OPERATING MANUAL

WaferPlate ™
PROGRAMMABLE BAKE PLATE
MODEL HP90

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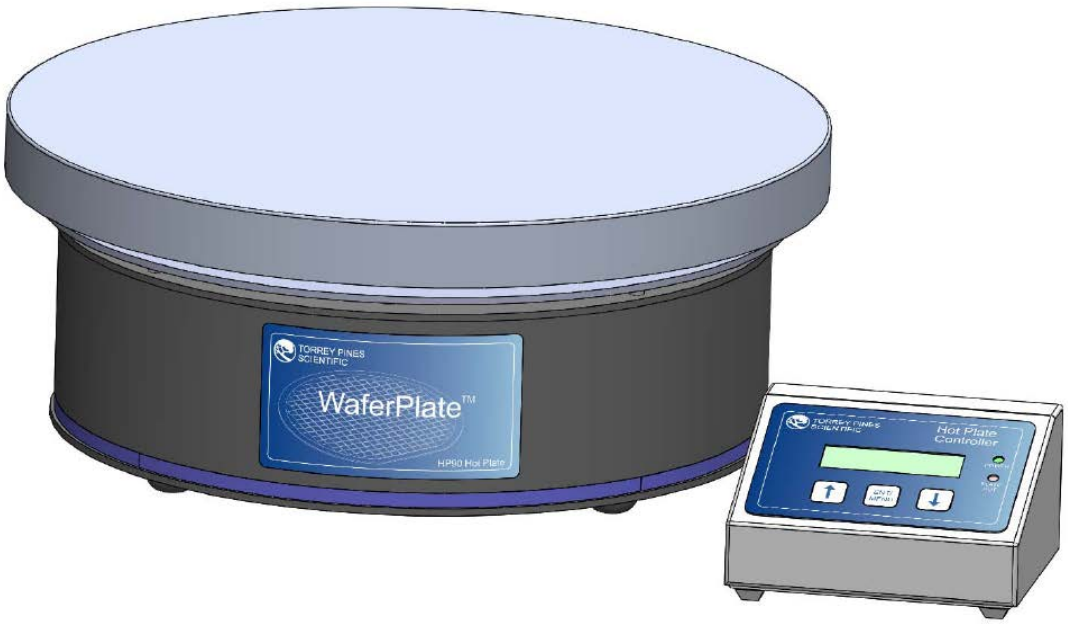

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I. INTRODUCTION

Congratulations on your purchase of a *WaferPlate* ™ Digital Electronic Bake Plate Series HP90. Please read the instructions carefully to insure that you receive the maximum benefit from it. Also, be sure to go to our web site and register your unit for warranty coverage. When users in the USA and Canada do they will receive a Torrey Pines Scientific, Inc. T-Shirt free.

II. WARRANTY

Torrey Pines Scientific warrants this product to be free from defects in material and workmanship for a period of one year from the date of purchase. If repair or adjustment is necessary and has not been the result of abuse or misuse within the one year period, please return---freight prepaid---and correction of the defect will be made without charge. Out of warranty products will be repaired on a charge basis.

III. RETURN OF ITEMS

Authorization must be obtained from our Customer Service Department before returning items for any reason. When applying for authorization, please include data regarding the reason the items are to be returned. For your protection, items must be **carefully packaged** to prevent damage in shipment and **insured** against possible damage or loss. Torrey Pines Scientific will not be responsible for damage resulting from careless or insufficient packing. A 15% restocking charge will be made on all unauthorized returns.

Note: Torrey Pines Scientific reserves the right to make improvements in design, construction, and appearance without notice.

IV. LABELS

There are various labels on the body of this unit. Listed below are the labels and their meanings.

This symbol means: ATTENTION. The INSTRUCTION MANUAL IS TO BE CONSULTED FOR FURTHER INFORMATION

This symbol means: WARNING. HOT SURFACE.

This symbol means: GROUND OR EARTH CONNECTIONS

V. CAUTIONS

HEATER PLATE SURFACE

The Torrey Pines Scientific HP90 Programmable Bake Plates are capable of temperatures in excess of 350C at the plate surface. Touching the heated surface will cause severe burns.

USE EXTREME CAUTION AT ALL TIMES. Never leave your Bake Plate accessible to others while it is hot. Although the unit is equipped with a **"PLATE HOT"** warning indicator on the control box front panel and the HP90 light ring (red), do not rely on those alone. It is good practice to never touch the heater surface.

NOTE: DO NOT INSTALL THIS UNIT CLOSER THAN SIX (6) INCHES (15.24 CM) TO A WALL OF COMBUSTIBLE MATERIAL. ALSO, THIS UNIT IS NOT FOR USE WITH FLAMMABLE SUBSTANCES.

ELECTRICAL

These Bake Plates are made in models that operate at 100, 115, and 230 volts AC +/- 10%. Be certain that your voltage matches the unit you receive. Check the nameplate on the bottom for the voltage setting on your unit. Be certain to use a three-wire, properly grounded AC input. Take the normal care and precaution one would use with any electrical appliance. Be careful to keep the AC line cord away from the Bake Plate.

Be certain to use a line cord of the same type and rating as the one supplied with this unit. Note: all fuses are fast blow.

Bien vérifier que le cordon utilisé est du même type que celui livré avec lunité. Note: tous les fusibles sont à action rapide.

VI. GENERAL DESCRIPTION

The Torrey Pines Scientific HP90 Series Programmable Bake Plates are specially designed digital/programmable units intended for applications which require very uniform surface heat distribution. The temperature uniformity is within 1% across the milled-flat cast aluminum useable heater plate surface. All functions are settable and may be monitored using the push buttons and digital LCD display in the cabled HP90 WaferPlate Controller. Additionally, full control and data collection also may be accomplished remotely using a PC or industrial controller via the RS232 serial line.

CONTROL OPTIONS

- Benchtop Method: When the HP90 Hot Plate Controller is connected to the HP90 Bake Plate, push buttons and LCD enable standalone operation.

- Remote Control via PC: The HP90 Bake Plate can be controlled by a remote PC or industrial controller using the serial port and an extensive library of commands.

- Constant Power Up Settings: The Set Point and Ramp Rates (and all other settings) retained in memory and will restore upon power cycles regardless of the control method. For example, if the Set Point for a unit is set to 250C, it will return to 250C with each power cycle with the HP90 Hot Plate Controller disconnected and no PC COM.

HEATER PLATE

The surface is a very flat aluminum plate designed for good contact with any flat surfaced item placed on it. The plate size of the HP90 is large circular 13.875" (352.4 mm) diameter. It was designed specifically for working with silicon wafers up to 12" (304.8 mm) and other samples where temperature accuracy and surface uniformity is a must. The temperature uniformity is better than 1% across the useable surface area.

TEMPERATURE STATE LED RING

The units have an LED ring around the bottom of the base to indicate the current temperature range and steady state of the plate. The LED ring will display one of three colors. Blue indicates a temperature below 30C, yellow if the temperature is between 30C and 50C, and red if the plate temperature is 50C or above. When the plate temperature is equal to the set point temperature and is steady, the LED colors will be on continuously. When not steady, the LED colors will gradually cycle from bright to dim . See BAKE PLATE LED TEMPERATURE STATUS INDICATOR section of this manual for more detail.

RAMP RATE CONTROL

The units have the ability to set a heating and cooling rate to control how fast the heater plate temperature changes to the new set point temperature. The rate value may be set from 1C/hr to 450C/hr or the ramping feature may be disabled (“off”). See “MENU: Set Ramp Rate” for more details. NOTE: Ramp rate must be set before new Set Point is entered.

PROGRAMS

The HP90 Hot Plate Controller enables the user to define up to 5 individual programs consisting of up to 10 steps per sequence. See “MENU: Program” for more information. Using the HP90 with the serial port connected to a remote PC or industrial controller provides control of the unit to enable unlimited sequencing and data collection opportunities. See “HP90 Programming Manual.pdf” for more information.

POWER FAILURE DURING PROGRAM NOTIFICATION

If power is interrupted while a program is running, both the HP90 and the Hot Plate Controller will provide notification when power is restored. The message “Power Failure During Program” will be displayed on the Hot Plate Controller LCD display and the LED ring on the HP90 will blink rapidly.

TIMER

All units have a countdown timer reading in hours, minutes, and seconds. It can be set to a maximum of 99:59:59. When the timer reaches 00:00:00 it will count up to show how much time has elapsed since the timer timed-out. Additionally, there are options to sound an alarm or to put the unit in Heater OFF Mode when the timer reaches 00:00:00. See “MENU: Timer Options” for more details.

ALARM

The units have an optional audible alarm that sounds for one minute when the timer counts down to zero. Touching the UP ARROW will turn the alarm off during this first minute. However, if the alarm sounds for the entire minute, it will shut-off the sound automatically. When the alarm first sounds, the timer will start to count up. This lets the user know how much time has passed since the timer first sounded. See “MENU: Timer/Stop Timer” for more details.

Heater OFF

The units have an Heater OFF Mode feature that enables the user to “turn off the power” to the heater plate. In the HP90 Hot Plate Controller, Heater OFF Mode can be set directly like a set point using the keypad, or by choosing the option in the Menu, or it can be set when the countdown timer reaches 00:00:00. Additionally, it can be set in a program step as a set point value. See “Heater OFF Mode” and/or “MENU: Timer Options” for more details.

CALIBRATION

The units have been calibrated in the factory to NIST standard prior to shipment. In the event that the user wants to calibrate to a different standard, the ability to recalibrate each of the two calibration points is provided. Additionally, the ability to easily restore the factory calibration values is included. See “MENU Calibrate” and/or “MENU: Reset Cal Pts” for more details.

NON-VOLATILE MEMORY

The units are equipped with EEPROM memory that will store user settings such as the last set point, MENU options, user changed calibration points, and program steps. These stored values will be recalled each time the unit powers up to maintain the configuration of the previous session.

VII. HP90 Bake Plate and Controller

BAKE PLATE BACK PANEL

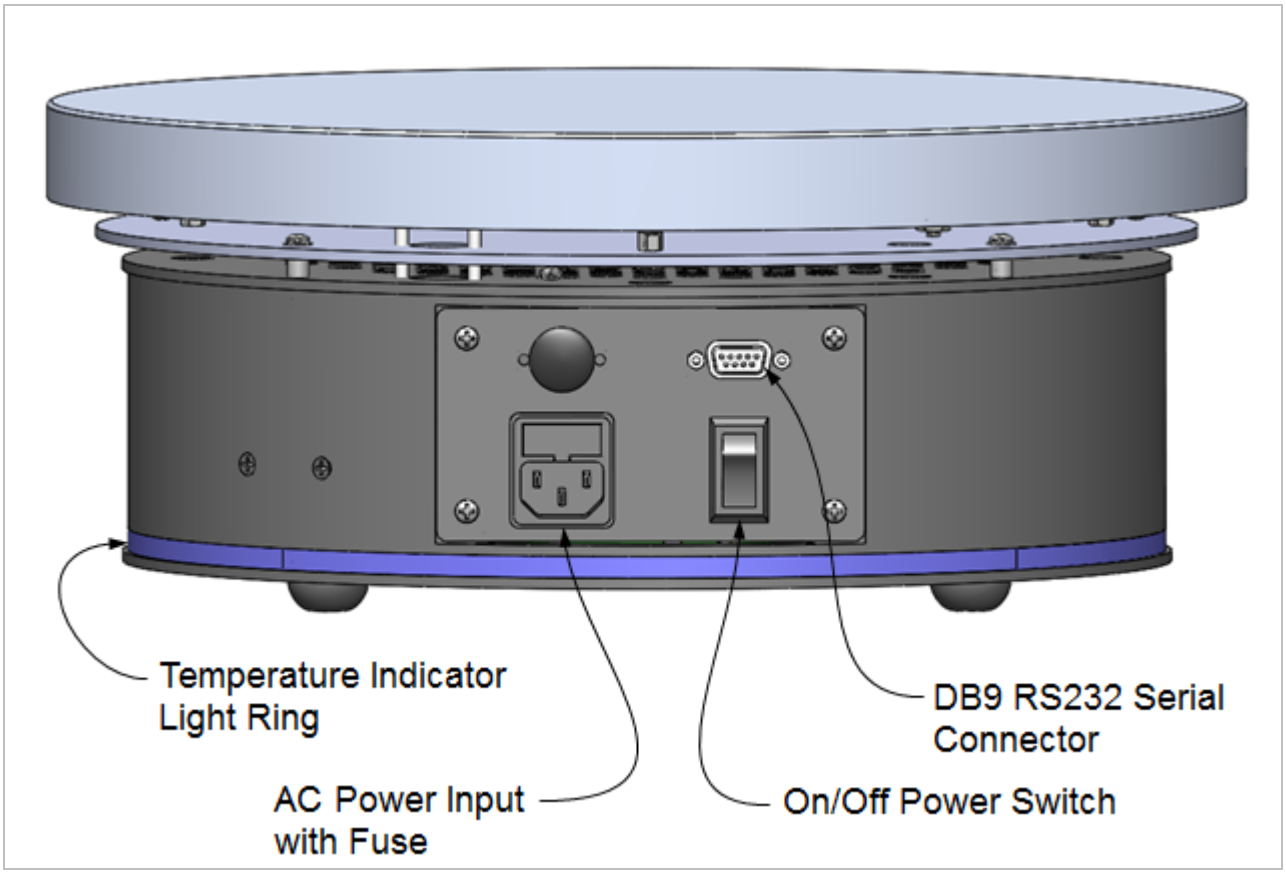
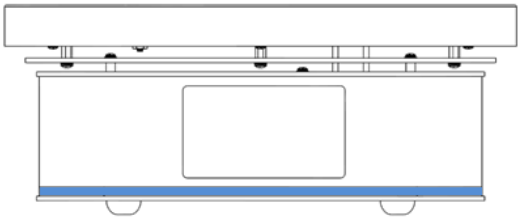
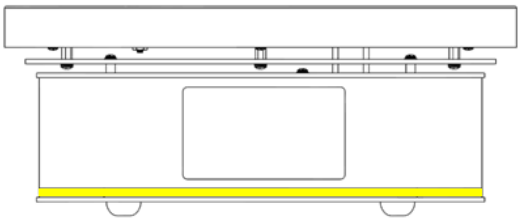
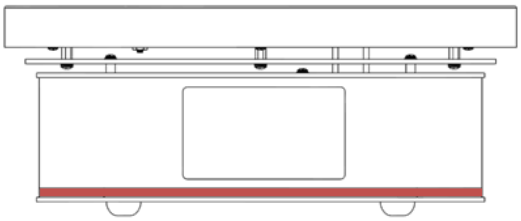


Figure 1: HP90 Face Plate Components

The back panel components are shown above in Figure 1. The AC power line connector includes a fuse holder. The on/off power switch is located close to the base away from the heater plate. The DB9 RS232 serial connector may be used in two ways. The first is to plug in an HP90 Hot Plate Controller for benchtop-type, stand-alone operation. The second method is to connect to a PC or an industrial controller where the HP90 may be controlled remotely using the extensive serial commands described in the “HP90 v1.0 Program Guide.pdf”. Control via a remote PC enables unlimited temperature sequences and rich data collection.

