRIVER	1	EA
1134-0093	ADAPTER, USB C MALE TO USB3 FEMALE	1	EA
1340-0174	K-TYPE THERMOCOUPLE 40 GA	4	EA
3008-0295	Cable, USB-A / USB-B, Male, 6'	1	EA
3008-0931	CABLE,1M,USB3.0,TYPE A MALE,TYPE B MALE	1	EA
4018-0100-P1	OPTICAL ALIGNMENT	1	EA
6000-0245	FLUX TRAY ASSEMBLY	1	EA
6000-0247	STENCIL PLATFORM ASSY.	1	EA
6000-0448	CENTERING CLAMP ASSY	1	EA
6000-0453-P4	ODD-SHAPED BOARD HOLDER KIT	1	EA
6000-0473-P4	HEAVY DUTY ODD-SHAPED BOARD HOLDER KIT	1	EA
6016-0033	SET, HEX KEY TF1700/2700	1	EA
6993-0276	KIT, TF VACUUM PICK 7 SIZES	1	EA
6993-0313	JAWS KIT, SQUARE COMPONENT	1	EA
6993-0314	JAWS KIT, RECTANGULAR COMPONENT	1	EA
7027-0001-M	HANDPIECE, PV-65, PIK-VAC	1	EA

\* Only included with 120V units (8007-0574)

† Only included with 230V units (8007-0575)

‡ Do not discard, save for future transport needs.

**8007-0582**  
**8007-0583**

**TF 2800, 120 VAC**  
**TF 2800, 230 VAC**

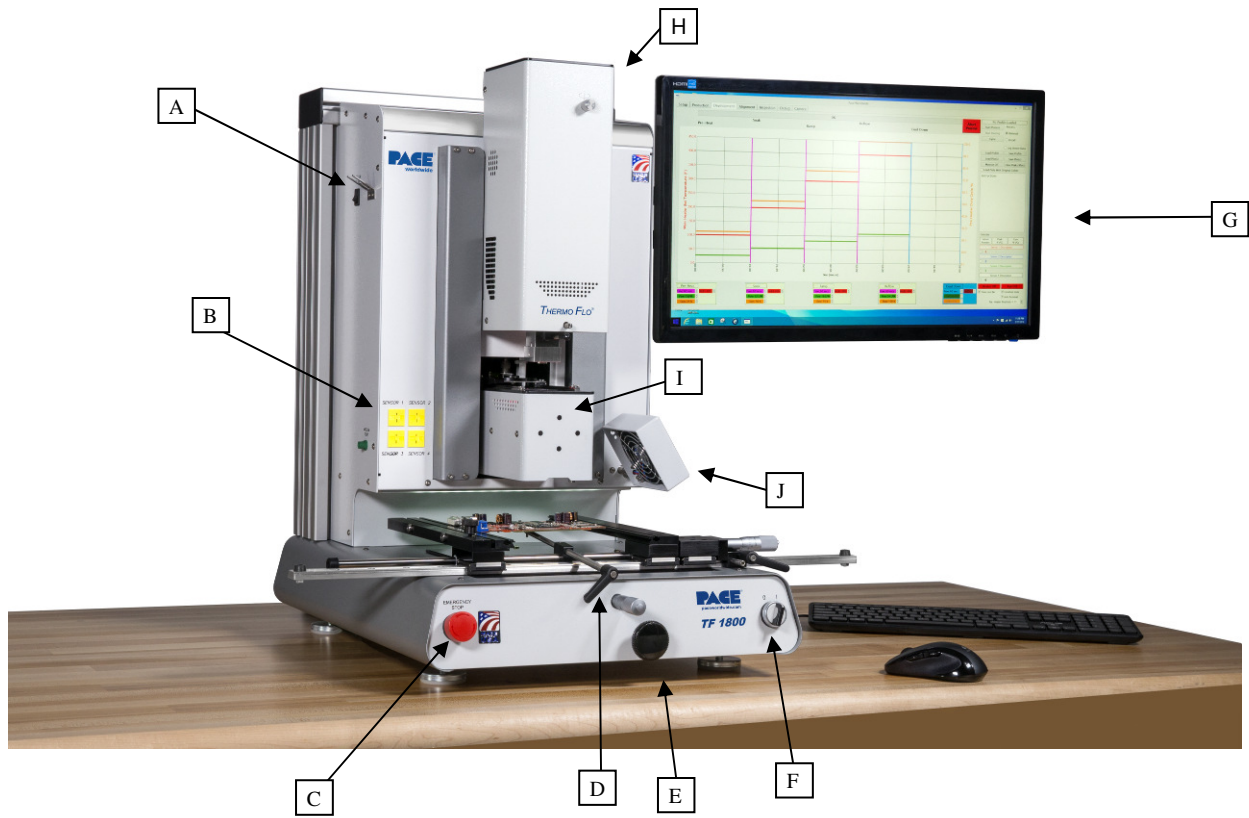
Part Id	Description	Qty	UM
1107-0037	PC MONITOR, 24" Widescreen, LCD	1	EA
1107-0041	Keyboard, Computer, Wireless	1	EA
1274-0059‡	Silicone Rubber Cord, 1/2" dia. (reusable cushion)	1	IN
1332-0134*	POWER CORD, DOM DETACHED	1	EA
1332-0093†	POWER CORD,DETACHABLE,230V	2	EA
1332-0280†	Power Cord, Type G, to C13, 230V, Fused	2	EA
1332-0287†	AC Adapter, Type G to Type A/B (US)	1	EA
1332-0288†	AC Adapter, Type E/F to Type A/B (US)	1	EA
3008-0383	Cable, HDMI to HDMI, Male to Male, 1M	1	EA
5005-0169‡	SHIPPING CRATE, TF2800	1	EA
5005-0173‡	HOOK & LOOP STRAPPING, 1-PC, 3/4" WIDE, BLK	91	IN
6020-0257	COMPUTER, INTEL NUC613SYH loaded build	1	EA
6993-0306	IR/TF Monitor Arm Kit	1	EA
7008-0328*	TF2800 machine, 120V	1	EA
7008-0329†	TF2800 machine, 230V	1	EA
7950-0159	TF2800 PACKOUT	1	EA
Part Id	Description	Qty	UM
1001-0001	STENCIL,COMPONENTS,LEADS	1	EA
1100-0100	PACE MousePad, 9-2014	1	EA
1100-0231	TOOL,NOZZLE/CHIP ASSY	1	EA
1100-0303	NOZZLE CHANGE PAD	1	EA
1132-0070	TOOL, 3/32" BALL_END SCREWDRIVER	1	EA
1132-0071	TOOL, 5/64" BALL END SCREWDRIVER	1	EA
1134-0093	ADAPTER, USB C MALE TO USB3 FEMALE	1	EA
1340-0174	K-TYPE THERMOCOUPLE 40 GA	4	EA
1348-0700-01	LEG,BOARD HOLDER,KIT 5.25LG	1	EA
1405-1047	SCR,SKT,8-32X2.25,SSNAHS	4	EA
3008-0295	Cable, USB-A / USB-B, Male, 6'	1	EA
3008-0931	CABLE,1M,USB3.0,TYPE A MALE,TYPE B MALE	1	EA
4018-0100-P1	OPTICAL ALIGNMENT	1	EA
6000-0245	FLUX TRAY ASSEMBLY	1	EA
6000-0247	STENCIL PLATFORM ASSY.	1	EA
6000-0448	CENTERING CLAMP ASSY	1	EA
6000-0453-P4	ODD-SHAPED BOARD HOLDER KIT	1	EA
6000-0463	PCB ANTI-SAG SUPPORT MECHANISM, TF2800	1	EA
6000-0473-P4	HEAVY DUTY ODD-SHAPED BOARD HOLDER KIT	1	EA
6016-0033	SET, HEX KEY TF1700/2700	1	EA
6993-0196	KIT, VACUUM CUP	1	EA
6993-0276	KIT, TF VACUUM PICK 7 SIZES	1	EA
6993-0313	JAWS KIT, SQUARE COMPONENT	1	EA
6993-0314	JAWS KIT, RECTANGULAR COMPONENT	1	EA
7027-0001-M	HANDPIECE, PV-65, PIK-VAC	1	EA

\* Only included with 120V units (8007-0582)

† Only included with 230V units (8007-0583)

‡ Do not discard, save for future transport needs.

