



LHS-730 SERIES



Digital Hot Plate / Stirrer



Operator's Manual
M1593/0993

**DIGITAL HOT PLATE/STIRRER
SERIES LHS-730**

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NOTES

SECTION 1 INTRODUCTION

Congratulations on your purchase of an OMEGA ® LHS-730 Series Digital Hot Plate/Stirrer. The unit is designed to do a number of jobs within your laboratory. Please read this manual carefully to ensure that you receive the maximum benefit from your unit.

1.1 GENERAL DESCRIPTION

The OMEGA LHS-730 Series Hot Plate/Stirrer is a programmable, general purpose digital laboratory hot plate with stirrer. The Series includes the Model LHS-731 single position stirrer, the Model LHS-735 5-position stirrer and the Model LHS-739 9-position stirrer. All functions on the LHS-730 Series can be set from a digital front panel keyboard and display. Both the temperature and the stirrer speed are controllable to an accuracy never before offered in similar devices.

- The LHS-730 Series Hot Plate/Stirrer contains a program memory of 75 steps. The user may enter a sequence of temperatures, stir speeds and time delays which may then be run by pressing a single button. The program memory is battery-powered so the program remains in the unit indefinitely when it is turned off.
- The LHS-730 Series Hot Plate/Stirrer also has an infrared remote control sensor circuit. The optional Model LHS-745 remote control keyboard can be used to operate the various models from distances of up to 15 feet. This typically is used in situations where the unit is kept under a fume hood or is otherwise inaccessible.

1.1.1 Heater

The heater plate is made from stainless steel coated with porcelain. The Model LHS-731 heater plate is 7 inches wide by 7 inches deep. The Models LHS-735 and LHS-739 heater plates measure 10 inches by 10 inches.

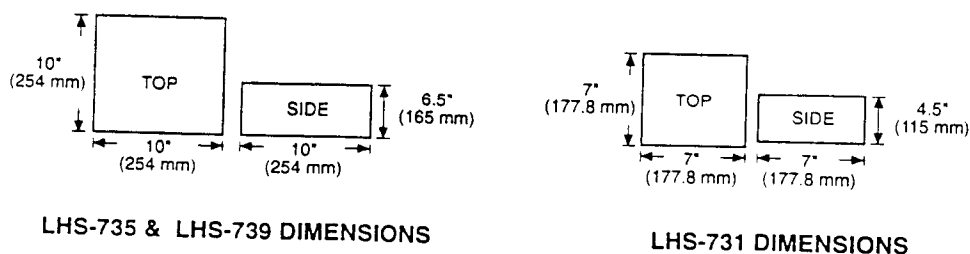


Figure 1.1. Dimensions

Either the plate surface temperature or the actual sample temperature may be set by the user. A sensor in the plate is used to monitor surface temperature. Alternatively, a temperature probe may be connected to the rear of the unit and inserted into the sample. An optional 100Ω, 3-wire, platinum RTD temperature probe is available with a 6" stainless steel, glass, or solid Teflon® jacket. When a temperature is set by the user, power is applied to the heater to control the temperature precisely at the plate surface or at the sample, as directed.

An optional "ramp value" may be entered into the unit which causes the temperature to approach the target value at a controlled rate of temperature change. The unit may also be programmed to follow any temperature versus time profile which the user desires, so long as the program does not exceed 75 steps.

Temperature may be displayed in either °C or °F as set by a rear panel switch.

1.1.2 Stirrer

The stirrer is a motor-driven magnet which, in the model LHS-731, revolves directly under the center of the heater plate. The Model LHS-735 has five motors with one placed in the center and one at each corner of the plate. The Model LHS-739 has nine stirrer motors placed in three rows of three each.

It is common practice, when heating solutions, to spin a "stir bar" (Teflon-coated bar magnet) which is placed in the solution. This assures a more uniform temperature throughout the solution.

The stirrer speed is set from the front panel keyboard and may be one of the variables in programmed operation.

1.1.3 Timer

All LHS-730 Series units have built-in timers. The timer counts down in hours, minutes and seconds, sounding an alarm when it reaches zero. You can use the timer independently of the heater and stirrer, or in conjunction with the "Auto Off" function to shut off both the heater and stirrer after a pre-set length of time.