BAKE PLATE LED TEMPERATURE STATUS INDICATOR

	LED Ring Color	Plate Temperature
	Blue*	Less Than 30C
	Yellow*	Between 30C and 50C
	Red*	50C and Higher

*Light intensity is changing, solid, or flashing depending on the current state

Table 1: HP90 LED Temperature Status Ring Color Description.

The HP90 LED ring around the base of the unit provides a visual indication of the state of the plate temperature. As shown in Table 1 above, the LED ring color indicates the temperature range of the plate. Additionally, the state of the Bake Plate is indicated by the intensity of the light as listed below:

1. Slowly Cycling Brighter then Dimmer: Plate temperature is not yet steady at the set point temperature.
2. Constant Brightness: Plate temperature is at the set point temperature and is steady. When the temperature of the plate has been within 0.5C of the set point temperature for at least 60 seconds, the LED light will stop cycling and will remain steady. This is the “TEMP_STEADY” condition.
3. Flashing: The power to the HP90 Bake Plate or to the Hot Plate Controller has been interrupted while a program was running. The Hot Plate Controller will also display the message “Power Failure During Program”.

HOT PLATE CONTROLLER FRONT PANEL

Figure 2: HP90 Hot Plate Controller

The front panel of the Hot Plate Controller shown above in Figure 2 has a tactile touch membrane keyboard with audible feedback. The keyboard is used to set all operating parameters. The display is a two-line alphanumeric LCD with backlighting. When the unit is turned on the display will light and show the current Plate Temperature, Set Point Temperature, and the current Ramp Rate. Plate temperature will be displaying the actual temperature of the plate surface. There are two LEDs on the front panel. One is a power-on indicator and the other is the plate surface hot indicator that will illuminate when the plate is at or above 50C.

HOT PLATE CONTROLLER REAR PANEL

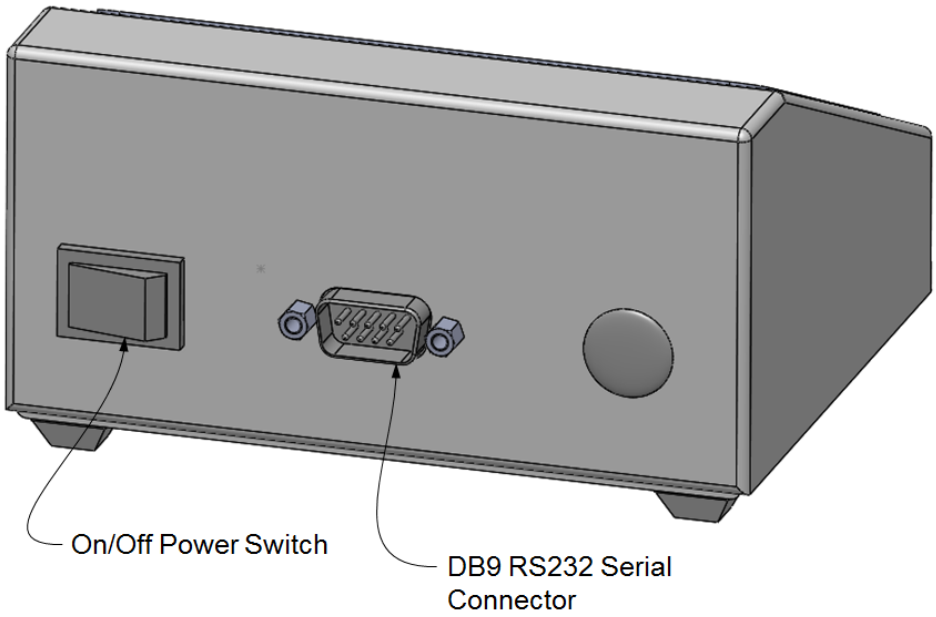


Figure 3: HP90 Hot Plate Controller Rear Panel Components

The rear panel shown has the on/off power switch and the DB9 RS232 I/O port connector that will be connected to the HP90 hotplate using the serial cable provided.

VIII. SET UP PARAMETERS

SET UP PARAMETERS

1. Ambient operating room temperature range is from 5ºC to 40ºC.

2. Maximum altitude of operation should not exceed 2000 meters.

3. Maximum ambient operating relative humidity should not exceed 80% at 31ºC decreasing linearly to 50% relative humidity at 40ºC.

SET UP INSTRUCTIONS

1. Place the unit on a level, dry surface.
2. If using the Hot Plate Controller, plug one end of the serial cable into the DB9 connector on the back of the Hot Plate Controller unit (ref: Figure 3) and the other end into the DB9 connector on the back of the HP90 Bake Plate (ref: Figure 1).

   If using a PC or industrial controller to control the HP90, plug one end of the serial cable into the appropriate connector for the PC or industrial controller and the other end into the DB9 connector on the back of the HP90 Bake Plate (ref: Figure 1).

3. Plug the line cord provided into the rear of the HP90 Bake Plate.

4. Plug the power supply cord into a properly grounded, 3-wire outlet of proper voltage.

5. Place the sample on the plate surface.

6. Turn the unit on by the switch on the rear of the HP90 Bake Plate. The ring LED will illuminate and most likely display the cycling blue color. If using the Hot Plate Controller, turn the controller on using the power switch on the rear panel (ref: Figure 3). The unit display will light and the power LED will illuminate.

7. If using the Hot Plate Controller, set the Ramp Rate if wanted and the Set Point temperature, and any other parameter required according to the instructions that follow.

   If using a PC or industrial controller to control the HP90, consult the “HP90 v1.0 programming guide.pdf” for information on the use of the serial commands available.

Note: Do not use this equipment in any manner not specified by the manufacturer.

ENVIRONMENTAL INFORMATION

1. This unit is for installation category II.

2. This unit is rated pollution degree 2.

IX. HP90 HOT PLATE CONTROLLER DESCRIPTION

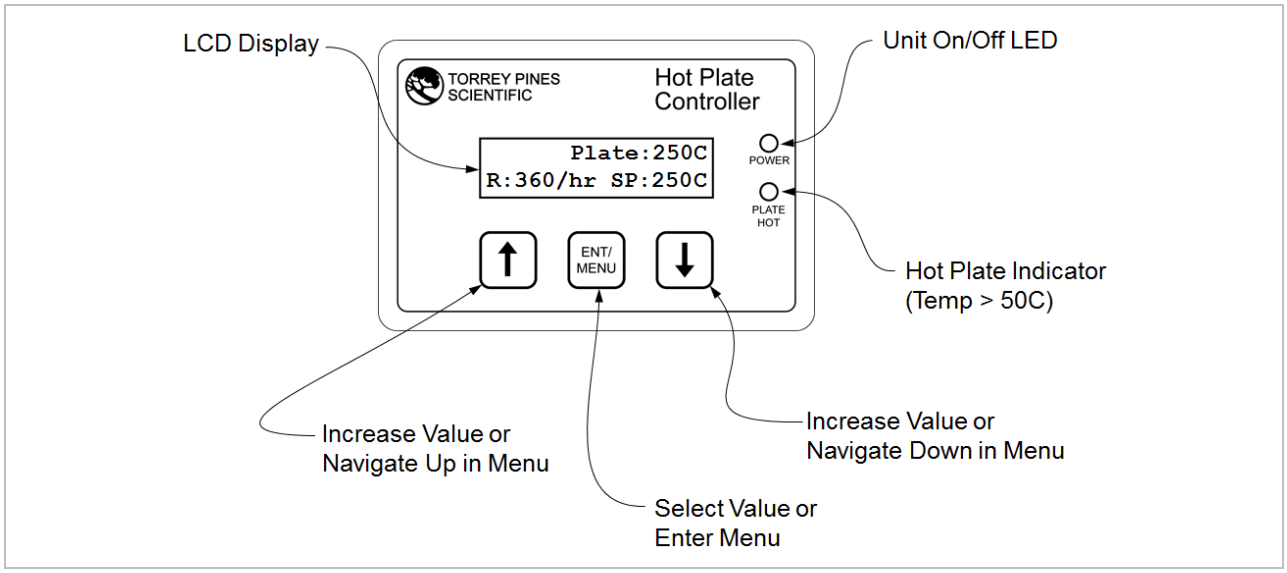


Figure 4: HP90 Hot Plate Controller Face Plate Description

LCD DISPLAY

The display is a two-row alphanumeric LCD with backlighting for easy viewing. The main screen displays relevant information depending on the current mode of operation. For example, in the default mode the Plate Temperature, the Set Point Temperature and the Ramp Rate are displayed. When a program is running, timer values, program ID, cycle count, and step are also displayed.

KEYBOARD

The keyboard consists of three buttons labeled with an UP ARROW, a DOWN ARROW, and ENT/MENU. The function of pressing the up arrow is typically to increase the value of a parameter and the down arrow is typically to decrease a value. They are also used to navigate through the structure of the menu options (ref: the Hot Plate Controller section of this manual for several menu maps). When the keys are touched, an audible beep will occur. The keys also have tactile feedback when they are depressed.

Single key presses are described as briefly pressing and releasing a button. If a single key is pressed and held for 2 seconds, the setting will increase or decrease rapidly depending on the button pressed. For example, in the default display, briefly pressing and releasing the UP ARROW will increase the set point temperature by 1C with each press. If the UP ARROW is pressed and held down, the set point will increase by 1C after the first press but after holding for 2sec the set point temperature will rapidly increase until the button is released or until the maximum set point for the unit is reached.

X. HOTPLATE CONTROLLER OPERATION

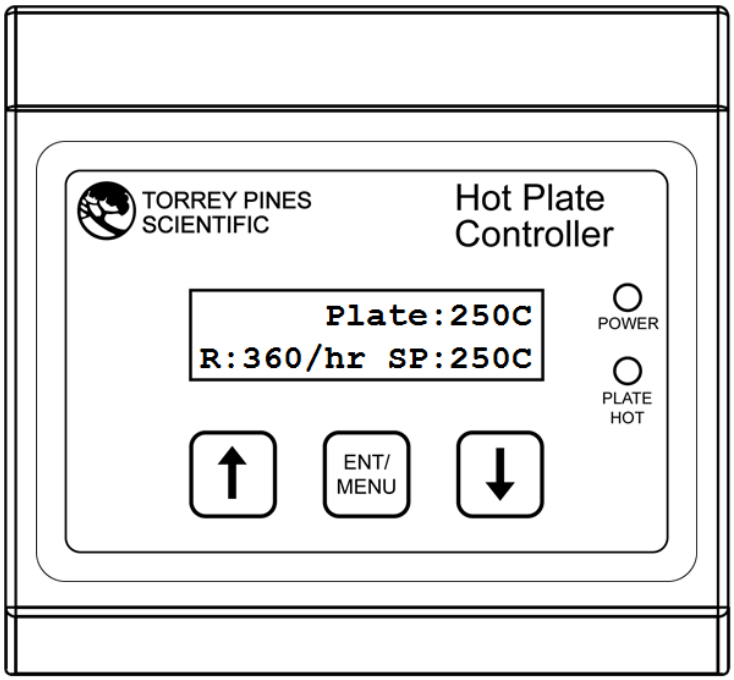


Figure 5: HP90 Hot Plate Controller Example

LCD DISPLAY MODES

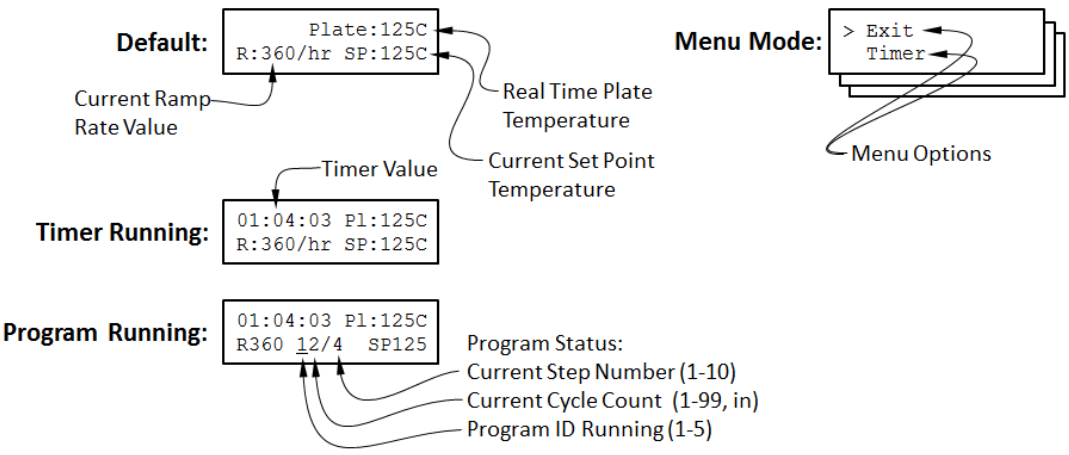


Figure 6: Description of Four Different LCD Display Modes

The four main LCD display modes are shown above in Figure 6. In normal operation, the plate and set point temperatures are displayed, as well as the current ramp rate settings. When the timer or a program is running additional relevant information is

added. When the ENT/MENU button is pressed, the menu options are displayed where multiple features are accessible. Menu options are described more in the "MENU OPTIONS" section of this manual.