## Hardware Overview and Identification



- A) Pik-Vac switch and mount – The switch will activate the vacuum pump for 15 minutes so that components can be handled manually with the included PV-65 Pik-Vac tool.
- B) Thermocouple Inputs – Up to 4 K-type thermo-couples can be used to measure temperatures. Temperature readings are displayed in real time via the TF software.
- C) Emergency Stop – This button can be used to cut power to the machine immediately in case of an emergency.
- D) Board Holder with Board Support Wand – Fine adjustment of the board holder can be made in the X and Y directions by using the micrometer knob on the front of the unit and right side of the holder itself. The board holder also has a support bar to help prevent sag of large/heavy boards.
- E) Bottom Heater Height Adjustment – Used to bring the bottom heater closer to the workpiece for faster heating.
- F) On/Off switch – Used to turn the machine on or off. Always turn the machine on before opening the software and allow the software to close before turning off the unit.
- G) LCD Monitor – Displays software package from PC (not shown).
- H) Reflow Head – Contains inductive-convection heater for fast and efficient top heating of components. The entire head moves up and down via an electric stepper motor that is controlled through the software.
- I) Optics Housing – Contains the High-Def (1080p) Optical Alignment System (Camera, Prism and lighting.) The optics housing extends and retracts automatically as needed during the process.
- J) Cooling Fan – The component and PCB are cooled by the cooling fan, which is activated automatically during the cool down zone or operated manually as needed.

## Set up

### 1. Connections –

- a. The TF-x800 series machines use a self-contained air pump, therefore shop air is not required. If desired, an external pressurized Nitrogen source can be used instead.
- b. Place the PC next to the machine and connect the provided USB/HDMI cables.
- c. Assemble the monitor arm kit onto the right side of the TF machine, then attach monitor and connect to PC.
- d. Set out wireless keyboard and mouse, make sure they are turned on and the wireless receiver has been plugged into the PC.
- e. Plug in the power cords for the PC, Monitor, and the TF unit.

### 2. Accessories –

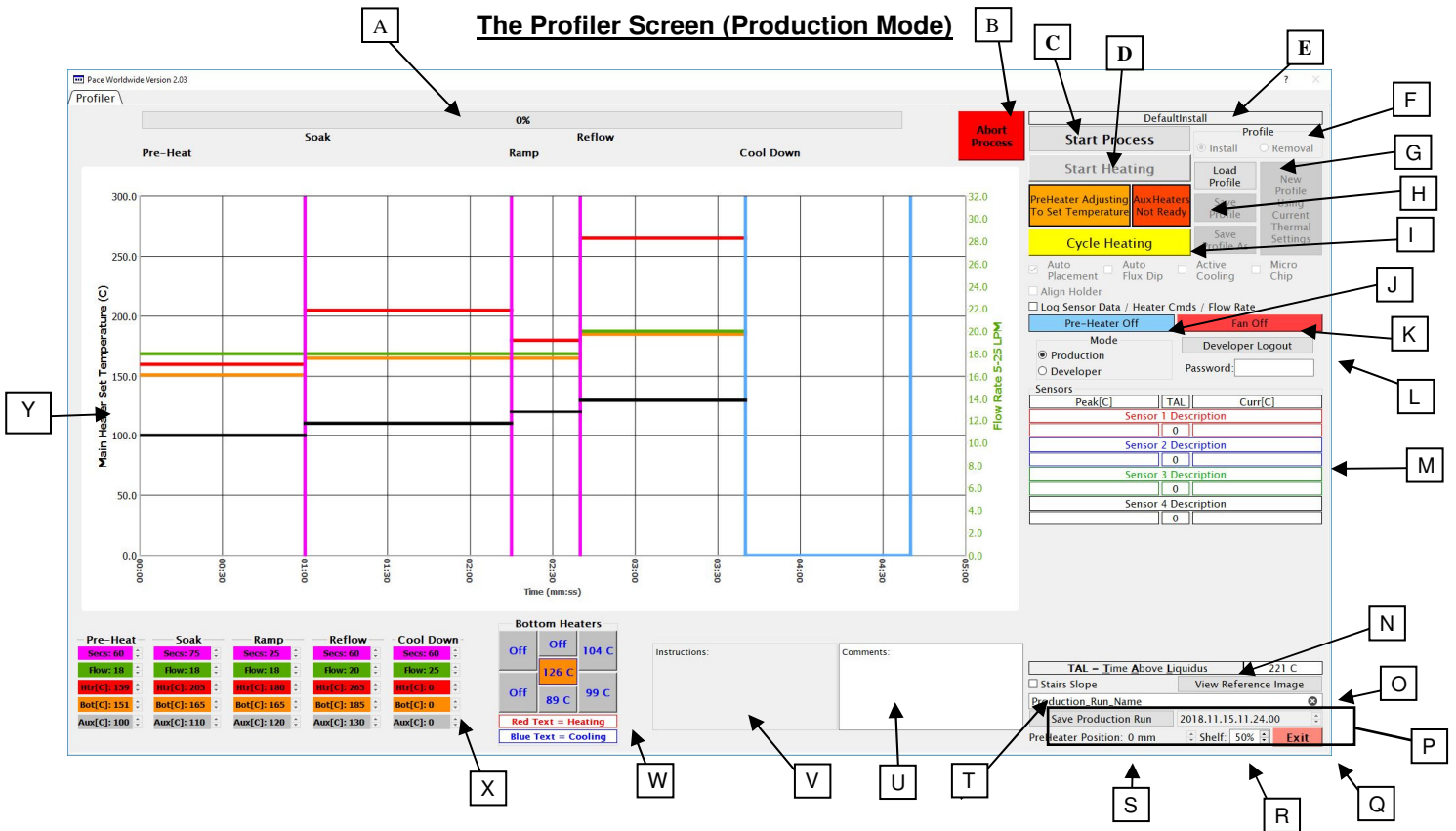
- a. Insert a vacuum pick-
  - i. Select the smallest vacuum pick that can lift the component. If the component cannot be reliably picked up, move to a larger vacuum pick but keep in mind this may slow down heating of the component in relation to the surrounding area.
  - ii. The vacuum pick will thread into the shaft in the middle of the large circular opening on the bottom of the heater head assembly. Never use tools to tighten the vacuum pick as doing so can damage the threads or bend the pick.
- b. Insert an appropriate nozzle-
  - i. Ideally, the inside of the chosen nozzle should be about 3 mm larger than the component being worked with to allow for proper air flow. A smaller nozzle can be used if neighboring components are too close, or the heater head can be positioned higher above the surface during reflow. Both options will change the performance and efficiency of the unit.
  - ii. The nozzle will attach to the ball detents in the underside of the heater head in the large square opening surrounding the vacuum pick.

### 3. Power on –

- a. Make sure everything is connected to an appropriate power source.
  - i. The 120V TF-x800 requires a dedicated 20amp circuit.
  - ii. The 230V TF-x800 requires a dedicated 10amp circuit.
- b. Turn on circuit breaker on back of the TF machine.
- c. Turn on PC and monitor.
- d. Turn on the switch at the front of the machine.
- e. Once PC has finished booting up and the TF machine is running, double-click on the TF-1800 software icon.

# Software Overview

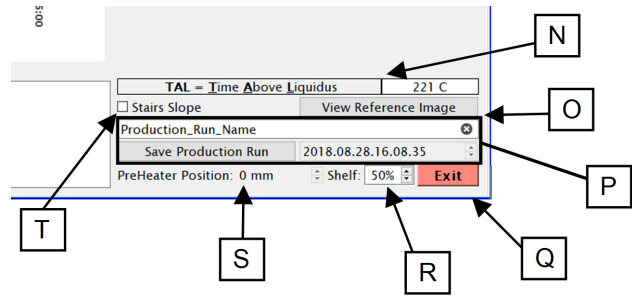
## The Profiler Screen (Production Mode)



- A) Progress Bar – A Visual reference indicating progress status of the process.
- B) Abort Button – Used to abort current process.
- C) Start Process – Used to begin the removal or installation process from the home position.
- D) Start Heating – Click this button to initiate heating by the primary heater as directed by the selected profile.
- E) Profile Name – Displays the name for the active profile.
- F) Profile type – Indicates if the loaded profile is an install or removal.
- G) Load Profile – Click here to select an existing profile.
- H) Preheater Indicators – Reference showing if the main and/or auxiliary pre-heater is at an acceptable temperature for starting the currently loaded profile.
- I) Cycle Heating – This button will move the heater head down into position over the board assembly and run the thermal profile, skipping all set-up and alignment steps. For use when manually placing components.
- J) Preheater Temperature – Shows the current temperature of the main pre-heater.
- K) Cooling Fan – Turns the external cooling fan on or off. (Fan runs automatically during the cool down portion of the thermal profile.)
- L) Developer Login – Used to enter “Developer Mode” for profile creation and editing.



