

A.P.E. Wide Area Radiant Surface (WAR'S) Hot Plate Station

Operator's Manual

Revision III 03/31/99

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WARNING:

To avoid electrical shock, always:

- 1. Use a properly grounded electrical outlet of correct voltage and current handling capacity.
- 2. Disconnect from the power supply prior to maintenance and servicing.

To avoid personal injury:

- 1. Do not use in the presence of flammable or combustible materials; top surface can reach the "Flash Point Temperature" of many chemicals. Fire or explosion may result. This device contains components which may ignite such materials. This Hot Plate is not explosion proof.
- 2. Refer servicing to qualified personnel.

3. “Caution: Hot Surface. Avoid Contact. “The surface of the hot plate will remain hot for a considerable time after use.

1.1. INTRODUCTION

1.1.1 Automated Production Equipment’s Radiant System Hot Plate 8100-6000 has been specifically designed and engineered for the electronics industry, as an accessory to prevent board distortion during rework and repair of larger printed circuit boards, such as Mother Board type products. However the Hot Plate, also by design, can be used as an independent hot plate station, suitable for applications of preheating, stabilizing and baking, the model 8100-6000R is suitable for total area reflow.

CONSTRUCTION: *(See illustration #1)*

1.2.1 An aluminum top plate 12” x 12” (304.8mm x 304.8mm) provides a total area of 144 sq. inches (929.03 sq. cm) and is heated by two resistant heaters embedded in a refractory material. The plate is made of cast aluminum to aid in uniform temperature. It should be understood that this high stabilized mass, which is necessary for constant maintainable temperature control, initially requires between 30 to 40 minutes to set to temperature. The base of the unit is 11.50 “ x 11.50” (292.10 mm x 292.10mm), which allows “Drop In” bench mounting, if required. Four (4) guards are provided for immediate assembly upon receipt of the Hot Plate (**See Guard installation 1.3.2**). The Guards are designed not to exceed 120 F (48 C), at 350 F (176 C), typically, 90 F (32 C) can be expected. All parts and the sum of the unit is ESD safe, non generative and does not support static charge.

1.2.2 The Hot Plate is controlled by a microprocessor-based programmable storage controller. This is essentially the “brain” of the unit. which uses Fuzzy logic to determine precise control of the large thermal mass, this learning feature ensures constant stability after initial warm up.

1.2.3. Controls for the Hot Plate are located on the front of the unit. These include Main Power On/Off, a Timer actuator and the Controller itself,

Illustration #1



1.2.4. This manual is designed and intended for personnel using the Hot Plate and contains an overview, how to unpack, inspect, assemble, and power up the unit. The operator will learn how to create, store and operate temperature settings, and to program the controller. The Hot Plate is an easy to use, reliable unit that is easy to understand and learn. If you have questions regarding the use of the unit that are not answered in the manual, contact the A.P.E. factory at (305) 451-4722. We would appreciate your comments, and they will help us create a better manual for you, your co-workers, and your colleagues in the field.

1.3 UNPACKING AND ASSEMBLY

1.3.1. Before opening the shipping box, make sure that the box is in an upright position. Gently remove the package sealing tape, and open the box. Remove the Styrofoam panels containing the Hot Plate, locate the four (4) Safety Guards and four (4) assembly screws and set aside for immediate installation after unpacking. The fitting of the foam within the carton is very tight and assistance may be necessary to extract the unit from the carton. The model that you purchased will be marked on the carton and this manual will be included. If the Hot Plate is part of an A.P.E rework machine carefully open the other boxes in the same manner, and inventory the parts inside, checking them carefully against the packing list and shipping documents. Inspect for damage. Report any damage immediately to the A.P.E. factory, Tel. (305) 451-4722.

1.3.2 Remove the Hot Plate from the carton as described and set on a firm and level benchtop near a 110/220VAC power source (20 amp capacity is required if the Hot Plate is used with a Chipmaster Radiant System, or 10 amp if the Hot Plate is used alone) and with a grounded (3-prong) outlet. **Do not attach the Hot Plate power cord until the safety guards are installed as follows:**

- a. The four Safety Guards should be divided into two (2) Side Guards, without mounting angles and two (2) Front/Rear Guards, which have stand off mounting corner angles.