SETTING TEMPERATURE

NOTE: Use of the ramp feature always requires entering a ramp value prior to entering a set point temperature. If a ramp rate is required that is different from the currently stored ramp rate, the ramp rate must be changed before a new set point temperature is entered. If a different ramp rate is set after a new set point temperature has been entered, the HP90 will heat or cool per the previous ramp rate—not per the different ramp rate. See section "MENU: Set Ramp Rate".

To set a temperature for the unit, simple press the UP or DOWN ARROW until the set point temperature ("SP") on the display shows the desired temperature. The unit will now go to that temperature. Note that the actual plate temperature will be shown in the display as "Plate". You will be able to watch this number change as the unit drives to the set point (SP) entered. If there is a problem with the temperature measurement circuitry or if the calibration values are invalid, an error code will be displayed in the location of the "Plate:" temperature. For example, if the low calibration measured value is out of range, the unit will display "Plate: cal1". See the "XII Temperature Measurement Error Codes" section of this manual for a complete listing.

MENU OPTIONS

Pressing the "ENT/MENU" button enters the menu where multiple features are available. The top level list of menu items are:

- Exit
- Timer
- Heater OFF
- Set Ramp Rate
- Program
- Pgm Options
- Timer Options
- Calibrate
- Reset Cal Pts
- Get HP90 Info

Two menu choices are shown per screen. Pressing the UP arrow button moves the selection cursor up through the list and pressing the DOWN arrow button moves the selection cursor down through the list. Pressing the "ENT/MENU" button will select the menu item.

Descriptions of each menu item are shown in the following sections of this manual.

MENU: Timer/Stop Timer

The HP90 Hot Plate Controller includes a countdown timer that may be started at values up to 99:59:59 in hours:minutes:seconds format. When the timer reaches 00:00:00, it will begin to increment to provide information on how long ago the timer finished. Additionally, when the timer reaches 00:00:00 a 60 second max alarm tone may sound and/or the HP90 unit may enter Heater OFF Mode (see "MENU: Heater OFF) depending on the state of the settings in the "Timer Options" menu (see "MENU: Timer Options"). Figure 7 and Figure 8 show steps to set and start the timer and how to stop.

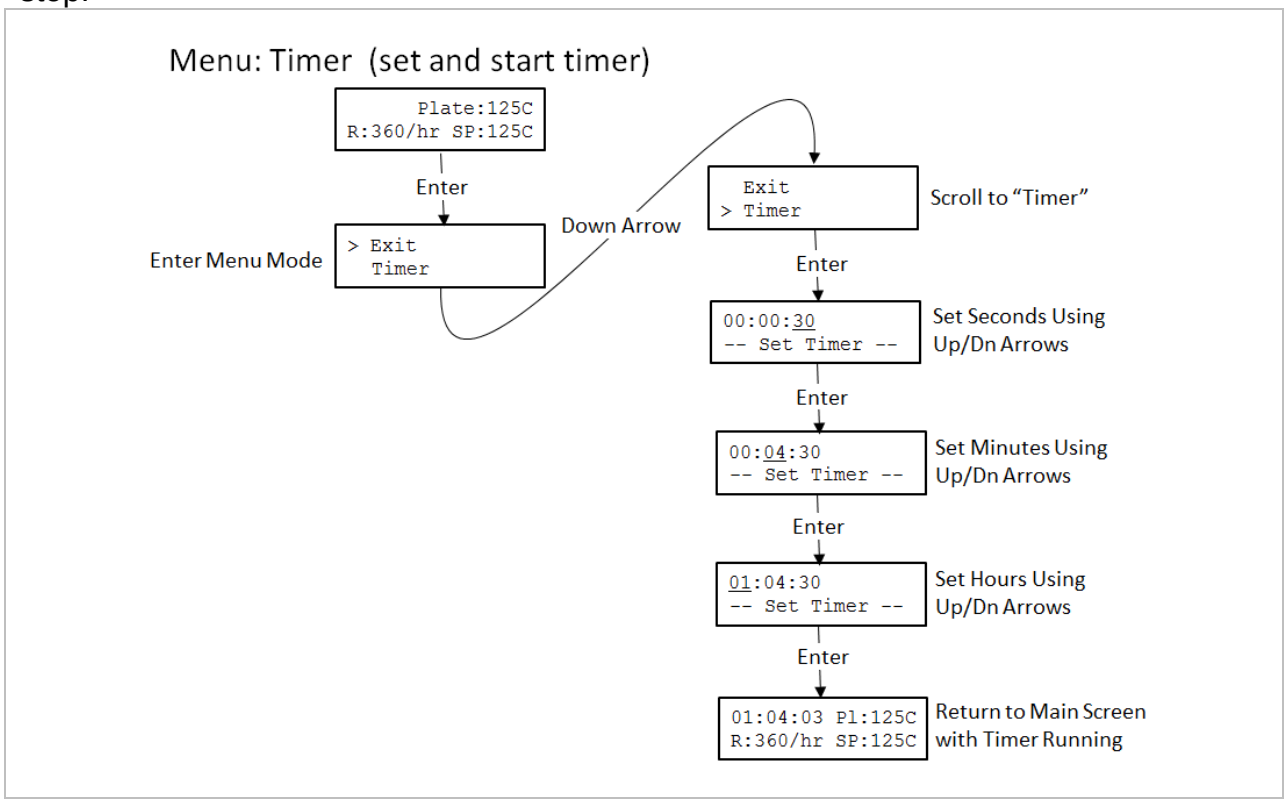


Figure 7: Menu Map to Set and Start the Timer

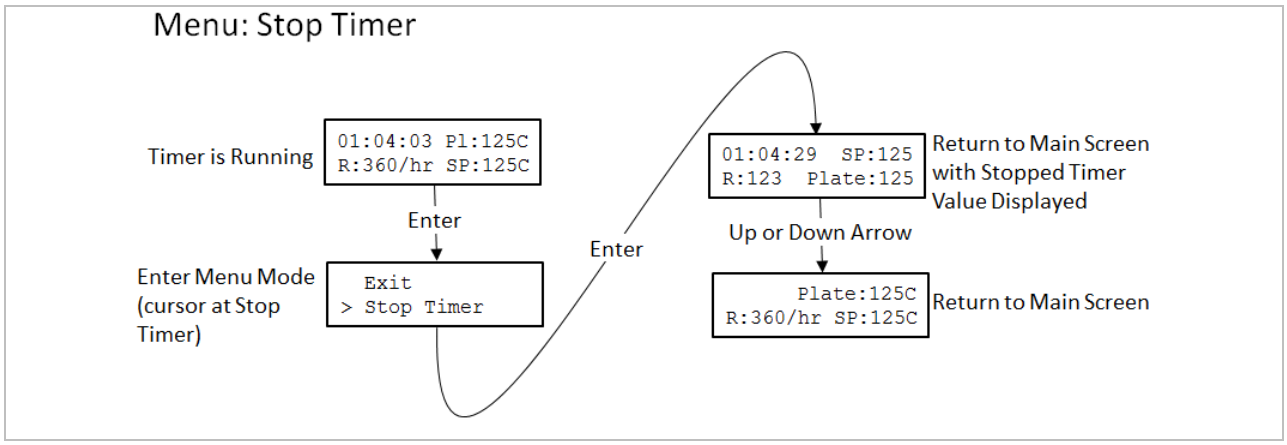


Figure 8: Menu Map to Stop the Running Timer

MENU: Heater OFF

The menu option “Heater OFF” enables the user to turn off power to the plate. When in Heater OFF Mode, the HP90 controller stops controlling the plate temperature based on the set point value. In this state the set point is essentially off so the LCD display indicates “off” when the unit is in Heater OFF Mode.

The unit will enter Heater OFF Mode in multiple ways:

1. By using the down arrow button and scrolling down to the lowest value (“off”)
2. By using the Menu option (“Heater OFF”)
3. By setting the “Auto-Off” option to “yes” in the Timer Options menu. The HP90 will enter Heater OFF mode when the countdown timer reaches 00:00:00.

The unit will cancel Heater OFF Mode in the following ways:

1. By pressing the up arrow button then setting a new set point starting at 20C.
2. By using the Menu option (“Heater ON”)

If Heater OFF mode is cancelled by pressing the up arrow button, the set point will always start at 20C. If the menu is used to enter and cancel Heater OFF mode, the previous set point value will be restored. Table 2 is an example of the actions and responses of the various Heater OFF/ON options.

Set Point Was	Turn Heater OFF	Turn Heater ON	Set Point Now
125	Down button to "off"	Menu:Heater ON	start at 20
		Up button press	
	Menu:Heater OFF	Menu:Heater ON	125
		Up button press	start at 20

Table 2: Heater OFF/ON Example with Set Point = 125C

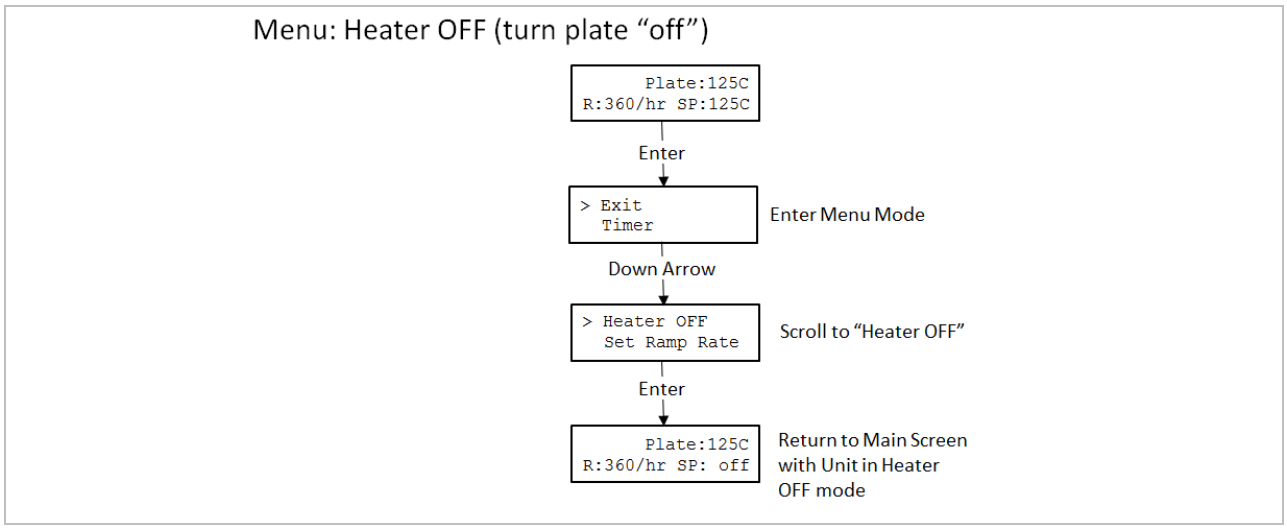


Figure 9: Menu Map to Set Heater OFF Mode and Retain Previous Set Point

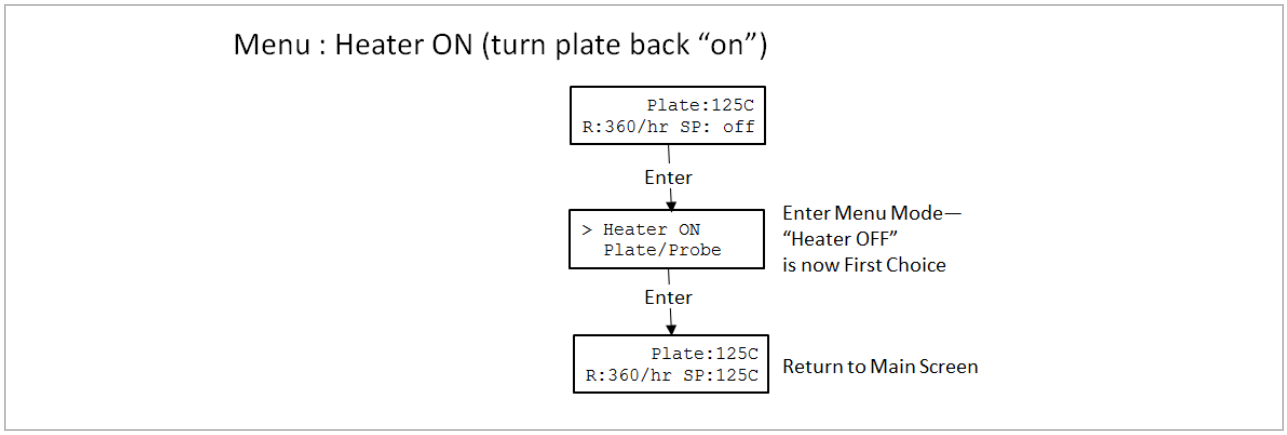


Figure 10: Menu Map to Set Heater ON Mode and Restore Previous Set Point

MENU: Set Ramp Rate

The menu option “Set Ramp Rate” enables the user to set the rate that the HP90 will attempt to heat or cool the plate. The value may be 1C/hr to a maximum of 450C/hr. A value of 0 will read as “off” and will be interpreted as “disable ramping” which means that the HP90 controller will heat and cool as quickly as possible. **The ramp rate feature is intended to slow heating rates. For the fastest heating rates, set to “off”.**

It is important to note that the ability of the HP90 unit to achieve the set ramp rate is dependent on the thermal load applied to the plate. If the thermal load is too high for the Ramp Rate set, the HP90 will “heat as fast as possible”.