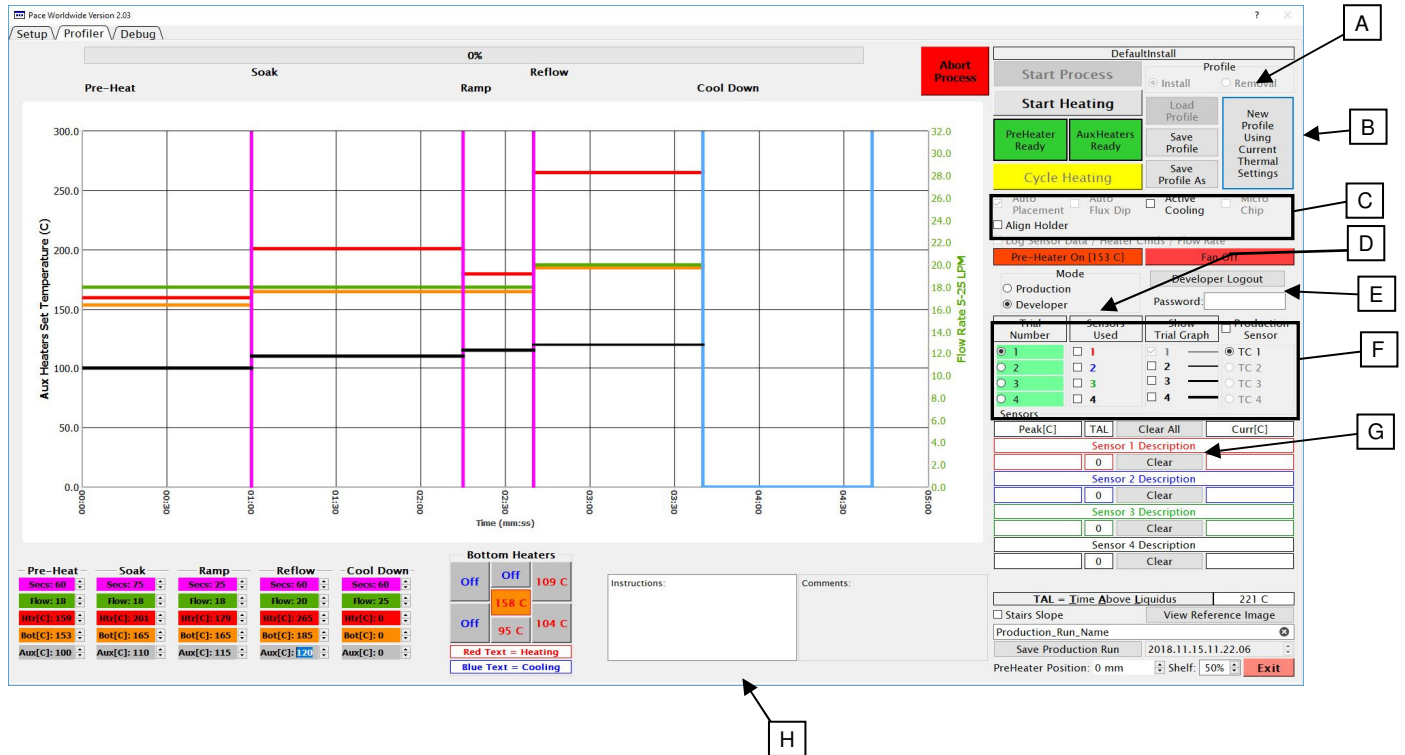
- M) Sensors – The current and peak temperatures for any attached K-type thermocouples will be shown in real time during a profile run. Also displays how long the thermocouple has spent above the temperature for the solder being used to be completely liquid.
- N) Time Above Liquidus – Reference to the liquidus temperature set in the current thermal profile.
- O) View Reference Image – Used to view the reference image associated to the current profile, if one was added during development.
- P) Save Production Run – For saving temperature graphs and other information from a production run in a .PDF for later reference. If “Log Sensor Data” is checked, saving the production run will also create a time-tagged CSV file including information thermocouple data and heater commands. The file will be named with text input to the block shown here as “Production\_Run\_Name” and a time stamp.
- Q) Exit – Exits the TF software.
- R) Shelf – Used to change brightness of the under-shelf lighting illuminating the back of the board holder.
- S) Preheater Position – Indicates what height to set the preheater for the currently loaded profile.
- T) Stairs Slope – Controls the temperature slope measurement in the profile graph. Selecting two points on the same temperature curve will display the temperature over time (or slope) for that portion of the curve. When Stairs Slope is checked, selecting a point outside of an existing slope measurement will create a new measurement from the nearest end of the existing slope. When Stairs Slope is not engaged, selecting a point outside of an existing slope will lengthen the slope measurement to that point of the temperature curve.
- U) Comments – This block can be used by the operator to enter information about the production run to the file created by the Save Production Run feature.
- V) Instructions – This block will display any information left by the developer for the currently loaded profile.
- W) Bottom Heaters – The icons here are used to turn on/off the different sections of the preheater for the TF-2800. The TF-1800 uses a single unified pre-heater and does not have auxiliary heaters. When any of the auxiliary heaters for the TF-2800 are turned on, a new entry is added to each phase of the profile the as well as to the profile graph.



- X) Phase Indicators – These colored blocks show the numerical values of the different variables for each profile phase and correspond to the colored lines on the Profile Graph.
  - Magenta – Time
  - Green – Air flow
  - Red – Top heater
  - Orange – Bottom heater
  - Grey – Auxiliary bottom heaters (if turned on.)
- Y) The Profile Graph – This chart will display real-time information about the temperature profile.

## The Profiler Screen (Developer Mode)

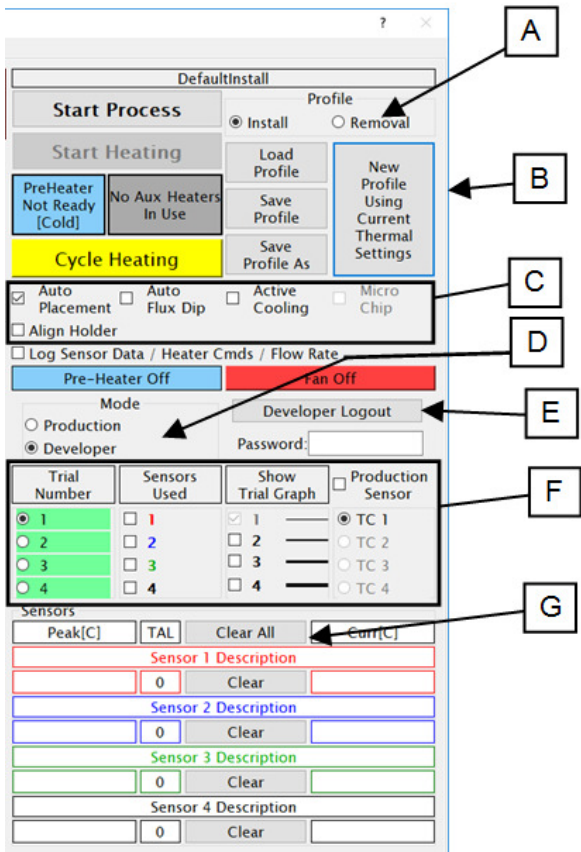
The developer mode contains all of the options from the production mode with a few key additions and changes.