- b. With the Hot Plate control facing front, take one of the Front/Rear Guards and one of the Side Guards and using one of the four (4) screws insert the screw through the mounting hole in the Side Guard and also through the Mounting hole in the Front/Rear Guard, then present both parts to the mounting hole on the top right hand side of the Hot Plate. Do not tighten fully. Now do the same to the left hand side, assembling the left Side Guard to the left hand side of the Front/Rear Guard. Each of the two Side Guards will be only loosely supported by one screw on each side of the Front Guard.
- c. Turn the Hot Plate around and finally fit the remaining Front/Rear Guard.
- d. Tighten all four (4) screws to complete the assembly.

The Sides of the four (4) perforated heat shield guards have been designed to clear the Hot Plate by 0.50" (12mm) around the perimeter and 0.325 (8.25mm) below the surface.

POWER UP:

1.4.1. The Hot Plate power cord is directly connected within the Hot Plate and cannot be removed. The free end is a male 3-prong plug and connects into the wall outlet. Before plugging the cord into the outlet, locate the green plastic Main Power switch on the front of the Hot Plate (See Illustration) and make sure that it is in the OFF position.

Plug the main power cord into the wall outlet or appropriate 110/220VAC power source.

1.4.2. Take note of the back of the Hot Plate. Besides the plug for the power cord, there is also a 15 ABC amp fuse socket.

1.4.3. Once the Hot Plate has been assembled and plugged into a power source, it is ready for power-up. Depress the Main Power On/Off switch to the ON position. The green-colored switch will illuminate, indicating that power is ON. Immediately, the Controller will light up and indicate "SELF TEST" as it momentarily runs through its test sequence. If the Reflow Hot Plate 8100-6000R is being

installed the system cooling fans will also begin operating at this stage and will blow a stream of cool air to the controller and extract hot air out the rear of the unit. to prevent any possible degradation caused by the high reflow temperature. The upper RED L.E.D. indicator of the controller will indicate ACTUAL SURFACE TEMPERATURE of the Hot Plate in the Factory Set scale (degrees Fahrenheit or Centigrade). The bottom GREEN L.E.D. will indicate TEMPERATURE SET POINT, i.e. the desired maximum temperature of the Hot Plate surface that the controller has been set for. Factory default setting for Set Point is 250 degrees F. The Temperature cycle will immediately start ramping, as indicated by the RED L.E.D in the upper display, however due to the high mass of the aluminum surface, the rise will be very slow in the first minutes of operation, steadily increasing to the Set Point Temperature. Note that the Temperature will initially overshoot the required temperature, until the Fuzzy Logic learns to control the power cycling, via a thermocouple closed loop feed back sensor.

At this point, you have completed the assembly and initial power-up of the Hot Pace . Now this manual will explain its method and theory of operation, and will show you how to use, program, and maintain your Hot Plate.

1.5 Getting Started

1.5.1 The standard Hot Plate is designed to operate at temperatures well below the eutectic temperature of solder 361 F (182 C), for preheating of circuit boards, typically 150 F (66 C) to 300 F (149 C). Temperature absorption will be more efficient, if the board or component sits directly on the Hot Plate, if it is necessary to stand off the board/component the temperature should be increased to compensate for the loss in the air gap between the Board/component and the surface of the Hot Plate. The surface may also be machined to compensate for protrusions, enabling the work to lay flat on the surface. The optional 8100-6000R Reflow Hot Plate is designed to operate above the eutectic temperature of solder and generally at 450 F (232 C), the maximum temperature of operation for the Reflow Hot Plate is 550 F (288 C). Operation is simply allowing the Hot Plate to settle at the required

temperature and to place the board/component onto the surface, then operate the *Timer function* (**See *Timer Operation* below**) and allow a sufficient time to reach the required condition. In the case of a Chipmaster Radiant Rework system for PCB's an articulating board holder will be used to support the board during preheat and rework using the Chipmaster, (**refer *Chipmaster operation manual***)

1.5.2 Rework is the process of removing and replacing BGA and chip components on a circuit assembly. Removal involves heating up the component area and where the component's leads attach to the circuit board, known as the lead attach area, until the solder connecting the leads to the board melts and becomes liquidous, or molten. It's important to remember that the solder establishes both a *physical* as well as an *electrical* connection between the legs or leads of the component and the circuit board. This connection is called a *solder joint*. Once the solder holding the solder joint together is molten, the component can be lifted off the circuit board by the Chipmaster's vacuum nozzle pickup, or by an external vacuum wand. The only force holding the component to the board will be the surface tension of the solder. This surface tension can help align or center components when re-attaching them; it also ensures that, after removal, some solder will be left on the component leads, and some will be left on the "pads" on the circuit board.