The Ramp Rate also applies to cooling. Since the HP90 does not have the ability to actively cool, the rate of cooling will be dependent on the difference between the plate and ambient temperatures. If the Ramp Rate value set is incompatible with the plate/ambient conditions, the HP90 will simply “cool as fast as possible”.

When the unit is in Heater OFF Mode, any ramp rate value entered is ignored.

NOTE: Use of the ramp feature always requires entering a ramp value prior to entering a set point temperature. If a ramp rate is required that is different from the currently stored ramp rate, the ramp rate must be changed before a new set point temperature is entered. If a different ramp rate is set after a new set point temperature has been entered, the HP90 will heat or cool per the previous ramp rate—not per the different ramp rate.

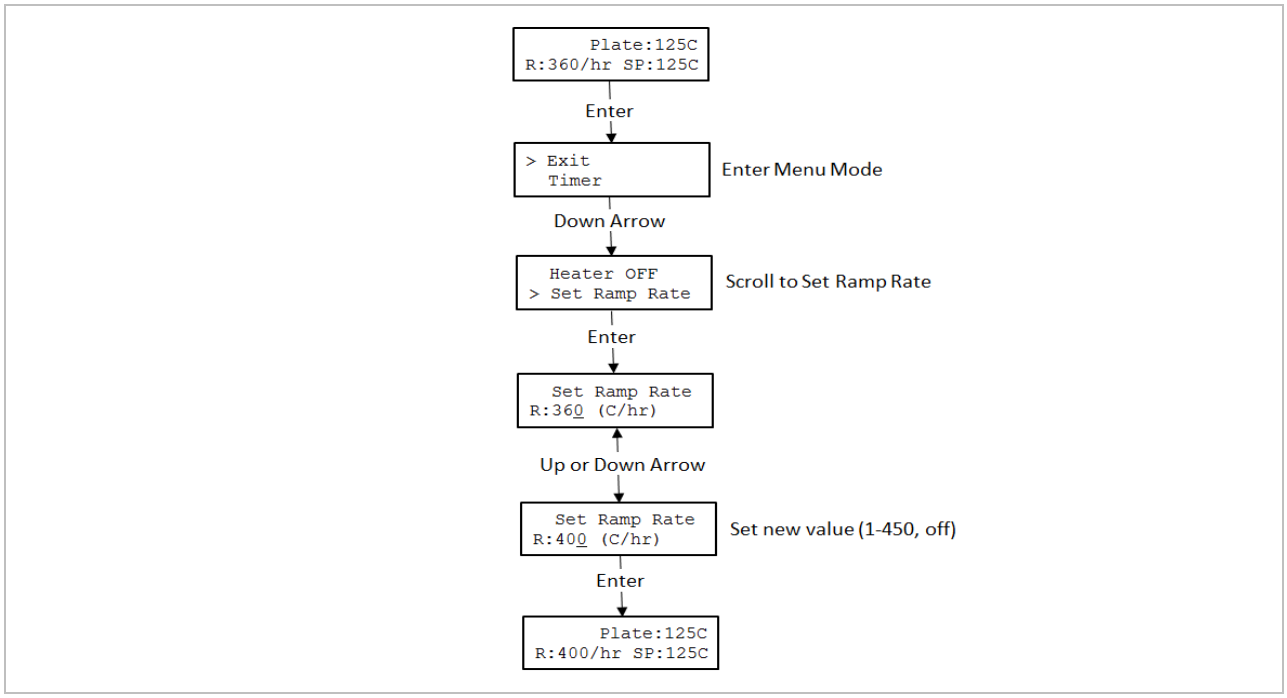


Figure 11: Menu Map to Set Ramp Rate

MENU: Program

The HP90 Hot Plate Controller enables the user to define up to 5 individual programs consisting of up to 10 steps per sequence. The “Program” Menu option provides the ability to choose a program to run or to edit. Figure 12 below shows the menu map for the Program feature.

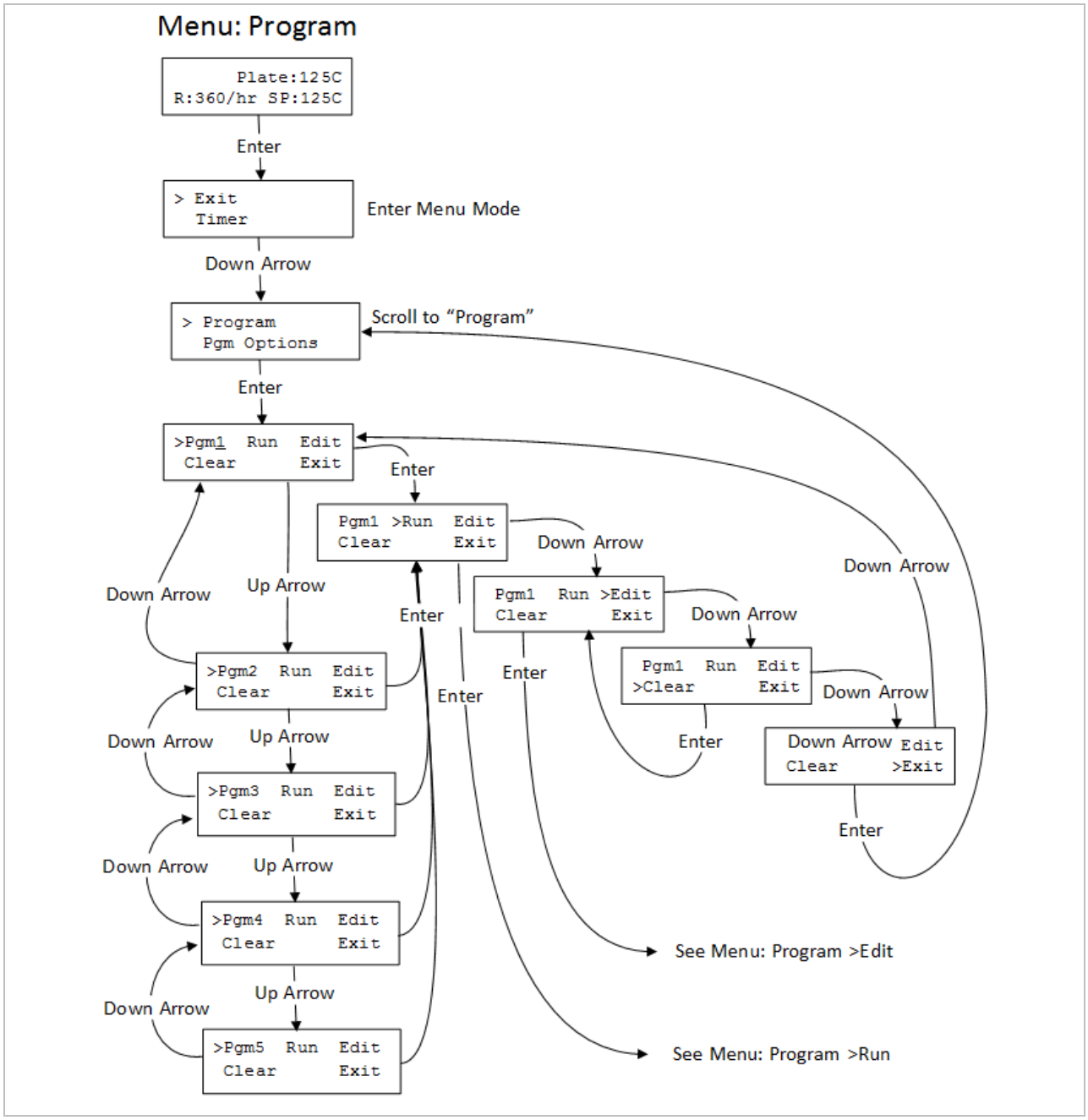


Figure 12: Menu Map For Program Control

MENU: Program >Edit

To start a program from scratch, select the “clear” option in the Program Menu before selecting “Edit”.

The Program >Edit sub-menu selection enables the user to specify the values for the Set Point, Ramp Rate, and time for each step in the program sequence. Figure 13 below provides a description of the items shown on the LCD in the Program >Edit mode.

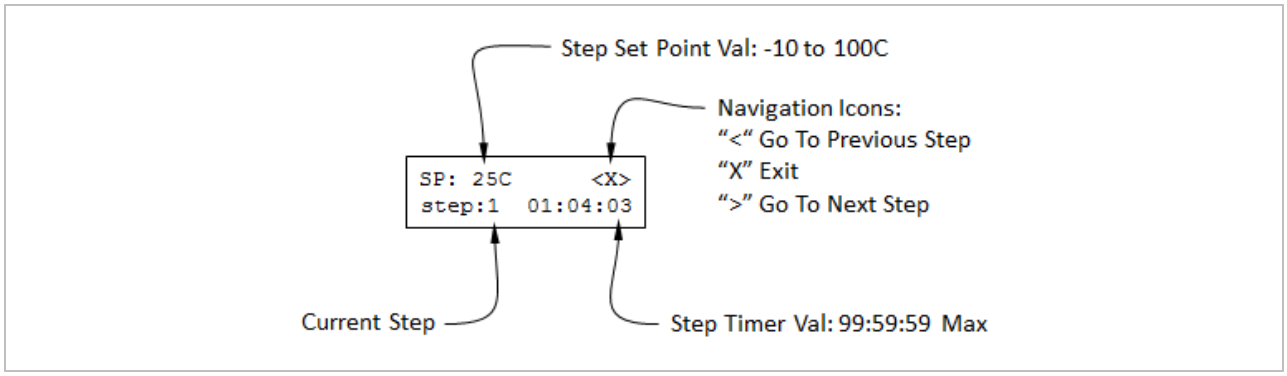


Figure 13: Description of Items in Program >Edit Screen

Figure 14 below shows the keystrokes required to set the values for each step parameter and how to navigate from one step to the next.

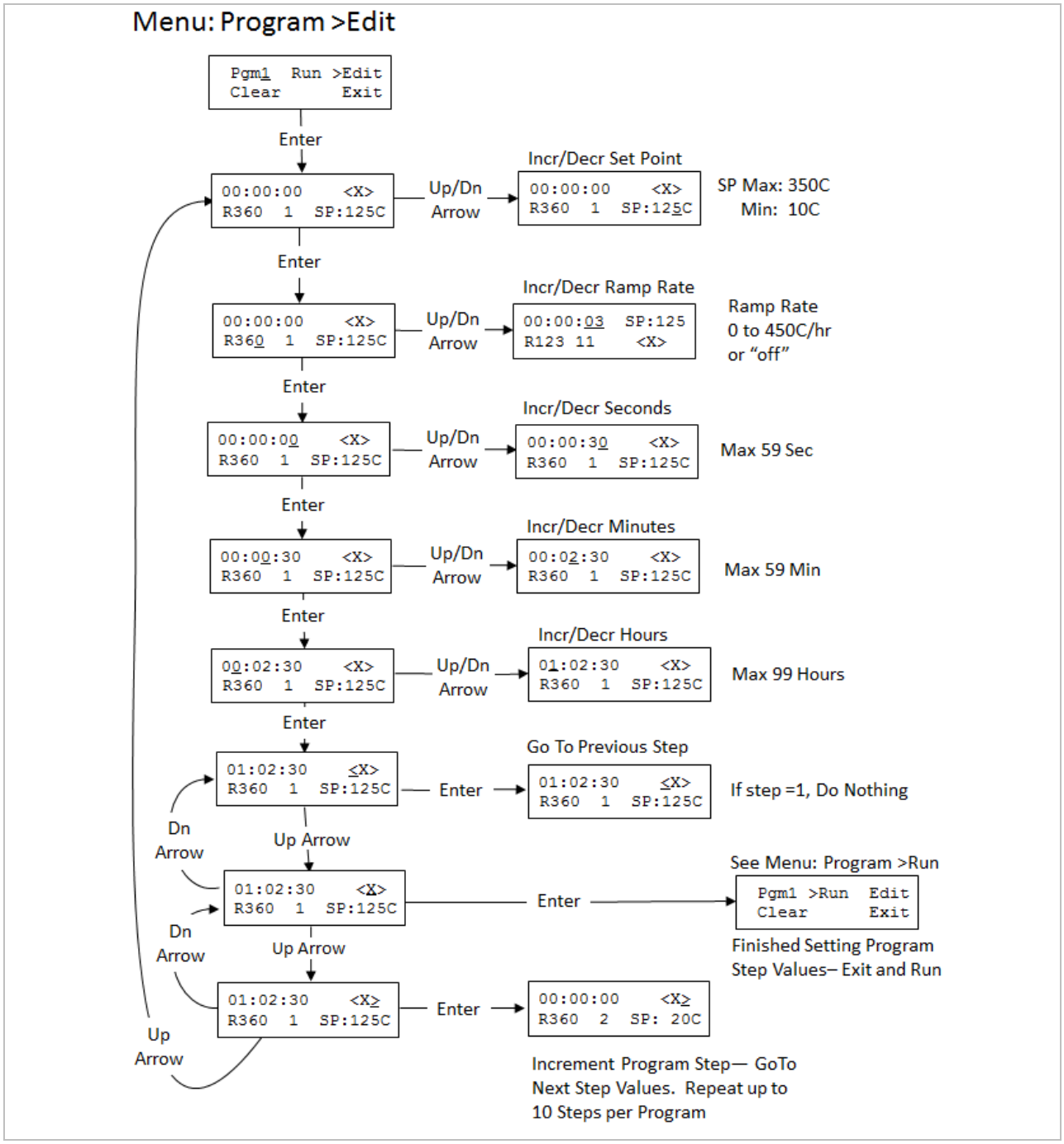


Figure 14: Menu Map For Defining or Editing Program Steps

MENU: Program >Run

The Program >Run sub-menu selection enables the user to specify the number of cycles that the program will repeat before ending. The range for cycle values are 1 to 99 and “in” which means infinite—the program will repeat until the user stops the program.