1.2 OTHER INSTRUMENTS IN THE LHS-700 SERIES

OMEGA provides a full line of Hot Plate/Stirrers and accessories, including the following:

1.2.1 LHS-720 Series Digital Hot Plate/Stirrer

The LHS-720 Series, available in 1, 5, and 9 position stirrer models, is a general purpose, digital laboratory hot plate/stirrer. The LHS-720 Series has all of the features of the LHS-730 Series with the exception of the programmed operation and the remote infrared sensor.

1.2.2 MODEL 740 Multi-controller

Both LHS-720 and LHS-730 Series Hot Plate/Stirrers may be operated as remote stations to the Model LHS-740 Multi-Controller. The Multi-Controller connects to the units through a small cable, and is capable of controlling up to 8 units at a time. The Multi-Controller provides a number of enhancements, including 0.1 degree temperature resolution, larger program memory, real-time clock and printer interface. When connected to the Multi-Controller, front panel controls on both LHS-720 and LHS-730 Series Hot Plate/Stirrers remain operational. Also available for use with the LHS-740 Series Multi-Controller is the LHS-710 Series Hot Plate/Stirrer which is the same unit as the LHS-720 Series but has no front panel controls. It is designed to be operated remotely from the Model LHS-740 or LHS-750 Multi-Controllers.

1.2.3 MODEL 750 Plug-In Controller for Personal Computers

The Model LHS-750 remote controller is a plug-in circuit board which can control up to five LHS-700 Series Hot Plate/Stirrers from an IBM PC, XT or AT compatible computer. The user must create the command software which accomplishes the various control tasks. A "demo" software package is supplied with each unit.

SECTION 2 INSTALLING THE DIGITAL HOT PLATE / STIRRER

2.1 UNPACKING

Remove the Packing List and verify that you have received all equipment. If you have any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378 or (203) 359-1660.

When you receive the shipment, inspect the container and equipment for any signs of damage. Take note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2 SETTING UP THE UNIT

1. Place the unit on a level, dry bench or surface.
2. Plug the unit into a properly grounded, three-wire outlet of proper voltage.
3. Plug the temperature probe (if used) into the jack on the rear of the unit.

2.3 BATTERY REPLACEMENT

The battery used in all LHS-730 Series instruments is a 3 volt Lithium battery which should have a useful lifetime of at least 5 years. The replacement battery is available from OMEGA Engineering. To replace the battery:

1. Turn the unit over so that it rests on the hot plate. Use a soft cloth or paper towel between the plate surface and the workbench to ensure that the plate is not marred or scratched in the operation.
2. Use a phillips screwdriver to remove the four screws which hold the bottom plate in place.

CAUTION

ALWAYS DISCONNECT THE POWER CORD BEFORE REMOVING THE BOTTOM PLATE.

With the unit arranged so that the keyboard faces forward, the battery PC board is directly behind the front panel display on the far right. The picture below shows the approximate location of the battery on the board.

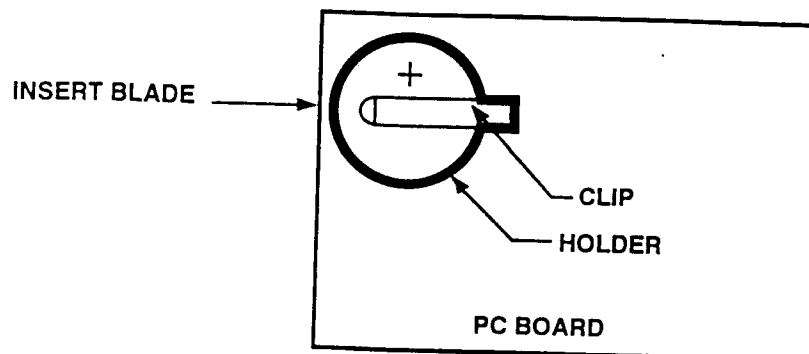


Figure 2-1. Battery Location

The battery is held in place by a metal clip in a plastic case.

3. To remove the old battery, place a small flat metal blade into the forward section of the case (as shown in the figure above) and pry upward until the sides of the battery are exposed sufficiently to force the battery out with a finger placed on either side. Use a small, flat-bladed screwdriver, pocket knife blade, metal nail file or similar tool for this operation.
4. To insert the new battery, hold the clip up and slide the battery into the case until it rests in a flat position. Make certain that the positive side of the battery faces up. The battery will not fall into place properly if it is not positioned correctly.
5. Now replace the bottom plate and the power cord and the unit is ready to operate.