1.5.3 Circuit boards are designed to dissipate heat - spread it out evenly. Since different types of materials expand at different rates when heated, heat applied to a circuit board results in *thermal stress* - physical forces that increase as the board gets hotter. These stresses can break electrical connections within the components, cause solder joints to fail, and cause chip caps to crack. Fatigue caused by thermal stress can cause the circuit board to fail later on, perhaps at a critical time. On larger boards the stress can cause warping and to prevent this problem a large area radiant heat source must be used to preheat the entire board. When we preheat the circuit board before and during rework using the 8100-6000 Hot Plate, we are gradually stabilizing the entire board until such time as the Low Temperature operation Chipmaster can be used to remove or replace any desired component

1.6 TIMER FUNCTION:

The Digital Timer - How It Works

The Hot Plate controller contains an optional digital timer to help you control the preheat or operational process. The timer allows you to set a specific time for a heating cycle, or to count and record the amount of time needed to achieve a certain result. This feature is especially important in preheating circuit boards prior to rework. When a specific time has been set, e.g. 3:00 minutes, the Hot Plate's timer counts down to zero once the Timer button that begins the heat cycle has been depressed. It is also possible to zero the Timer and start the Timer counting UP, instead of programming a set time to count down, in this instance the Timer will continue to count until the Timer is set to zero once more. To do this, press the ENTER key and the DOWN arrow key simultaneously. The display will flash once, indicating that the timer has been reset to zero. Now press the Timer button and note the time counting up, this will continue until the Timer is set to zero again, by pressing the ENTER and DOWN arrow key.

To set a time period, so that the counter counts down to zero, press the INDEX key ONCE (from the Temperature Display) to reach the timer set field in the Operator Menu "t1". Use the UP arrow key to increase time in one-second increments; hold the key in to increase time rapidly. Once the time is set, press ENTER; then press the INDEX key TWICE to return to the Operator View Display. When the Timer button is pressed the Timer will commence counting down to Zero.

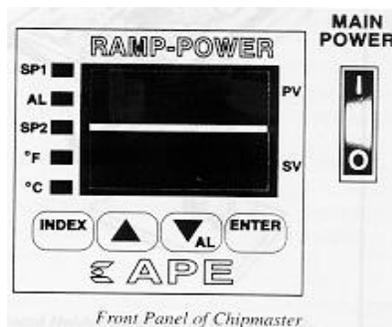
1.7 THE HOT PLATE CONTROLLER

1.7.1. The Hot Plate controller is a sophisticated microprocessor-based patented time/temperature controller developed by A.P.E. with an integral digital timer, and programmable temperature storage

facility. The programmable storage controller allows the user to *create*, *store*, and *instantly recall* temperature settings.

1.7.2. *Becoming Familiar With The Controller*

Illustration 2 shows the face and features of the Hot Plate controller. Note the Set Point, Alarm, and Degrees Centigrade/Fahrenheit indicators on the left side of the controller. Note the Index, Up and Down arrow keys, and ENTER key across the lower part of the controller. The two display windows are the Process (upper) window and Set Point/Timer (lower) window. All of these individual indicators will be explained.



Controller

1.7.3 Whenever the Hot Plate is turned on, the controller, after going through its self-test, will automatically go to the “Temperature Display.” This is the menu that should be displayed at all times when the Hot Plate is on. One only goes to different menus to change temperature or time as described in 1.6

1.7.4. **Advanced Programming and Process Optimization**

The Hot Plate's programmable storage controller will allow the user to create and store up to four separate temperatures for instant recall and use.

A.P.E. Storage Controller Specification and Operation

Menu Segments:

Temperature Display

Operator Menu

Primary Menu

Secure Menu

1.7.5 Operator Menu

The Operator Menu is used to select a Temperature Profile, set a time period or change an operating temperature.