If power is interrupted while a program is running, both the HP90 and the Hot Plate Controller will provide notification when power is restored. The message “Power Failure During Program” will be displayed on the Hot Plate Controller LCD display and the LED ring on the HP90 will blink rapidly. Pressing any button will cancel the notification and return the unit to the default display.

Figure 15 below provides a description of the steps and keystrokes required to define the program cycles and to start the program running.

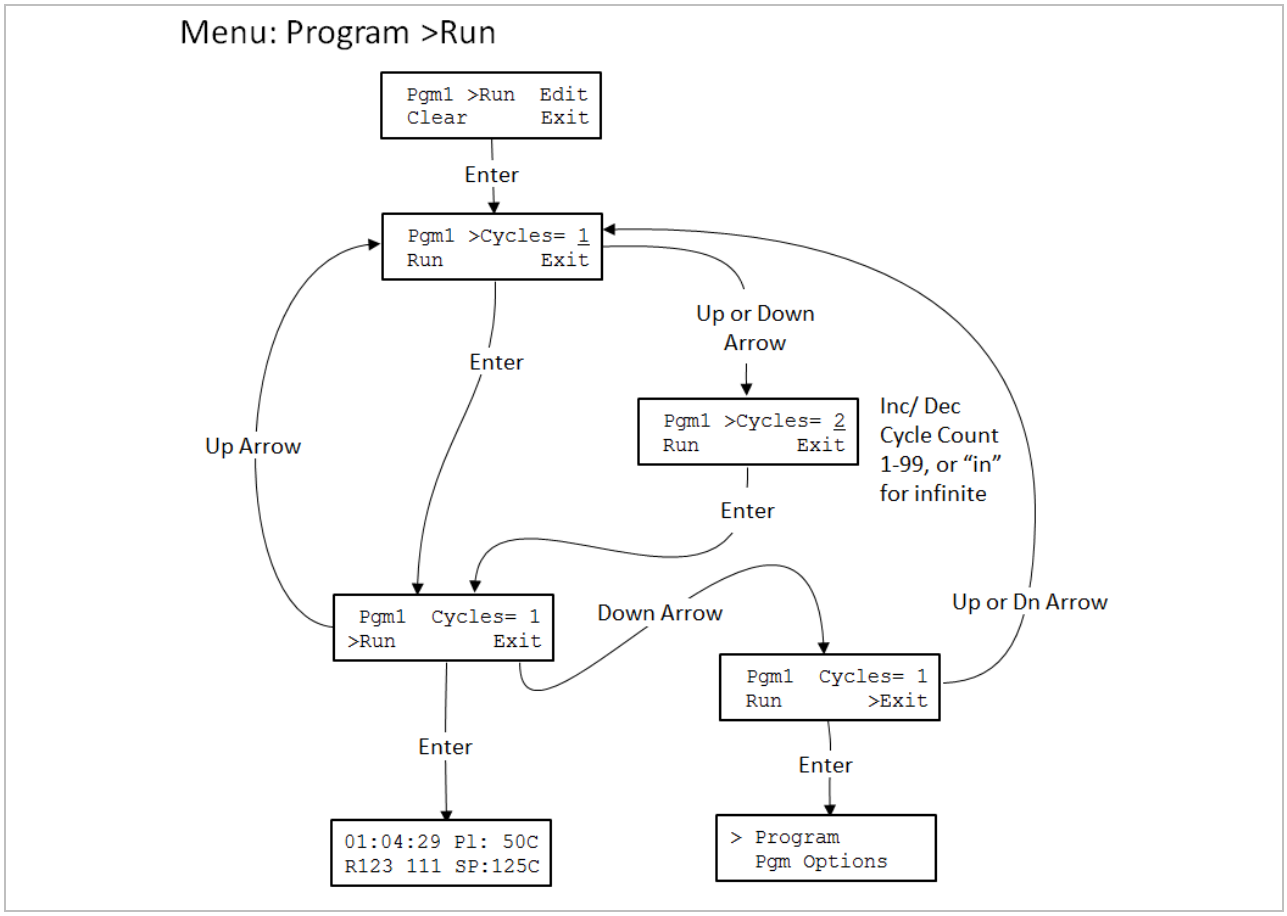


Figure 15: Menu Map For Setting Program Cycles and Running Program

MENU: Pgm Options

The menu option “Pgm Options” enables the user to specify if each step in a program sequence should wait for the Plate temperature to equal the Set Point temperature for the program step before beginning to decrement the step timer. If the option is set to “no”, the step timer will begin to decrement immediately when the next program step starts. This means that the transition time required to go from one step temperature to the next will be included in the step time.

The “Timer Waits” Program Option is global meaning that it applies to every step in the program.

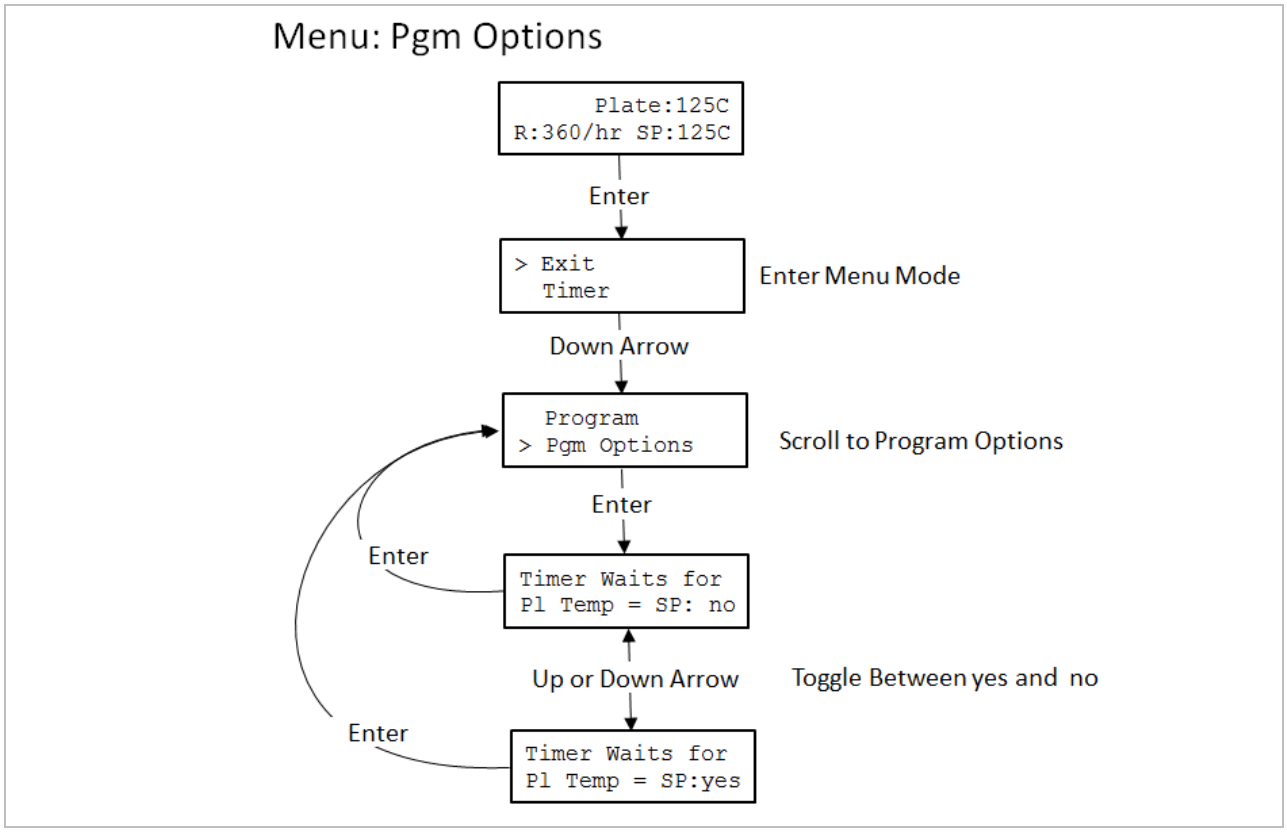


Figure 16: Menu Map For Setting the “Timer Waits” Program Option

MENU: Timer Options

The menu option “Timer Options” enables the user to choose what happens when the countdown timer reaches 00:00:00. The options include enabling/disabling the Alarm tone and/or enabling/disabling the “Auto-Off” feature.

If the Alarm Tone option is set to “yes”, when the timer times out the piezo beeper will sound for 60 seconds or until the user presses any button on the front membrane of the HP90 Hot Plate Controller. If the Alarm Tone is set to “no”, no sound will be emitted when the timer times out.

If the “Auto-Off” option is set to “yes”, the HP90 unit will be set to Heater OFF Mode when the timer times out. See Menu: Heater OFF for more information on Heater OFF Mode.

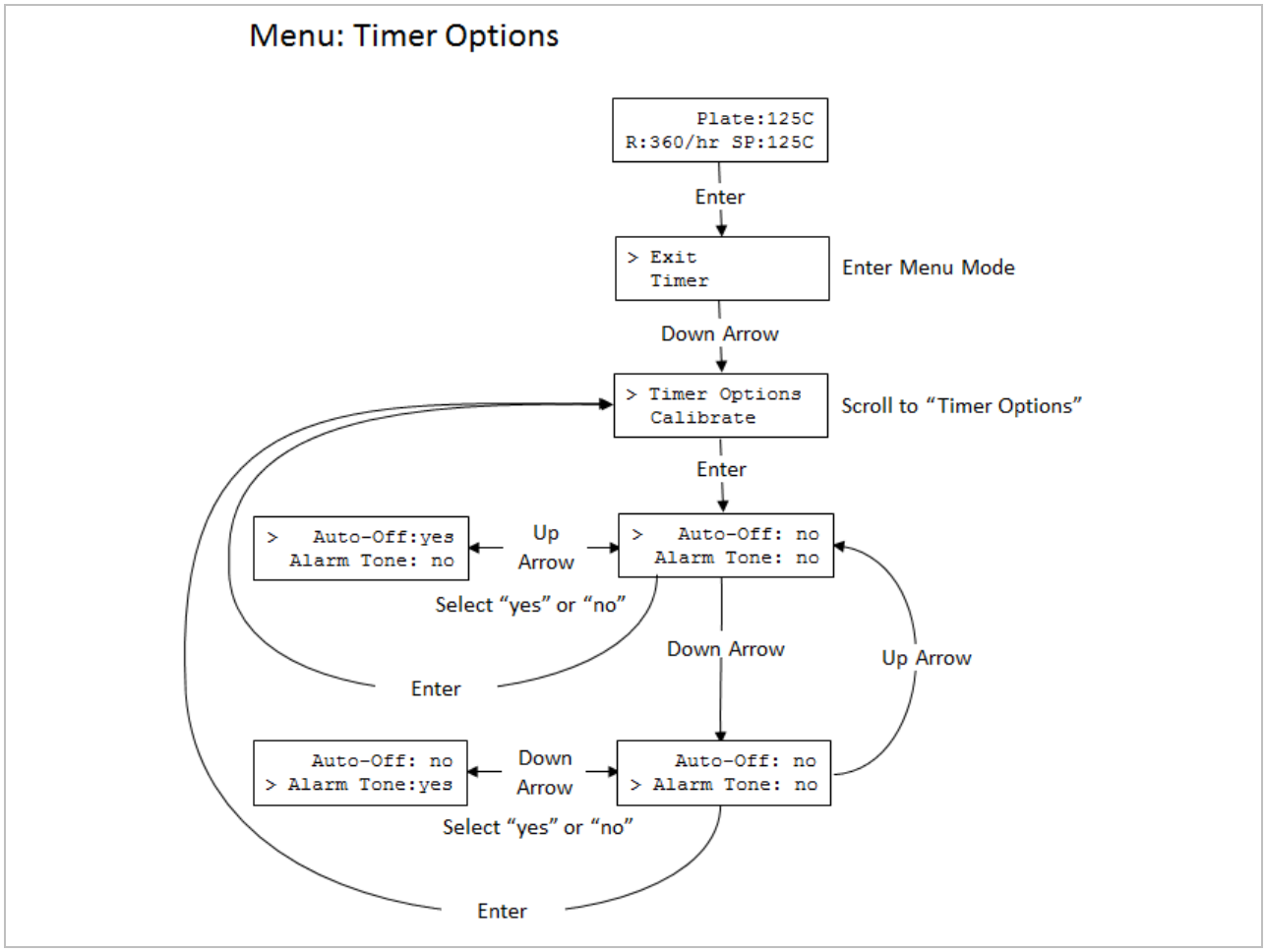


Figure 17: Menu Map For Setting and Clearing Timer Options

MENU: Calibrate

The HP90 Bake Plate incorporates two point calibration to adjust for offsets in the temperature measurement circuit. Every HP90 is calibrated (traceable to NIST) at ambient and at 250C at the factory before shipment. This provides accurate linear plate temperatures between these two points. It is stable and will hold without drifting.