- A) Install/Removal – Select to create either an Installation or Removal profile.
  
- B) Profile Buttons
  - I. Load Profile – Same as the production mode, it will load a previously saved profile.
  - II. Save Profile – Click to save the current profile.
  - III. Save Profile As – Click to rename profile.
  - IV. New Profile – Used to create a brand-new profile. Saves existing thermal, time and flow settings on screen, but clears all heater head and camera distance settings used during automatic operations.
  
- C) Automation Options – The TF-1800 has the capability to remember heater head position to automate different steps in the installation or removal processes.
  - I. Auto Placement – When checked, the TF-1800 will automatically place the component using distance settings input during the first profile development run. If unchecked the heater head and component will have to be manually controlled for each placement.
  - II. Auto Flux Dip – When checked the software will insert a step for an automated flux dip process using the position settings stored by the profile.
  - III. Active Cooling – Allows for an increased yet controlled cooling of the part by using the main blower inside the heater head. If unchecked, the heater head will rise after the Reflow Phase to allow the component to air cool or use the cooling fan.

- IV. Align Holder – Checking this box will add a step in the process which guides the user through alignment of the vacuum pick and centering nest for working with components ranging between 1-5mm.
- V. Micro Chip – This automation routine is intended for use in installation profiles of components smaller than 1mm square, or whenever it would be more convenient to pick-up a component from the board instead of a component nest.
- VI. Auto Removal (not pictured) – This option takes the place of the other automation options when creating a removal profile. When checked, the TF-1800 will automatically remove the component at the end of the heating cycle.

D) Mode Indicator – The person developing the profile can use this box to switch back and forth between the two versions of the Profiler Screen, without having to log completely out of the developer mode.



E) Developer Logout – Click this to logout of developer mode. Until the developer is logged back in profiles may only be loaded and run, no changes can be made to them.

F) Trial and Graph options – These four columns control information displayed on the profile graph while a profile is run during development, as well as what is seen by anyone later running the profile from Production Mode.

I. Trial Number – Selects active trial.

II. Sensors Used – Selects which thermocouple profile graphs will be recorded during a profile run.

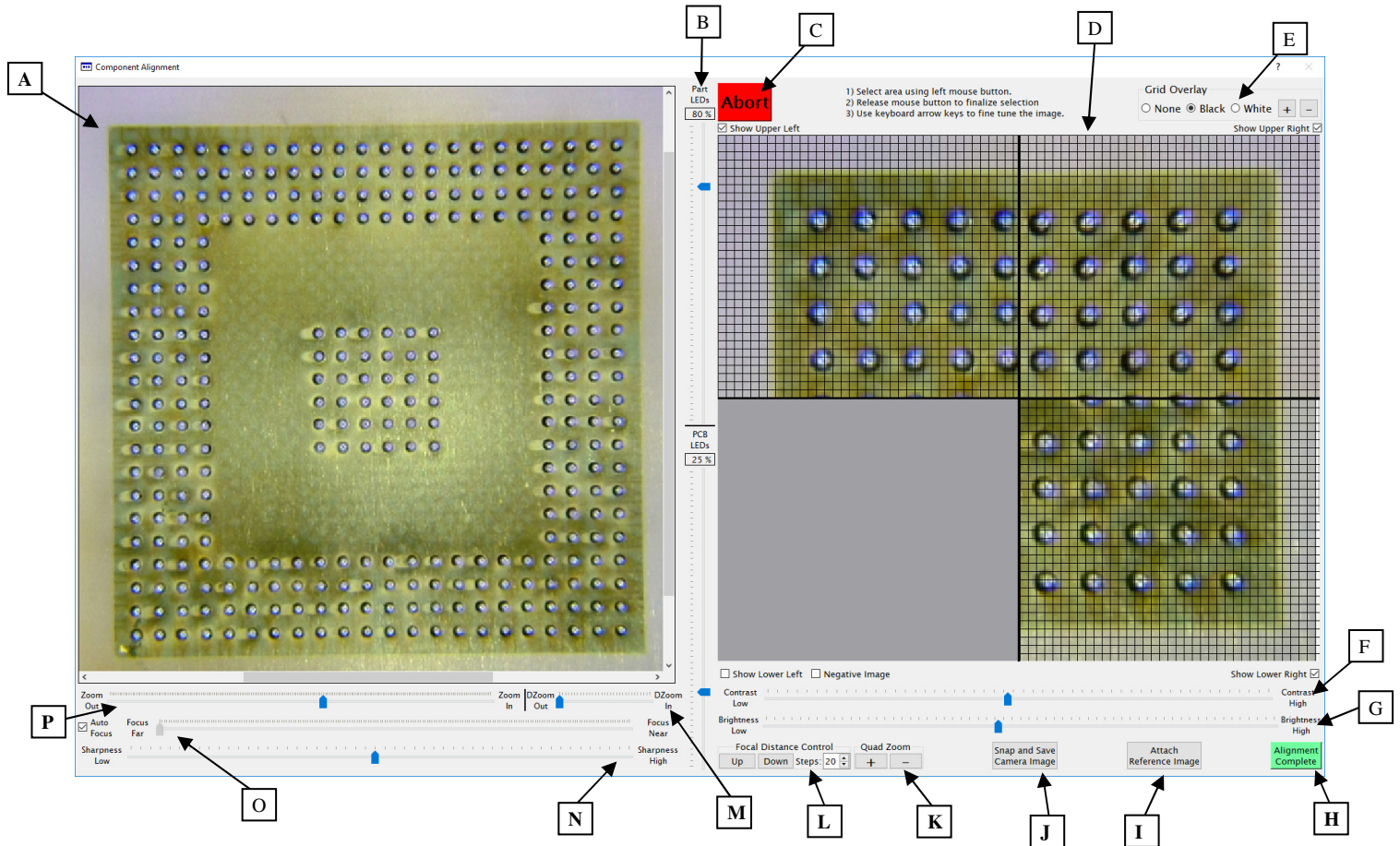
III. Show Trial Graph – Can be used to display the profile graphs of multiple trial runs in the Profile Graph Chart for comparison.

IV. Production Sensor – This is used to select which thermocouple profile graph will be displayed on the production screen as the primary reference once the profile has been saved.

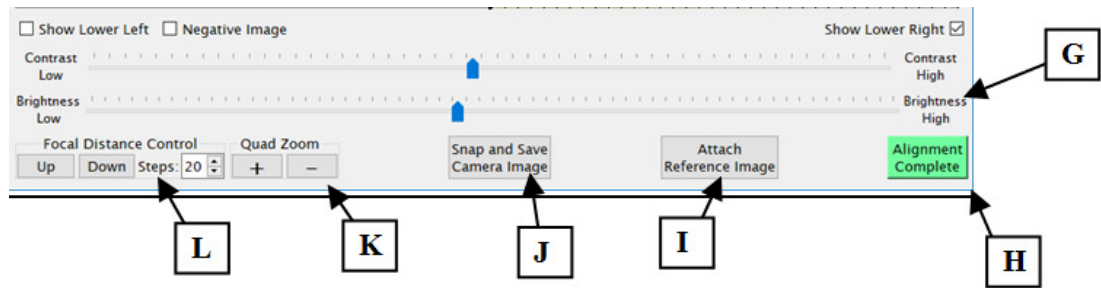
G) Clear buttons – Pressing clear will reset the current and highest temperature for the respective sensor.

H) Profile instructions/specifications block – This block can be used to store text notes or instructions about the profile for future reference during production runs. This information cannot be changed by the production mode user.