When the machine is initially turned on, the Controller will run a SELF TEST. Once completed, the Temperature Display will indicate "Surface Temperature" Red Display and the "Selected Temperature" Green Display. To change the temperature, the Operator Menu can now be accessed by the following procedure:

1.7.6. Changing Temperature

Changing a temperature "Set Point", or peak temperature, is easy. What you are setting is the maximum temperature of the surface plate. The factory default setting for the Hot Plate is 250 degrees (F) (121 C). To change the temperature, press the INDEX key to enter the Operator Menu and press INDEX TWICE to arrive at the Set Point Temperature Field. The lower display window will display the letters SPI. The upper display window will indicate the current Set Point. Now press either the UP

arrow key or DOWN arrow key to raise or lower, respectively, the temperature Set Point. Press ENTER when the desired Set Point is reached.

1.7.7. *Selecting a Temperature Profile*

To select a Temperature Profile, press the INDEX key to enter the Operator Menu and press INDEX ONCE to arrive at the Temperature Profile Field. The lower display window will display the letters Prof. The upper display window will indicate the Temperature Profile.. Now press either the UP arrow key or DOWN arrow key to change the Profile #, press ENTER to save and press INDEX ONCE to exit the Operator Menu.

Action	Green Display	Red Display	Explanation
1. Press INDEX once.	t1	0.00/or time set	Time is displayed; if no time set, 0.00 is displayed. Use UP/DOWN arrow to set time.
Press ENTER to save time.			
2. Press INDEX once.	prof	1or2or3or4	Select Temperature Program number using UP/DOWN arrows.
Press ENTER to save program.			
3. Press INDEX once.	1SP1		Temperature displayed. Use UP/DOWN arrow for desired temperature for program selected 1SP1 = Program 1, Set Point 1
Press ENTER to save.			

4. Press INDEX twice (Step over Editor).

Exit menu, to return to
“Temperature Display”.

Factory Set Temperature Programs (8100-6000) only:

- 1. PROGRAM NO. 1 250 F (121 C).
- 2. PROGRAM NO. 2 200 F (93 C)
- 3. PROGRAM NO. 3 150 F (66 C)
- 4. PROGRAM NO. 4 100 F (38 C)

1.7.8 Primary Menu

The Primary Menu needs only to be accessed should the L.E.D. “Alarm” Temperature setting need changing or if a “Temperature Offset” need be introduced from a calibration measurement (**See Calibration Procedure 1.8**).

IMPORTANT: USE ONLY THE INDEX KEY TO STEP THROUGH EACH FIELD!

Enter the Primary Menu by pressing the ENTER and UP arrow simultaneously for less than two (2) seconds.

To change the TEMPERATURE ALARM, press the INDEX twice to ALH1 and by using the UP or DOWN arrows change the alarm temperature and press ENTER to effect your changed setting.

Press INDEX continuously until you are back to the Temperature Display.

DEFAULT SETTINGS OF PRIMARY MENU

Green Display	Red Display Defaults
Auto	On
ALH1	500 “ALARM L.E.D. SETTING

Itun	nor	
ArUP	on	
lArt	Off	
PEA	Do Not Change	
UAL	Do Not Change	
Cyl	10	
Pct0	Off	
Prog	Off	
Stat	Off	
1rt	0.00	
1st	0.00	
Pend	Hold	
InPC	0	TEMPERATURE OFFSET CALBRATION
Filt	2	
Lphr	Off	

Explanation of Primary Menu Features

Green Display

Red Display

Auto	On	Automatic control of Hot Plate
	Off	Overrides Automatic setting and should never be entered.
ALH1		High Alarm setting, use UP/DOWN arrows to set Alarm temperature; ensure Alarm setting is above selected operating temperature.

**NEVER OPERATE THE HOT PLATE GREATER THAN 350F (177C)
(550F (288C) for Model 8100-6000R)**

1tun	Tuning of Ramp rate, normal, fast, slow, self and PID. Use only normal, fast or slow to alter ramp response. Tuning alters the response curve of rise time and sets proportional Band Gain temperature.
ArUP	Reset feature clears Reset offset value to 0% when not within Proportional Band .Always set to On.
1Art	Approach rate time, select OFF
PEA	Peak voltage record of highest voltage recorded by system.
VAL	Lowest voltage record recorded by system.
Cyl	Cycle rate, select 2-80 sec., default at 10.
Pct0	Percent output feature, select OFF only, default to OFF.
Prog	Ramp/soak feature, default to OFF.
Stat	Status Display Turn OFF, Default OFF.
1rt	Ramp time in hours and minutes, select 0.00 for profiles illustrations, default 0.00.
1st	Soak time in hours and minutes, select 0.00 for profile illustrations, default 0.00.
Pend	End of soak action, set at Hold at Set Point 1, default to Hold.
InPC	Input correction, allows input value to be changed to agree with external device, set at 0, default is 0.00. See Calibration Test Section 1.8.
Filt	Noise suppresser, set at 2, default at 2.
Lpbr	Loop Break protection, not utilized, set to OFF, default at OFF.