However, our standards for temperature measurement may not be the same as the users. The menu option "Calibrate" enables the user to calibrate the HP90 in the field based on their particular standards. In that case, the unit can be calibrated both at a "Low" and "High" temperature points that are appropriate for the expected range of use.

The re-calibration procedure is generally to set the HP90 to the required temperature. When the unit reaches the Set Point temperature, let it remain at the Set Point temperature for an additional 15 minutes or more to make sure everything is steady. Prepare to measure the temperature of the point of reference (example: the center of the Plate surface) using an external measurement instrument, and navigate to the Calibrate menu option on the HP90 Hot Plate Controller. Input the measured temperature to 0.1C for the appropriate "Lo" or "Hi" calibration point.

If the unit is intended to be exclusively used at a single temperature, then single point calibration might be appropriate each time that temperature is changed. **NOTE: Changing a single calibration point will affect the linearity/accuracy of the unit at other temperatures. If the unit is to be used at multiple temperatures, it is recommended that the unit be reset to factory calibration settings (ref: "MENU:Reset Cal Pts").** The choice of setting the specific "Hi" or "Lo" Temp Calibration point for single point calibration is dependent on the expected temperature that the HP90 is intended for use. Generally, if the single point temperature is below 100C, the "Lo" cal point should be selected. Above 100C, select the "Hi" cal point. Ensure that the external temperature measurement is stable and enter the measured value into the "Measured:" field in the calibration screen*. Figure 18 provides a guide for navigating through the calibration options.

*NOTE: PLATE SURFACE MEASUREMENTS ARE DIFFICULT TEMPERATURE MEASUREMENTS TO MAKE ACCURATELY. Use temperature probes specifically designed for surface temperature measurement and a digital meter that can accurately measure to 0.1C. Ensure that the unit and the measurement device have had sufficient time to stabilize at the new calibration temperature prior to entering in Measured Temperature Value. If the temperatures are not stable when the measured temperature value is entered, significant display and unit performance errors may result. Check with the factory if help is needed. Also, a calibration kit is available.

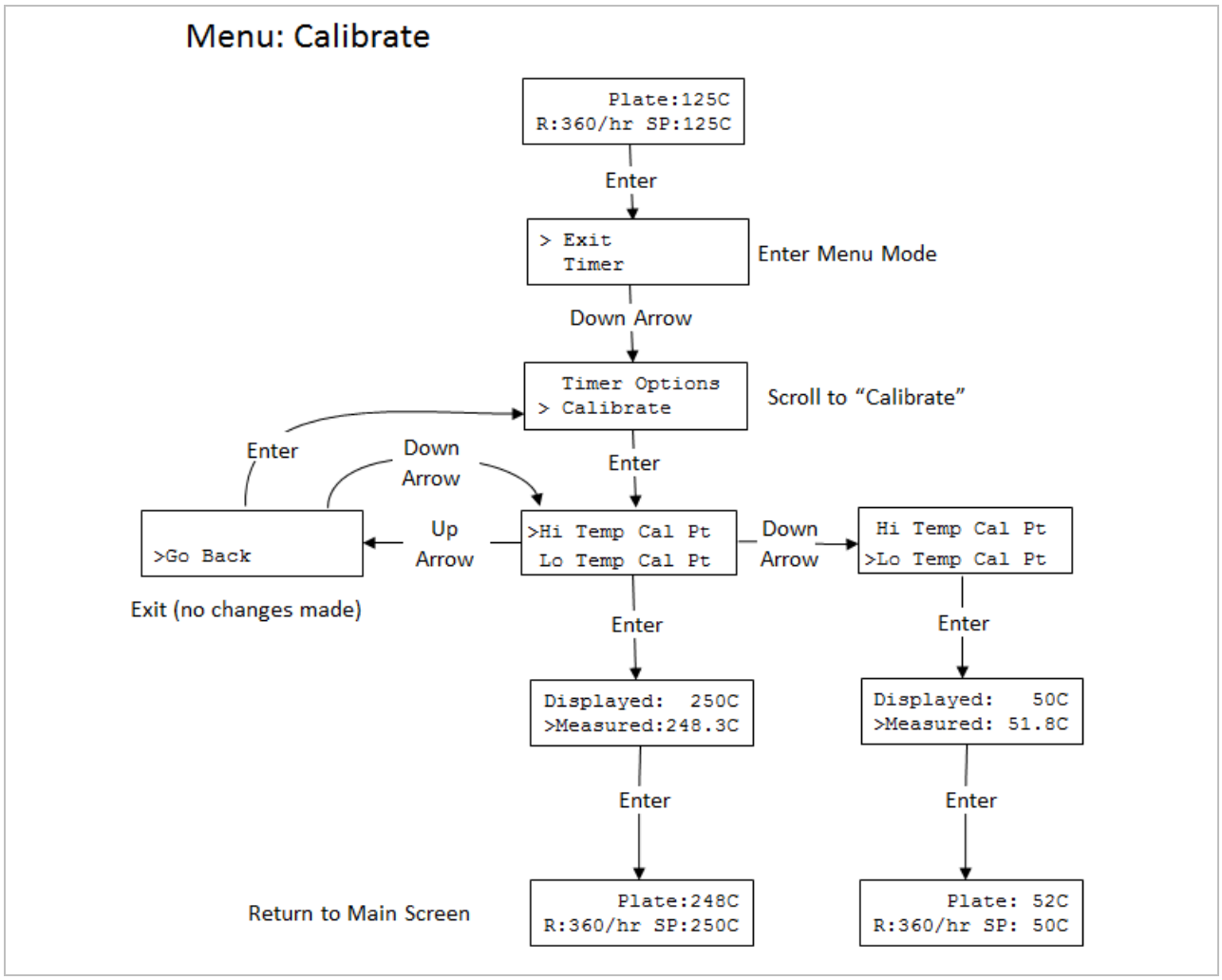


Figure 18: Menu Map For Setting Program Cycles and Running Program

MENU: Reset Cal Pts

The HP90 Bake Plate incorporates two point calibration to adjust for offsets in the temperature measurement circuit. Every HP90 is calibrated at the factory before shipment. The menu option “Calibrate” enables the user to calibrate the HP90 in the field based on their particular standards. In the event that the user calibration results in corrupted performance, the factory calibrations can be easily restored using the “Reset Cal Pts” menu option. There is a choice of restoring only the High or Low calibration point as needed. Figure 19 below shows the steps required to restore the factory calibration values.

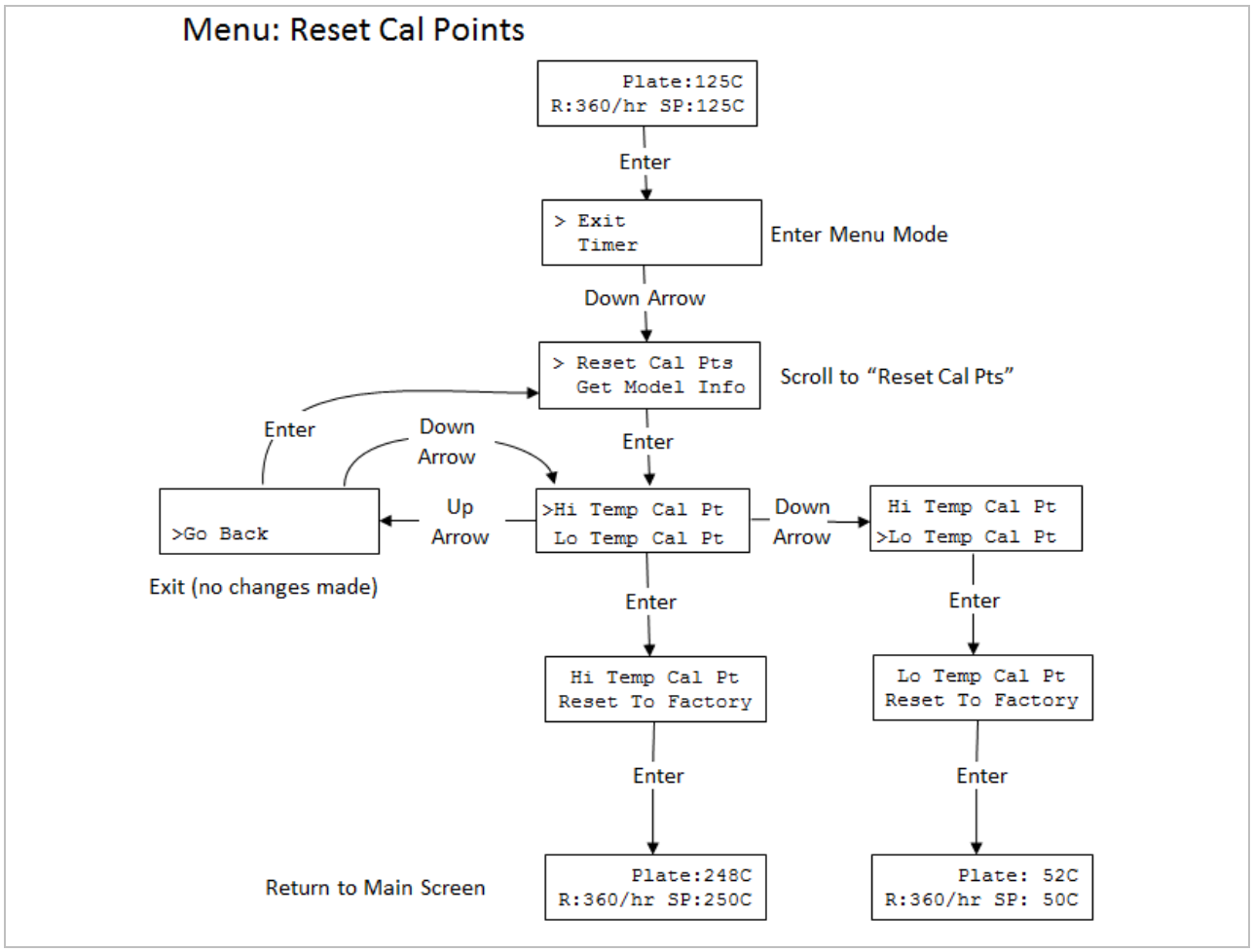


Figure 19: Menu Map For Resetting Calibration Points to Factory Values

MENU: Get HP90 Info

The menu option “Get HP90 Info” enables the user to determine the firmware version and the serial number of the HP90 unit to which it is connected. Figure 20 below shows the keystrokes to display the HP90 info.