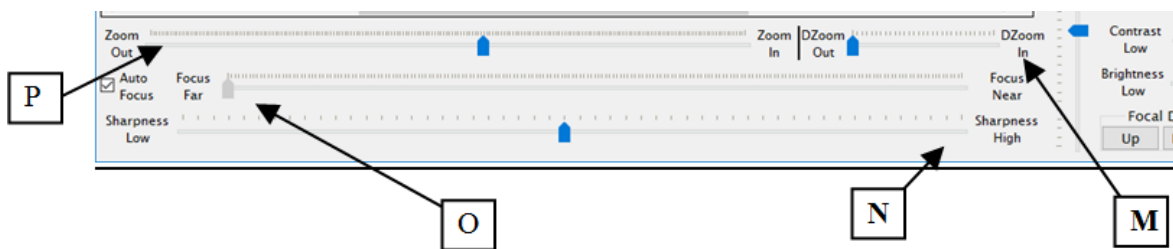
## The Component Alignment Screen



- A) Main Camera Image – This is the main camera viewport. The image is a combination of looking down at the top of the board and looking up at bottom of the component. This allows the user to align the solder balls or leads of a component to the corresponding pads on the board.
- B) LED controls – The two sliders in this column control LED intensity for the light shining up at the component part and down at the PCB.
- C) Abort – Pressing this button will abort the operation and return to the previous screen while also returning the heater head and camera arm to their home positions.
- D) Quad-Field Imaging – These four viewports, or quadrants, allow portions of the Main Camera Image to be viewed in more detail when fine tuning alignment without the need for adjusting the Main Camera Image. Use this feature by left-clicking a point in the Main Camera Image and it will appear in the associated Quad-Field viewport.
- E) Grid Overlay – This will show grid lines in the Quad-Field Imaging viewports. The grid lines can be set to black or white, and the +/- buttons will adjust the grid size.
- F) Contrast – Adjusts the color contrast of the camera.

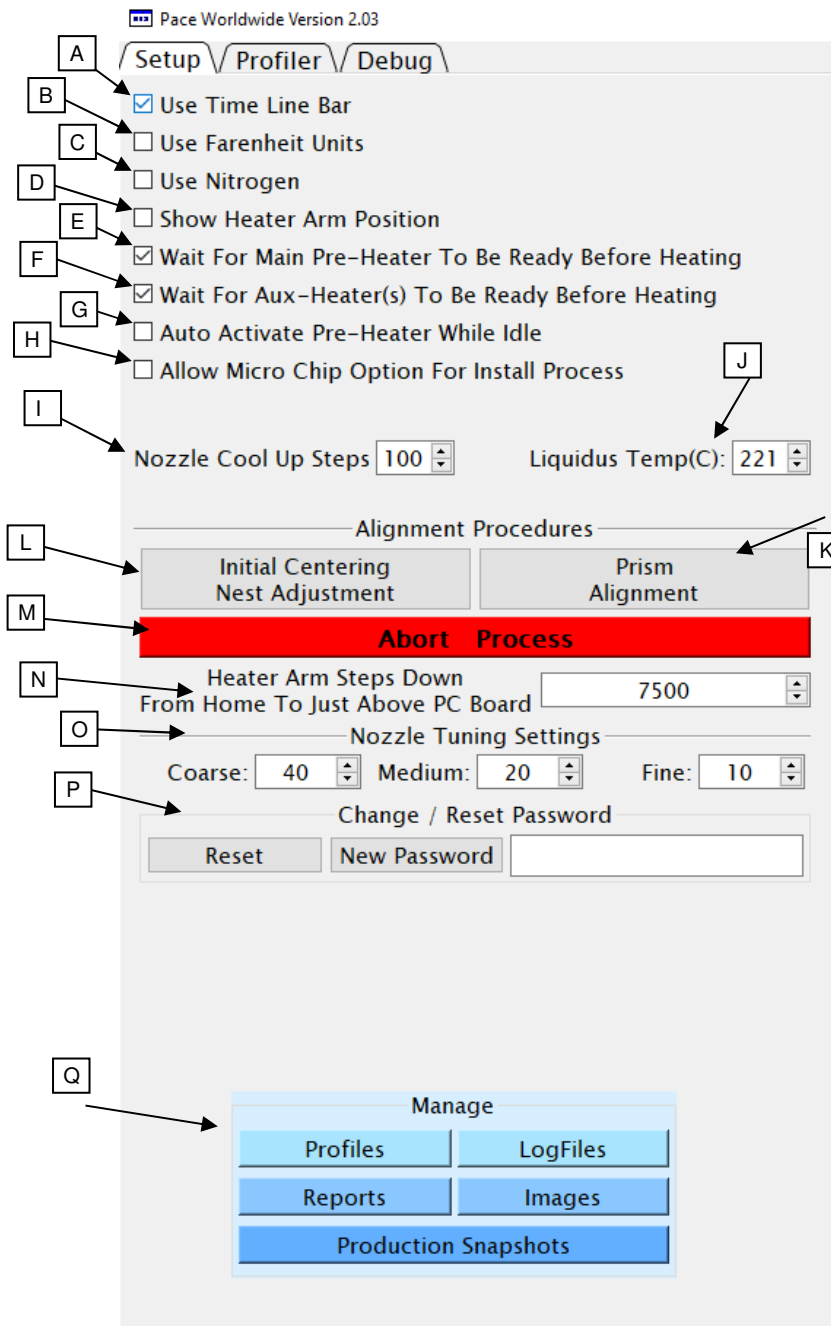


- G) Brightness – Increases/decreases amount of light let into the camera. Changes made will appear delayed on screen.
- H) Alignment Complete – Once the component and board have been properly aligned, click this button to continue with the rest of the profile.
- I) Attach Reference Image – Only appears in Developer Mode. Allows the developer to link saved images to a profile for reference during production runs.
- J) Snap and Save Camera Image – Allows the user to save images on the hard drive.
- K) Quad Zoom – Use this to increase/decrease digital magnification of the Quad-Field Imaging.
- L) Focal Distance – Depending on the sizes and distances of components and the board from the camera, changing the focal distance of the camera may help when aligning the BGA.



- M) Dzoom Slider – Used to zoom the Main Camera Image up to 9x. The slider bars below and beside the Main Camera Image can be used to reposition the view.
- N) Sharpness Slider – Adjusting this changes image clarity. Too little will cause blurriness but too much will make the image appear grainy.
- O) Focus Slider – Allows for manual adjustment of the camera focus, when auto focus is checked the slider is grayed out.
- P) Zoom Slider – This slider controls the optical zoom of the Main Camera Image. The slider bars below and beside the Main Camera Image can be used to reposition the view.