1.7.9 SECURE MENU

The Secure Menu provides:

- . Coded Security, preventing change of parameters in each menu
- . Selection of Centigrade or Fahrenheit.
- . Change of Temperature limit.

Great caution must be exercised in this menu as any unauthorized change will invalidate warrantee. The model 8100-6000 is Factory Limited to 350 F (177 C) and the optional 8100-6000R Reflow Hot Plate is limited to 550 F (288 C), should either of these temperature limitations be increased damage and hazard may occur.

Change of Security Code:

To change a security code, access the Secure Menu by pressing the ENTER and UP arrow simultaneously for six (6) seconds, the Security Code Field will be seen, using the UP and DOWN arrow keys, enter the desired security level as detailed in the Password Table below. Press ENTER to save and press INDEX continuously to exit the menu and return to the Temperature Display.

Password Table

<i>Security Level</i>	<i>Displayed Value when viewed</i>	<i>Password Value to enter</i>
Menu	Security	
Operator	Locked	
Primary	Locked	1 1110

Secure	Locked		
Operator	Unlocked		
Primary	Locked	2	1101
Secure	Locked		
Operator	Unlocked		
Primary	Unlocked	3	1011
Secure	Locked		
Operator	Unlocked		
Primary	Unlocked	4	111
Secure	Unlocked		

Fahrenheit/Centigrade selection:

To access the Secure Menu press the ENTER and UP arrow simultaneously for six (6) seconds, to select or change Temperature reading, press INDEX twice and use UP or DOWN arrows to select either Centigrade or Fahrenheit, press ENTER to effect the change
Press INDEX continuously to exit menu.

Maximum Temperature Limit:

To access the Secure Menu press the ENTER and UP arrow simultaneously for six (6) seconds:
Press INDEX nine (9) times to access SPH (Set Point High), use UP or DOWN arrows to select new limitation, press ENTER to effect change, **DO NOT INCREASE LIMIT ABOVE 350 f (177 C) FOR 8100-6000R 550 F (288 C).**
Press INDEX continuously to exit menu.

1.8 CALIBRATION:

1.8.1 The 8100-6000 is temperature controlled by a “K” Type Thermocouple sensor connected to a *Fuzzy Logic* PID Controller, because of the nature of thermocouple sensing, accuracy of temperature measurement is +/- 10%, in comparison of the surface of the Hot Plate to the display on the Controller. The Hot Plate will therefore require an “Off Set” to be entered in the Controller to compensate for any error, between a calibrated surface reading and that measured by the Controller. Once the “Off Set” has been entered for each temperature set point, the 8100-6000 will maintain this accuracy to 2° F.

1.8.2 To calibrate the surface of the Hot Plate, an independent and calibrated temperature sensor should be laid firm and flat on the center of the Hot Plate. The temperature reading should then be compared to the Temperature Display RED L.E.D. on the controller, any difference should be offset in the INPC field in the Primary Menu. To change the INPC, enter the Primary Menu by pressing the ENTER and UP arrow simultaneously for less than two (2) seconds, press the INDEX fourteen (14) times until the INPC field is located, use the UP arrows to off set the controller if the reading on the controller Temperature Display is less than the independent test measurement and use the DOWN arrows to offset , if the Temperature Display is more than the independent test measurement. Press ENTER to effect your changed setting and press INDEX continuously until you are back to the Temperature Display.

1.9 Maintenance:

1.9.1 **Note:** Avoid getting flux, solder, adhesives, etc. on the aluminum surface. Foreign material could cause erosion, contamination and possible harmful vapors from the heating of the material. Keep the surface clean and occasionally wipe (when cool) with a small amount of light alcohol or solvent. For severe contamination of the Hot Plate, use a general household utensil abrasion pad with a very small

amount of industrial detergent, be very careful not to soak or spill any liquid into the sides of the unit and thoroughly dry the surface before operation.