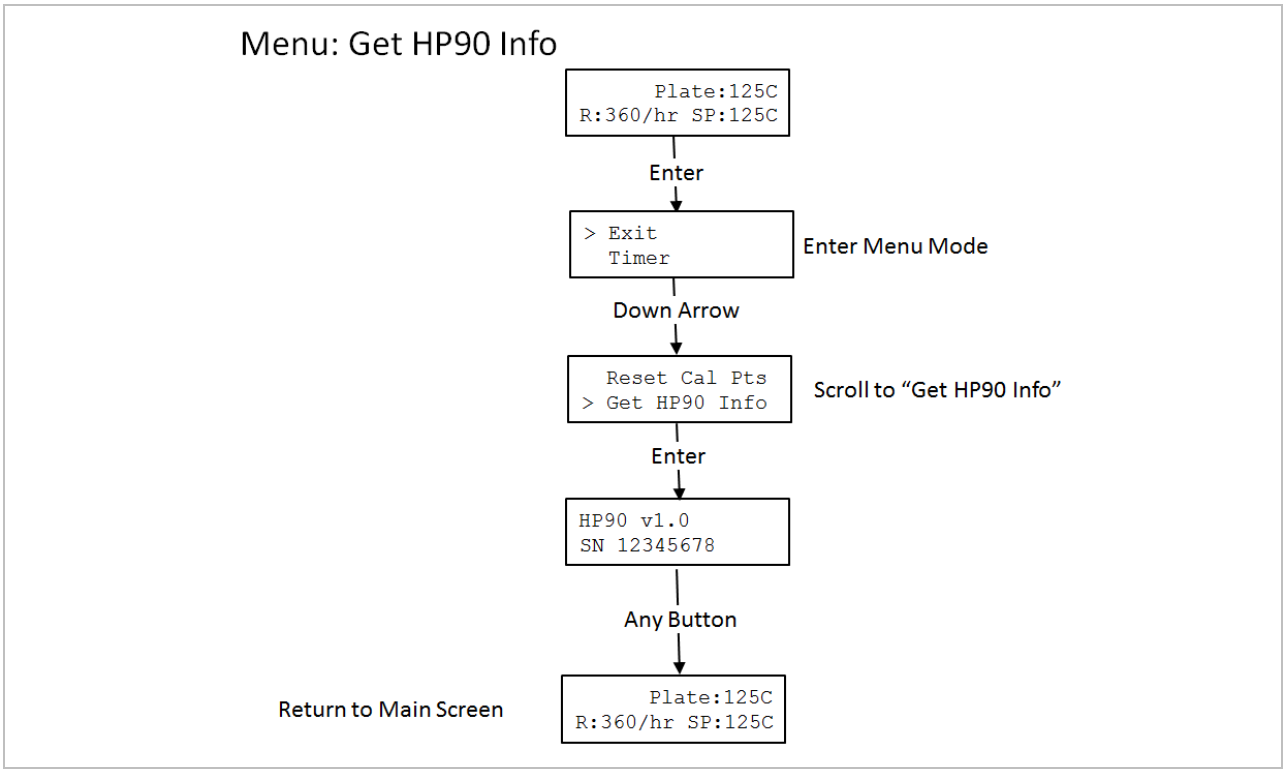


Figure 20: Menu Map For Accessing the HP90 Firmware Version and Serial Number

XII. TEMPERATURE MEASUREMENT ERROR CODES

If an issue occurs with the temperature measurement circuitry or with a calibration value, the unit will display the error code in place of the plate temperature value. If an error is detected, the unit will go into Heater OFF mode (power to the heater plate will be turned off). Table 2 below lists the error codes, the likely cause, and recommended action to address the error. Calibration errors (cal0-cal4) are easily addressed by performing the action to reset the appropriate calibration points to the factory settings. The unit can then be re-calibrated if necessary.

Error Code	Possible Cause	Recommended Action
RTDo	The RTD Sensor is not connected or has failed	Inspect Sensor and Sensor Connector and/or Contact Torrey Pines Scientific
RTDs	The RTD Sensor has shorted or has failed	
cal0	The Calibrated Temperature Value is out of range	Reset High, Low, or Both Cal Points
cal1	Low Cal Point out of range	Reset Low Cal Point
cal2	High Cal Point out of range	Reset High Cal Point
cal3	High Point Measured Cal Value is Lower than Low Point Measured Value (or reverse)	Reset High, Low, or Both Cal Points
cal4	High Point Temperature Value is Lower than Low Point Temperature Value (or reverse)	

Table 3: Temperature Measurement Error Codes

XIII. RS232 INTERFACE

The RS232 is available through the 9-pin D-subminiature connector on the rear of the unit. Pins 2, 3 and 5 on the connector are used. It operates at 9600 baud, 1 stop bit, no parity. No handshake hardware or software is necessary. All communications settings and queries are done using ASCII characters with carriage return as the terminating character. **See instructions at the end of this manual for the Serial Command Set.**

Note: To comply with CE and to avoid possible EMI radiation from the RS232 cable, use a shielded cable.

XIV. CLEANING, MAINTENANCE, AND CONSUMABLE PARTS

CLEANING

These units are subject to splashes and spills during normal use. Be sure to wipe up all spills with a soft cloth or paper towel as soon as they occur. If a cleaning solution is necessary, use a mild soap or detergent solution and a soft cloth. Do not use solvents.

Caution: Do not attempt to clean the plate surface when hot. Burns might occur.

MAINTENANCE

There is no ongoing maintenance program needed with these units other than the normal care and cleaning as instructed above, and a simple inspection done whenever the unit is to be used. This simple inspection should include:

1. Checking that the AC cord and the serial cable to and from the heater module are not frayed or burned.

2. Checking that the unit is not dirty to a point where proper performance is impaired. This is especially important relative to the membrane switch and LCD window.

3. Being certain to store the unit properly, when not in use, in an area that will not have items placed on top of the unit, and covering the unit in a way that will keep dirt and other foreign bodies out of the unit.

Note: Outside electrical interference such as lightning might on occasion cause the unit to lock up or change target temperature without being instructed to do so. The unit should be reset if this happens. See "Troubleshooting/Resetting the Unit" section of this manual for details.

TROUBLESHOOTING

Resetting the Unit:
Like all microprocessor controlled electronics, the HP90 and Hot Plate Controller may encounter situations when a master reset is appropriate. To reset the unit, turn off the Hot Plate Controller power switch then turn it back on while holding down one of the front panel buttons (Up Arrow, MENU/ENT, or Down Arrow) until 3 dots appear sequentially. Continue to hold down the button until the screen reads “Unit Reset”. At that time release the button and the unit will start up in the as-shipped configuration from the factory.

All calibrations, user settings, and PID values will revert to factory settings. In typical operation, the Reset will rarely if ever be necessary. The default values are shown in the table below:

Parameter	Default Value
Set Point	20
Ramp Rate	0
Cal Point Low	factory
Cal Point High	factory
Timer	0:00:00
Broadcast Period	0:00
Broadcast Events	none
Status Byte	0
User String	cleared

Contact Info:
For assistance, contact the factory at:
Torrey Pines Scientific, Inc.
Email: techsupport@torreypinesscientific.com
Phone: (760)930-9400

SPARE PARTS AND CONSUMABLES

There are very few spare or consumable parts. A simple list is below.

Part Number	Description
380-0012	Fuse,15A 125VAC Slow Blow 5x20mm
380-0011	Fuse, 8A 250VAC 5x20mm
730-0001	Power Cord, US
730-0002	Power Cord, Germany (European)
730-0003	Power Cord, UK
730-0004	Power Cord, Italy
730-0005	Power Cord, Australia/China

XV. ADDITIONAL SYMBOLS

The following are additional symbols found on labels on the instrument

Symbol	Description
V	Voltage
~	Alternating Current
A	Current
Hz	Frequency
W	Power

APPENDIX A: Example Programming Scenarios

The programming functionality available in the Hot Plate Controller enables the user to define up to 10 specific sequences and run the sequences automatically for a specific number of cycles or infinitely. There are 5 possible programs available which means that up to 5 different 10step sequences can be defined.

Each program step is the value for the set point, the ramp rate, and the starting value for the countdown timer. When the countdown timer reaches 00:00:00, and another program step is available, the values for the next step are loaded until the last step is reached.

There are global settings which can modify the behavior of both the running and the finished program. If MENU:Pgm Options, “Timer Waits for Pl Temp = SP” is set to “no”, then each step timer will start to decrement immediately after the step is loaded. If it is set to “yes”, then the timer will wait until the plate temperature is equal to the set point temperature for that step before it begins to decrement. Basically, if set to “no”, then the time to get to the set point and the time at the set point are combined in the step time. If set to “yes”, the step timer value only refers to the time at the set point temperature.

If MENU: Timer Options, “Auto-Off” is set to no, then the unit will remain at the last step set point value when the program ends. If it is set to “yes”, then the unit will enter “Heater OFF Mode” when the program ends which means that power will be removed from the heater plate and the unit will cool down as if unplugged (SP will read “off”).

The “wait until” and “Auto-Off” features are global—they cannot be assigned to individual steps. However, the Heater OFF mode is an available set point in each of the program steps. Using the appropriate combination of global settings and step settings offers flexibility in defining the behavior of a program both running and upon completion.

The following examples are provided to illustrate the settings for four sample programming scenarios.

Programming Example 1: No Wait-Until, No Auto-Off

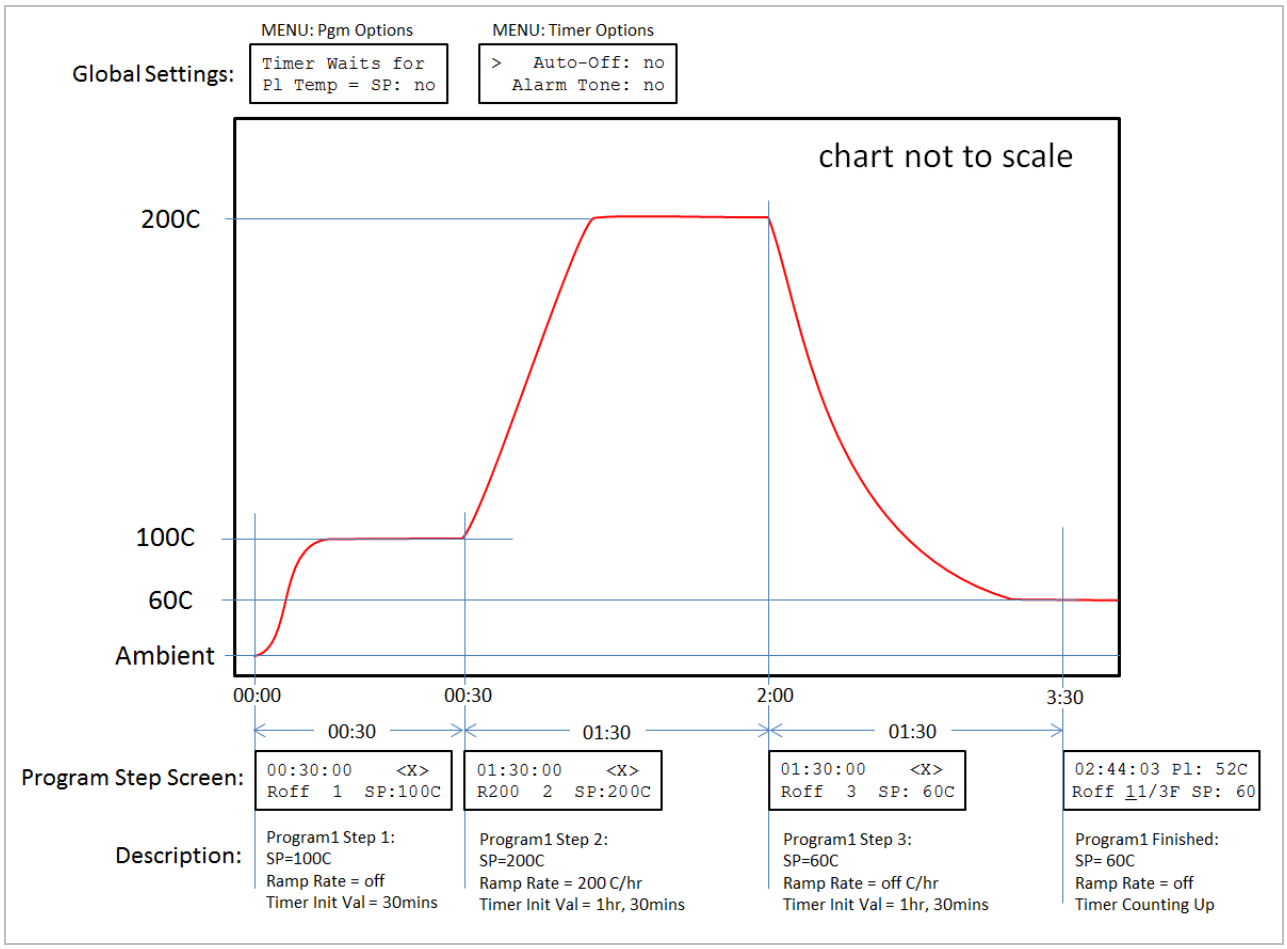


Figure 22: Global Wait-Until and Auto-off are Both Disabled

If the “wait until” and “Auto-Off” features are set to “no”, then Figure 22 above illustrates a three step program where the first step has a set point of 100C, the ramp rate is off (disabled), and the countdown timer starts at 30mins. When the first step is running, the plate will heat as fast as the controller will allow until the plate temperature is 100C. The plate temperature will then remain at 100C for the remainder of the 30minutes. When the timer reaches 00:00:00, step 2 loads it’s values and begins to execute. In step 2, the set point is 200C, the ramp rate is 200C/hr, and the countdown timer value is 1 hour, 30 mins. When step 2 is running, the heating rate is slowed down compared to no ramp and the rate is limited to 200C/hr. In step 3, the ramp rate is disabled and the unit is allowed to cool as quickly as it can to the new set point of 100C. In this example, the program ends with the same values as the last step. When the program ends, the timer will begin counting up until the user presses a button on the Hot Plate Controller to return to the default screen.