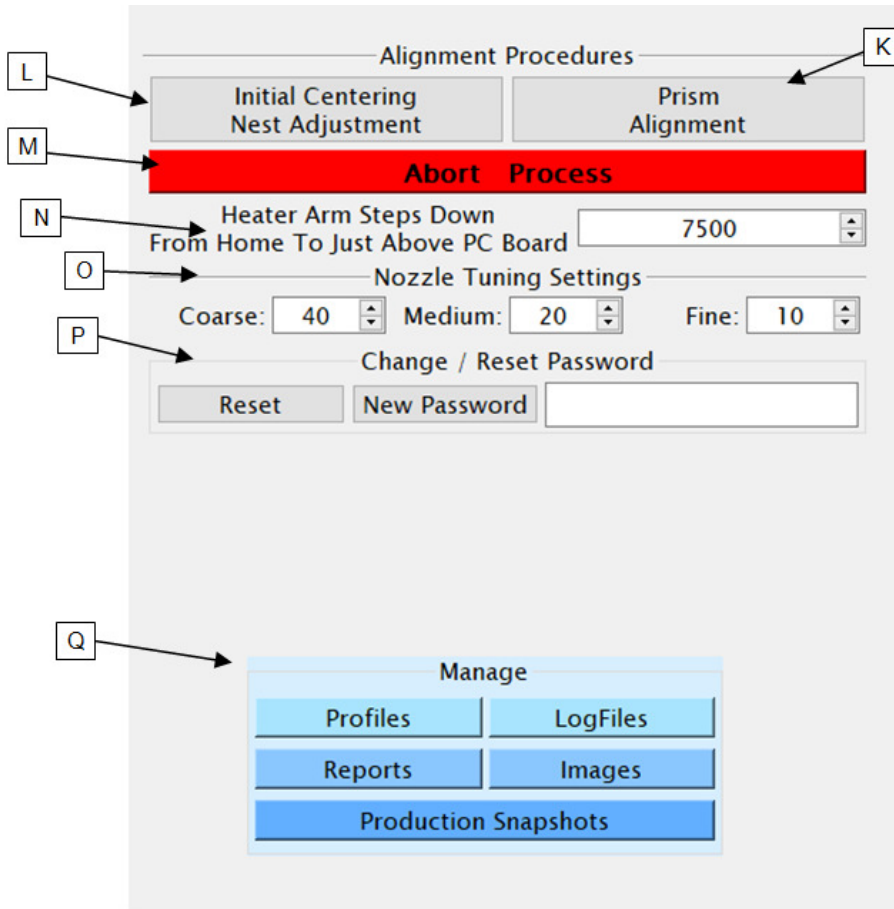
## The Setup Screen



- A) Use Timeline Bar – Turns on/off the progress meter at the top of the Profiler screen.
- B) Use Fahrenheit Units – Switches the default temperature units to Fahrenheit from Celsius.
- C) Use Nitrogen – Check this when using a pressurized nitrogen supply instead of the ambient air from the internal pump.
- D) Show Heater Arm Position – This checkbox will add an entry to the Profiler screen called “Arm Pos” which displays a numerical value corresponding to the heater head position.
- E) Wait for Main Preheater Ready – Checking this box will prevent starting a profile until the preheater has reached the temperature setting for the Preheat Zone.
- F) Wait for Aux Preheater Ready – Checking this box will prevent anyone from beginning a profile until the auxiliary preheaters have reached the temperature setting for the Preheat Zone.
- G) Auto Activate Preheater while idle – Checking this box will allow the preheater to begin heating as soon as the machine is turned on before a profile is loaded.
- H) Allow Micro Chip Option – This controls whether the Micro Chip automation process will be available for selection on the

Profiler screen.

- I) Nozzle Cool Up Steps – This sets the distance between the PCB and nozzle during Active Cooling. Lifting the nozzle will allow increased airflow and faster cooling.
- J) Liquidus Temp (C) – This is where to input the temperature used for calculating the “Time above liquidus” shown on the Profiler screen. The liquidus temperature will vary depending on your specific solder.
- K) Prism Alignment – This function is used to calibrate/verify the camera prism is properly aligned.



- L) Initial Centering Nest Adjustment – This can be used to extend the camera arm and component tray for re-aligning the component nest without having to run a profile.
- M) Abort Process – Stops any action the machine is performing and goes back to the home position.
- N) Heater Arm Steps Down – This controls the position the heater head will descend to before initiating auto or manual placement protocols.
- O) Nozzle Tuning Settings – The settings here control how many “steps” the heater head will move when the respective button is pushed during manual positioning.

P) Password Reset – The items in this section are used to reset or change the developer password. If the current password is forgotten, you will need to contact PACE for a temporary access code.

- Q) Manage – This section of the setup screen hosts several shortcuts directly to the folders containing the information stored by the TF software. The default locations for these folders are;
- "C:/Pace/Profiles" – Where profiles are stored as .dat file along with an .pdf showing an image of the developer’s Profiler Screen.
  - "C:/Pace/LogFiles" – This folder has the logs containing time stamped .csv files from the sensor, heater, and flow meter for profiles ran with the Log Data box checked on the Profile Screen.
  - "C:/Pace/Reports" – The .pdf reports created when “Save Production Run” is utilized from the Profile Screen are stored here.
  - "C:/Pace/Images" – This is the storehouse of .jpg images the developer has put in for reference during profiles run in production mode.
  - "C:/Pace/Snapshots" – This is the storehouse of .jpg images saved from profiles run in production mode for later examination.

## The Debug Screen

Pace Worldwide Version 2.03

Setup
Profiler
Debug

Setup Cmds

Lower  
 Upper  
 Ring  
 Shelf

LEDs Control  
 Up  
 Down  
 Pick Solenoid  
 In  
 Out  
 Optic Camera  
 View Optic Camera

Off  
 Nitrogen  
 Blower  
  
 Blower  
 Cooling Fan  
 Vacuum  
 Laser Pointer  
 IR Laser Pointer  
 Main  
 Calibration  
 Camera Link  
  
 Beep Time

Status Request Cmds

Htr Set Temp	Control Sensor	Optic Cam Pos
Htr On Time	Laser Pointer	Camera Link
Pre Htr Set Temp	IR Laser Pointer	LEDs Control
Pre Htr Actual Temp	TBD	TBD
Htr Core	Flowrate	Unit ID
Pre Htr Time	Blower	PreHtr Ver
Pre Heater Duty	Vacuum	Main Version
Heater Arm Pos	Cooling Fan	Errors
TC # 1	Heater/IR Temp	Comm Check
Thermocouples	Pick Solenoid	Abort

Display ASCII Sent / Received Packets

!! *Caution* !!

Careless use of the commands available on this screen can cause damage to the connected PACE equipment.

Be sure you know what you are doing.

Status Details

The Debug Screen is used to troubleshoot/test various aspects of the TF-1800 machine. The screen can be broken down into three sections. The Setup Commands on the left will make the machine perform an action. Status Request Commands will read off what the software believes to be the current setting, position or status of the different parts of the machine. The bottom area contains read outs for the Status Request commands along with a command selector to change available options (for future BGA equipment).



Setup Cmds

<input checked="" type="radio"/> Lower <input type="radio"/> Upper <input type="radio"/> Ring <input type="radio"/> Shelf <input type="text" value="0 counts"/>	<input type="checkbox"/> Off <input type="radio"/> Nitrogen <input checked="" type="radio"/> Blower <input type="text" value="15 LPM"/>	<input type="text" value="0 %"/> Heater Duty <input type="text" value="0"/> Heater Temp (°F)
<input checked="" type="radio"/> Up <input type="radio"/> Down <input type="button" value="Pick Solenoid"/>	<input type="button" value="Blower"/> <input checked="" type="button" value="Cooling Fan"/> <input checked="" type="button" value="Vacuum"/> <input checked="" type="button" value="Laser Pointer"/> <input checked="" type="button" value="IR Laser Pointer"/>	<input type="text" value="Pre Htr # 1"/> <input type="text" value="0"/> Pre Htr Temp (°F)
<input checked="" type="radio"/> In <input type="radio"/> Out <input type="button" value="Optic Camera"/>	<input checked="" type="radio"/> Main <input type="radio"/> Calibration <input type="button" value="Camera Link"/>	<input type="button" value="Heater Arm Pick"/> <input type="button" value="Heater Arm Home"/>
<input type="button" value="View Optic Camera"/>	<input type="text" value="0 * 5ms"/> <input type="button" value="Beep Time"/>	<input type="text" value="Steps: 9999"/> <input type="button" value="Heater Arm Up"/> <input type="button" value="Heater Arm Down"/>

To the left is the Setup Commands portion of the Debug screen. Each box deals with activating a different aspect of the TF-1800 machine. The user can select or change options, then press the associated button in the box to implement the changes.

For example, the vacuum pick can be made to move into the up position by first selecting the up bubble and then pressing the button labeled "Pick Solenoid" to activate the command.

The red buttons in the middle will turn on/off the respective item. The button will turn green to indicate the item is on.

Below are the various Status Request Commands. These will query what information the machine and software are sharing. Checking the "Display ASCII Sent/Received Packets" box will output information that may be helpful when attempting to diagnose problems the machine may be having or simply examining how different parts/functions of the machine operate in detail.

Status Request Cmds		
Htr Set Temp	Control Sensor	Optic Cam Pos
Htr On Time	Laser Pointer	Camera Link
Pre Htr Set Temp	IR Laser Pointer	LEDs Control
Pre Htr Actual Temp	TBD	TBD
Htr Core	Flowrate	Unit ID
Pre Htr Time	Blower	PreHtr Ver
Pre Heater Duty	Vacuum	Main Version
Heater Arm Pos	Cooling Fan	Errors
TC # 1	Heater/IR Temp	Comm Check
Thermocouples	Pick Solenoid	Abort

Display ASCII Sent / Received Packets

ASCII Sent	ASCII Received

Status Details

## Operation

### General Overview

There are many variables that need to be considered for each component removal or installation. Acceptable ramp rates and maximum temperatures of the items used in the operation should be obtained from the appropriate sources. The rework cycle can generally be broken down into five parts as follows;

#### **Pre-heat Phase**

This part of the cycle is primarily to warm the work piece up to a low, even temperature to reduce the chance of thermal shock or stress damage to the components being worked on, as well as components elsewhere on the PCB.