Programming Example 2: Auto-Off is Enabled

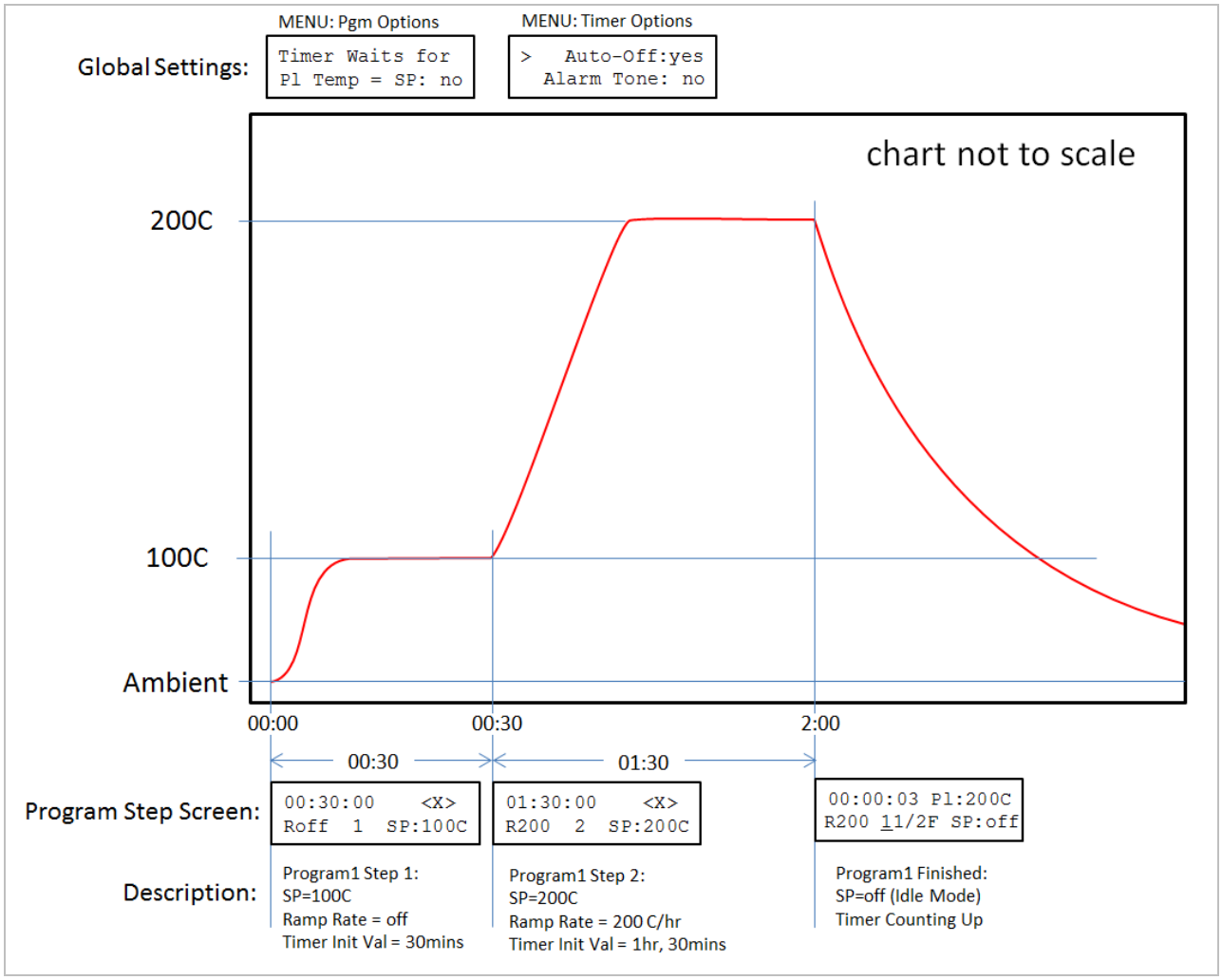


Figure 23: Global Wait-Until is “off” and Auto-off is “on”

In Programming Example 1, it may not be necessary to define a specific temperature for the last step—it may be sufficient or required to simply “turn the plate off” on the last step. Figure 23 above shows the modifications to the Figure 22 example. First, set the global setting MENU: Timer Options “Auto-Off” parameter to “yes”. This means that on the last step the unit will enter Heater OFF Mode and effectively “automatically turn off”. Since the unit will turn off after it is finished, step 3 in Figure 22 is no longer necessary. After step 2 the program will end and the timer will begin counting up until the user presses a button on the Hot Plate Controller to return to the default screen. It should be noted that when the unit is in Heater OFF Mode, any ramp rate value is ignored.

Programming Example 3: Wait-Until is Enabled and Auto-Off is Enabled

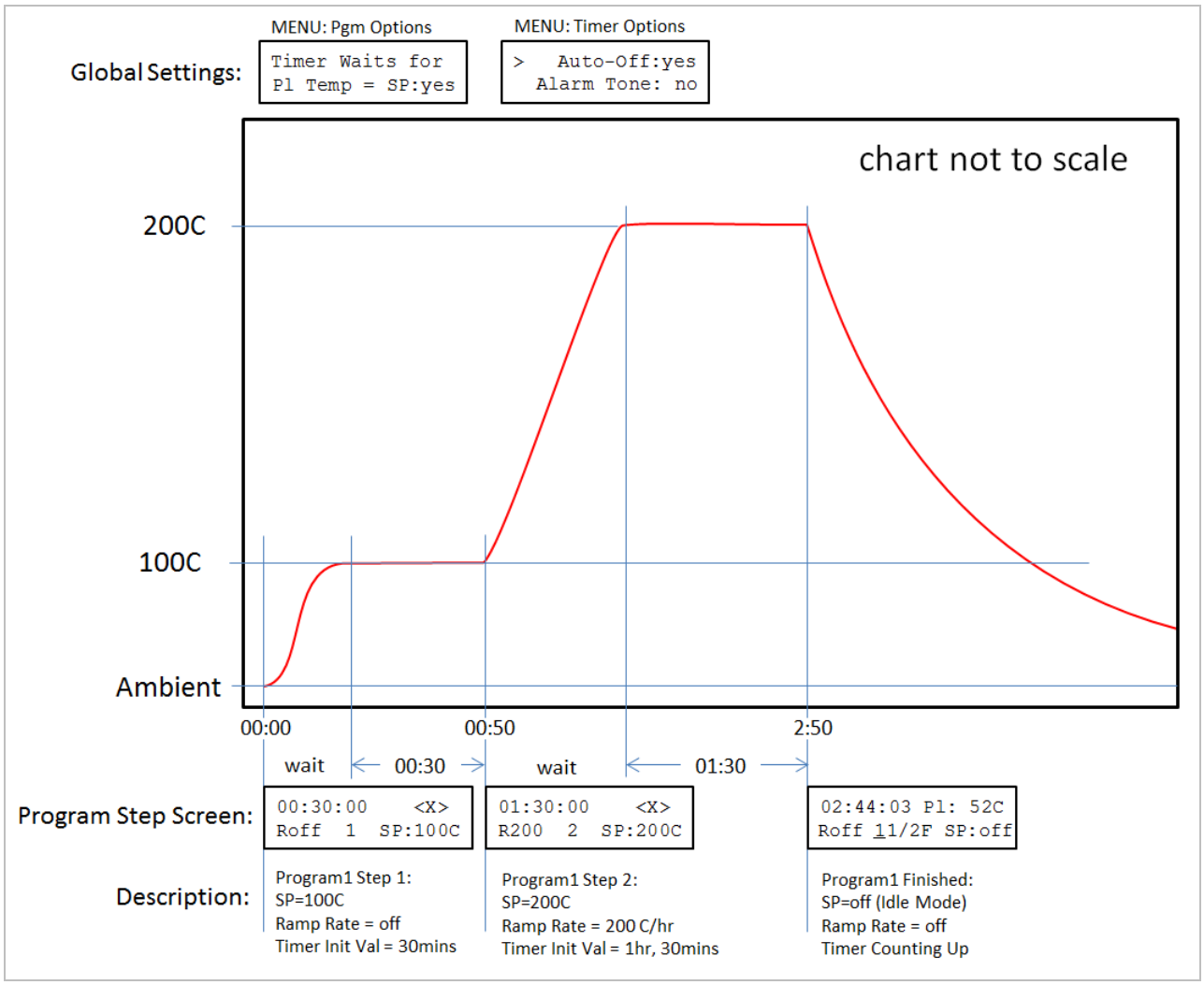


Figure 24: Global Wait-Until is “on” and Auto-off is “on”

In both Programming Examples 1 and 2, the time to reach the set point temperature was included in the step countdown timer value. In situations where the time at the set point temperature is important, the global MENU: Pgm Options “Timer Waits for Pl Temp = SP” option causes the unit to wait until the plate temperature is equal to the new set point temperature before the timer begins to decrement the step timer value. The behavior is illustrated in Figure 24 above where the unit simply “waits” during the temperature change periods. This example is the same as Programming Example 2 with the wait-until feature enabled. It should be obvious that only enabling the wait-until global setting will result in an increase in the overall time to complete a sequence. After step 2 the program will end and the timer will begin counting up until the user presses a button on the Hot Plate Controller to return to the default screen

Programming Example 4: Final Cool-Down Ramping

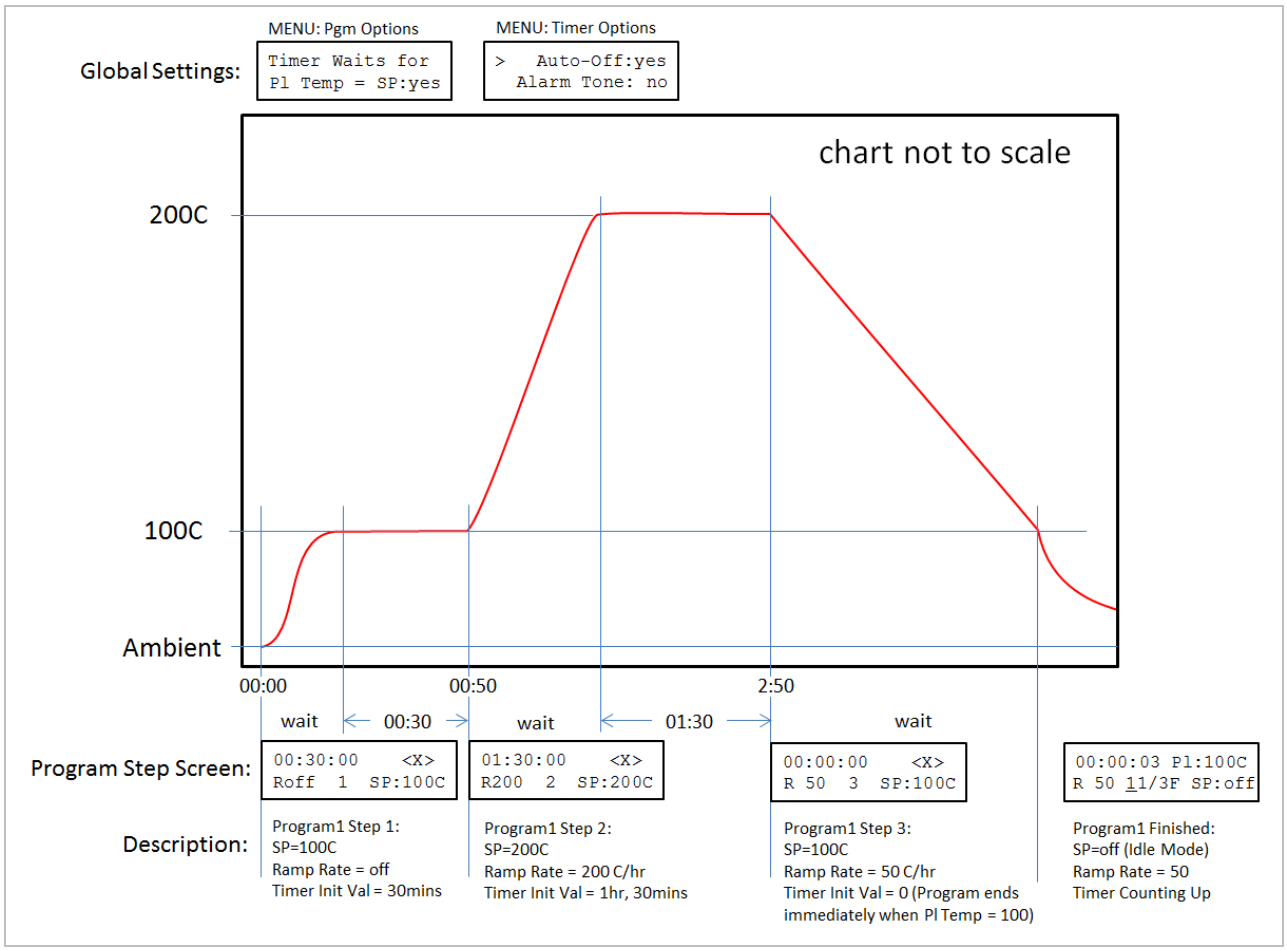


Figure 25: Cool Down Ramping

Programming Example 3 can be extended to control the rate of cooling down in the final step. In this example, both the wait-until and the auto-off settings are enabled so the unit will end in Heater OFF Mode. But we will add a step 3 that will define a cool-down ramp rate to an achievable temperature. In Figure 25 above, the step 3 ramp rate is set to 50C/hr and the new set point is set to 100C. Since the wait-until global feature is enabled, the unit will maintain the cooling rate of 50C/hr until the 100C plate temperature is reached. At that point the step 3 countdown timer will attempt to decrement but since the value is already 00:00:00 step 3 will immediately end and the program will immediately finish. Since the Auto-Off global feature is enabled, the unit will go into Heater OFF mode and the timer will begin counting up until the user presses a button on the Hot Plate Controller to return to the default screen.

It should be noted that the step 3 timer could be set to a non-zero value but it is assumed that in this example it's not necessary to dwell at the 100C set point but instead it is required to cool down at a slower rate than natural cooling above some

point. if the final step ramping set point temperature is not achievable, and the wait-until feature is enabled, the program will never finish. For example, if the set point of 100C in Figure 24 step 3 was instead less than ambient, the unit would maintain the cooling rate of 50C/hr as long as it could then the plate would eventually reach the ambient temperature. The unit would appear to be “stuck” on step 3 of the running program LCD screen because the plate would never reach the set point temperature but would still wait until it does. In that case, the user would be required to use the front panel menu to stop the program.