#### **Soak Phase**

The soak phase allows the temperatures to further normalize across the PCB and components while also beginning to gently bring the temperature up in preparation for the push through the ramp and reflow phases. Boards with large ground planes or other heat-sinking materials and components will benefit from a longer soak period to ensure uniform temperatures.

#### **Ramp Phase**

The ramp phase is where important things in the solder process start to happen. The temperature should begin climbing in order to activate the flux.

#### **Reflow Phase**

This is where everything comes together, and the solder reaches liquidus. **The lowest set temperature possible should be used to ensure safety of the component and PCB.** Refer to manufacturer specifications for temperature requirements of the materials being used.

#### **Cool Down Phase**

The cool down phase is used to bring the temperature of the component, solder joints, and PCB down below solder melt or reflow temperatures. This is beneficial for plastic component packages which can hold heat for a long time. Some components (such as CBGA or ceramic ball grid arrays) should be allowed to cool naturally without any external assistance. These types of components are sensitive to thermal shock and can be damaged by heating or cooling too quickly.

## Procedure

It is recommended to conduct a trial operation each day before commencing with production to ensure the heater temperatures will be uniform and that everything is operating correctly. It is important to verify if the machine is providing adequate airflow. Insufficient airflow can be detrimental to the job at hand and possibly cause damage to the machine itself if there is not enough airflow when the heater element is in operation.

Before operation, check for any components on both the top and bottom of the PCB that may not fit in the TF-1800. Ensure the components are not going to crash into the heater head or camera arm as they move up/down and in/out. Also check that the bottom heater will not be obstructed and does not make physical contact with components on the board as this could cause uneven heating.

### Production Mode

Example component installation – Note: If at any time you need to abort the process, click on the red abort button.

- 1) Turn on the TF machine and PC, and then run the TF software.
- 2) Navigate to the Production Mode screen if not already there.
- 3) Load a profile using the Load Profile button.
- 4) Install the proper vacuum pick.
- 5) Install the proper nozzle.
- 6) Click “Start Process” and follow the onscreen instructions which will guide you through the following steps.
- 7) Place the PCB between the arms of the board holder and position the board so the red laser point is in the center of the placement site and tighten the board holder retention screw.
- 8) Apply flux to the board if needed, and attach any thermocouples desired for additional process monitoring. Adjust the Board Support Wand as needed.
- 9) Place the component in the mounting plate on top of the camera housing. The component needs to have the same orientation as the nozzle. Click “okay”.
- 10) The BGA workstation will pick up component. If the vacuum pick fails to pick up the component, reset the component in the nest and click retry.
- 11) If Auto Flux Dip is selected, replace the component nest with the flux dip tray and follow onscreen directions. After fluxing is complete, restore flux dip tray and component nest to their original locations.
- 12) Slide component nest out of the way, towards the back of the machine so the optics are unobstructed.
- 13) The component alignment screen will appear and the heater head will move down to the focal position.
- 14) Adjust the zoom and lighting as needed in order to see the pads on the PCB as well as the solder balls or leads on the component. Then using the theta adjustment and X/Y micrometers, align the component to the PCB.
- 15) After alignment is complete, click the Alignment Complete button to prepare for heating.
- 16) If auto placement is active, the heater head will place the component and nozzle into position over the board. Otherwise, use the onscreen adjustments to manually lower the heater head into final position.
- 17) Make sure any extra thermocouples being used are in the correct location and click the Start Heating Button.
- 18) The selected temperature profile will run.
- 19) Allow the PCB to cool and remove.

Example component removal – Note: If at any time you need to abort the process, click on the red abort button.

- 1) Turn on the TF machine and PC, and then run the TF software.
- 2) Navigate to the Profiler Screen if not already there.
- 3) Load a removal profile using the Load Profile button.
- 4) Install the proper vacuum pick.
- 5) Install the proper nozzle.
- 6) Click “Start Process” and follow the onscreen instructions which will guide you through the remainder of the procedure outlined in the following steps.
- 7) Place the PCB between the arms on the board holder and tighten the retention screw.
- 8) Position the board so the red laser point is roughly in the center of the component.
- 9) Click on Start button.
- 10) Allow PCB and component to cool before touching.

## Developer Mode

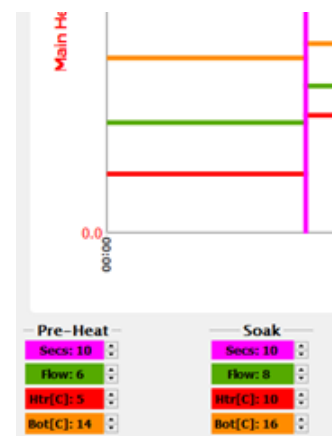
Developer Mode has all the same features of Production Mode, with a few additions to allow the creation and editing of installation and removal profiles. There are 2 recommended methods for developing a profile. The first method involves an actual component installation, while the second uses a previously 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 a profile by doing a complete component installation, it is critical to make sure the thermocouples remain in contact with the solder throughout the entire process. Unreliable data could be generated should a thermocouple lose contact with the solder. If measuring temperature at 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 which will cause problems with the install.

When using a previously installed package, the placement of the thermocouples is important. For best results the sensors must be in contact with the existing solder joints. This task can be accomplished by drilling through the bottom of the PCB into a solder joint and attaching the thermocouple, or by sliding the thermocouple under the package. When sliding a thermocouple under a component, it is critical that the thermocouple be in contact with the solder. Information from the thermocouples will assist in determining the proper time and temperature parameters. It is imperative for the thermocouple sensor bead to be in contact with the solder (preferred), the PCB and/or the component so that it is not floating in the open and measuring only the air temperature.

Adjusting the parameters for each phase or step of the profile is done by moving the colored bars in each phase. More precise settings can be input using the up/down arrows next to each entry at the bottom of the temperature profile graph.

- Magenta – Time in seconds
- Green – Air flow in standard liters per minute
- Red – Top heater set temperature
- Orange – Bottom heater set temperature. (Note: As soon as a temperature is put in the Preheat Zone for the bottom heater, the unit will begin warming to that temperature.)
- Purple – Auxiliary bottom heater temperature. (TF-2800 only.)



During the profile development process, up to 4 “trial runs” can be viewed for comparing and contrasting how well different settings work on a given application. The information displayed from each trial run can be altered using the buttons and check boxes above the temperature sensor readouts.

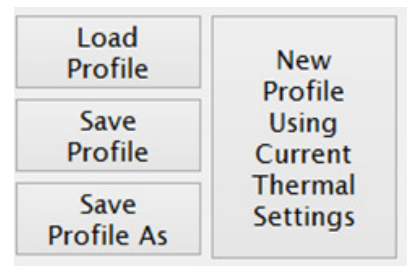
Trial Number	Sensors Used	Show Trial Graph	Production Sensor
<input checked="" type="radio"/> 1	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 1	<input checked="" type="radio"/> TC 1
<input type="radio"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="radio"/> TC 2
<input type="radio"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="radio"/> TC 3
<input type="radio"/> 4	<input type="checkbox"/> 4	<input type="checkbox"/> 4	<input type="radio"/> TC 4

Sensors

Peak[C]	TAL	Clear All	Curr[C]
Sensor 1 Description			
	0	Clear	
Sensor 2 Description			
	0	Clear	
Sensor 3 Description			
	0	Clear	
Sensor 4 Description			
	0	Clear	

- Trial Number – This column is used to designate which trial run is currently active for editing or being saved.
- Sensors Used – Check off the boxes for the sensor inputs you would like to use when doing a new trial run.
- Show Trial Graph – This will allow you to view the profile graphs from multiple trials at the same time.
- Production Sensor – Use this to select the thermocouple temperature graph that will be the visible reference for the finished production profile. Sensor descriptions can be changed by the profile developer.

Your new TF machine will come with default installation and removal profiles. These can be used as starting points for new custom profiles. The TF software will memorize the distance traveled by the heater head during some parts of an installation or removal process. The included default profiles do not have any distances stored. When altering any other pre-existing profile to work with different components, after loading the profile you must clear the distance settings with the “New Profile” button or the heater head could crash.



Following is a sample outline of steps needed to develop an installation profile by doing a new component installation. The process is essentially the same as doing a production run, except with the ability to make changes.

- I. Turn on the machine and PC, then run the TF software.
- II. Navigate to the Developer Mode screen if not already there.
- III. Load a profile using the Load Profile button.
- IV. Install the proper vacuum pick.
- V. Install the proper nozzle.
- VI. Click “Start Process” and follow the onscreen instructions which will guide you through the following steps.
- VII. Place the PCB between the arms of the board holder and position the board so the red laser point is roughly in the center of the component placement site then tighten the retention screw.
- VIII. Apply flux to the board if needed, and attach any thermocouples desired for additional process monitoring. Adjust the board support to the middle of the board.
- IX. Place the component in the mounting plate on top of the camera housing. The component needs to have the same orientation as the nozzle. Click “okay”.

- X. The BGA workstation will pick up component. If the vacuum pick fails to pick up the component, reset the component in the nest and click retry.
- XI. If Auto Flux Dip is selected, replace the component nest with the flux dip tray and follow onscreen directions. After fluxing is complete, restore flux dip tray and component nest to their original locations.
- XII. Slide component nest out of the way, towards the back of the machine so the optics are unobstructed.
- XIII. The component alignment screen will come up and the heater head will move down towards the focal position.
- XIV. Adjust the zoom and lighting as needed in order to see the pads on the PCB as well as the solder balls or leads on the component. Then, using the theta adjustment and X/Y micrometers, align the component to the PCB.
- XV. After alignment is complete, click the Alignment Complete button to prepare for heating.
- XVI. If auto placement is active, the heater head will place the component and nozzle into position over the board. Otherwise, use the onscreen adjustments to manually lower the heater head into final position.
- XVII. Make sure any extra thermocouples being used are in the correct location and click the Start Heating Button.
- XVIII. The TF unit will run the selected temperature profile.
- XIX. Allow the PCB to cool and remove.

If the component installation was successful, it is a good idea to try it once more to check for consistency and then save it! If the component installation was not successful, examine the situation and make changes to the profile for another trial run. Temperature graphs from up to 3 previous trial runs will be available for comparison to current settings. When saving a profile, don't forget to select the primary temperature sensor for future reference when repeating the profile in production mode.

## **Small Components**

The TF-1800 and TF-2800 are capable of working with very small components, as small as 1mm square. When working with components ranging from 5mm down to 1mm there are some additional steps required for accurate placement during installation procedures.

The standard Centering Nest can accommodate components between the sizes of 65mm and 5mm. To work with smaller components, the Centering Nest should be exchanged with the Microchip Nest. An in-program walk through of this process is added to a profile whenever the "Align Holder" box is checked.

Once the Microchip Nest has been installed onto the TF machine, the appropriate component slot will need to be aligned to the vacuum pick so the component can be lifted. This is achieved by adjusting two screws. To adjust the nest forward and back, use the screw on the left that controls the stop block on the rail. To adjust the nest left/right, use the screw protruding from underneath the center of nest.

## Maintenance

### LUBRICATION:

The horizontal rails of the board holder should be checked daily for debris and dry spots. The rails can be cleaned and lubricated by wiping with an ISOVG32 oil (such as; Mobil Vactra No. 2 SLC, Mobil DTE Light 32, Shell Tonna S2 M 32) with a lint-free cloth or sponge. A light coating should be left in the ball races. Avoid applying excessive amounts, which may pose a fire hazard near the preheater.

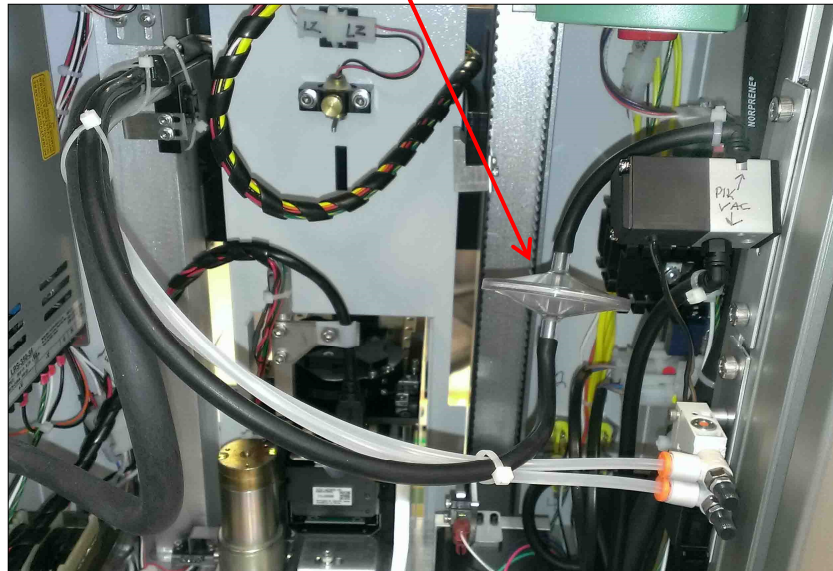
The two vertical rails should be lubricated if the heater head is sticking or stuttering. All rail covers will need to be removed (4 screws and brackets) in order to access the outer races. Apply ISOVG220 grease (Mobil Vactra No 4) to rails. Depending on the service conditions, the rails should be lubricated as a preventative measure at least annually.

Vacuum pick bearings should be checked if pick does not fully descend to bottom position. Must remove theta adjust knob and 4 screws to remove heater head cover. Carefully clean off dust or debris from exposed parts of the vacuum tube with an anti-dust aerosol or lint-free cloth. Apply a thin coat of NLGI Grade 2 lubricant (Dupont Krytox GPL 205) to the circumference of vacuum tube near each bearing. Next, manually move the vacuum pick up/down to allow grease to contact the balls; rotate the theta adjust knob and repeat the up/down movement. Depending on the service conditions, the bearings should be lubricated as a preventative measure at least annually.

### VACUUM LINE FILTER

Check VisiFilter (rear door)

VisiFilter (1309-0020-P1)



## Replacement & Spare Parts

<b>Part Number</b>	<b>Description</b>
1001-0001-P1	Leaded Component Stencil
1100-0231-P1	Nozzle/Chip tool
1100-0307-P1	Hot Grip Pad
1121-0927-P1	Micro-Vacuum Pik (20 gauge)
1161-0008-P1	5x20mm Fuse Holder
1198-0021-P1	Posifa TF Flowmeter
1198-0022-P1	Honeywell TF Flowmeter
1259-0135-P1	Vacuum Panel Mount Fitting
1263-0036-P1	Proportional Valve
1334-0021-P1	Low Pressure Pump
1336-0045-P1	Flow pump for 120v
1336-0046-P1	Flow pump for 230v
1336-0049-P1	Fish Pump for pik-vacuum
1340-0174-P1	K-type Thermocouples (package of 2)
3008-0295-P1	USB-A/USB-B Cable
6000-0239-P1	Laser Pointer
6000-0245-P1	Flux Tray Assembly
6000-0247-P1	Stencil Platform Assembly
6000-0313-P1	Nitrogen Solenoid
6016-0033	Hex-Key Set
6020-0157-P1	TF Sensor PCB
6020-0219-P1	TF/IR High Voltage PCB
6993-0196-P1	Vacuum Cup Kit, 2 each of 6 sizes
6993-0276-P1	TF vacuum pick kit – 7 size assortment
7027-0001-P1	PV-65 Pik-Vac Vacuum Wand



## **Warranty**

PACE warrants that this equipment will be free of defects in materials and workmanship for a period of one (1) year from the date of receipt by the first user.

This warranty does not cover repair or replacement required as a result of misuse, mishandling or improper storage. Failure to perform recommended routine maintenance, alterations or repairs made other than in accordance with PACE'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 therein apply to all persons and entities.

This warranty does not apply to consumable items such as filters.

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

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

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

To obtain warranty service, contact the appropriate PACE company listed below

Do NOT return defective equipment or parts to PACE without obtaining prior authorization.

Any warranty or other claim with respect to the equipment must be made in writing and delivered to PACE (or local authorized PACE Distributor outside the U.S.) within a reasonable time of the expiration date of this warranty. Sufficient evidence of purchase and date of receipt must also be included, otherwise user's rights under this warranty shall be deemed waived.



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