SECTION 3 OPERATING THE DIGITAL HOT PLATE / STIRRER

The Digital Hot Plate/Stirrer is simple to use. Once you've learned, you won't want to twist a dial or knob on another hot plate/stirrer again.

3.1 OPERATING INSTRUCTIONS

1. Place the sample on the heater plate. Put the temperature probe and stir bar into the sample. Position the vessel properly on the plate and center the stir bar in the vessel. Also, be sure that the temperature probe will not obstruct the rotation of the stir bar.

TIP

Try to match the stir bar to the sample and container size to optimize mixing. Generally, use a larger stir bar to mix a more viscous sample. However, two-inch-long bars match the magnet in the stirrer best.

2. Turn the unit ON using the rocker switch on the front panel. The unit will beep once and enter PLATE TEMPERATURE mode. At this point, you can change the display modes by touching PLATE TEMP, PROBE TEMP, STIRRER RPM, TIMER HR:MIN, or TIMER MIN:SEC. The display indications will change as you touch the different keys.
3. Set the target temperature, stirrer speed, timer and ramp rate according to the instructions given in Section 3.3.

CAUTION - HEATED SURFACE

The LHS-730 Series Hot Plate/Stirrer can reach temperatures in excess of 400 °C at the plate surface. Touching the heated surface will cause severe burns. **USE EXTREME CAUTION AT ALL TIMES.** Never leave your Hot Plate/Stirrer accessible to others while it is hot. Although the unit is equipped with a "Hot Warning" indicator on the front panel, do not rely on this alone. Never touch the heating surface unless you are absolutely sure that it is cool.

CAUTION - TEMPERATURE CONTROL

When attempting to control PROBE TEMPERATURE, you must plug in a temperature probe and place it in the sample **AT ALL TIMES.** If the probe is not placed in the sample and plugged into the rear of the hot plate, the unit will not be able to sense the rising temperature of the sample as heat is applied. This will drive the heater to its maximum and could ruin the sample.

CAUTION - ELECTRICAL HAZARD

The LHS-730 Series Hot Plate/Stirrer is available in models that operate at 100, 115 and 230 Vac. Be certain that your voltage matches the unit that you receive. Check the plate on the bottom for the voltage setting on your unit. Take the normal care and precautions you would use with any electrical appliance. Be very careful to keep the AC line cord away from the hot plate.

3.2 HELPFUL HINTS

- Use on a level surface when stirring, especially when stirring vigorously. If the unit is not level, the sample container will "walk", and could walk right off the plate.
- Stirring thicker solutions may require using a larger stir bar. Generally, the more viscous a solution the larger the stir bar needed. For best operation overall, the stir bar should match the magnet poles in the stirrer. These are 2 inches apart.
- Temperature targets may overshoot, especially with small liquid samples and when target temperature is close to ambient. If it is important not to overshoot, try ramping up to the target. Alternatively, target your temperature 5°C to 10°C below the desired temperature. When that temperature is reached, reinstruct the unit to go to the final temperature. Temperature overshoot is generally less than 5°C. Large samples and target temperatures over 100°C very seldom overshoot.

- When entering a new program into memory, always clear the previous program. This is done by pressing the OMIT key when the display is showing step 00.
- On multistirrer units, place the probe in one of the vessels on the corner of the unit. This will ensure the most uniform sample temperatures due to the symmetry of the arrangement.
- If the boiling point of water is to be used for the high temperature calibration, then you must adjust for the effect of reduced pressure if the procedure is carried out well above sea level. The table below gives values of the boiling point of water as it relates to altitude.

ALTITUDE (FT)	BOILING POINT (C°)
0	100
1000	99
2000	98
3000	97
4000	96
5000	94.9
6000	93.9
7000	92.9
8000	91.9
9000	90.9
10000	89.8

3.3 NON-PROGRAMMED OPERATION

3.3.1 Front and Rear Panel Controls

Front Panel

The front panel of the LHS-730 Series has a digital keyboard display for monitoring and controlling hot plate functions. The ON/OFF switch is located on the right side of the front panel. When the unit is ON, the display located on the left side of the unit will be lighted. See Figure 3-1.

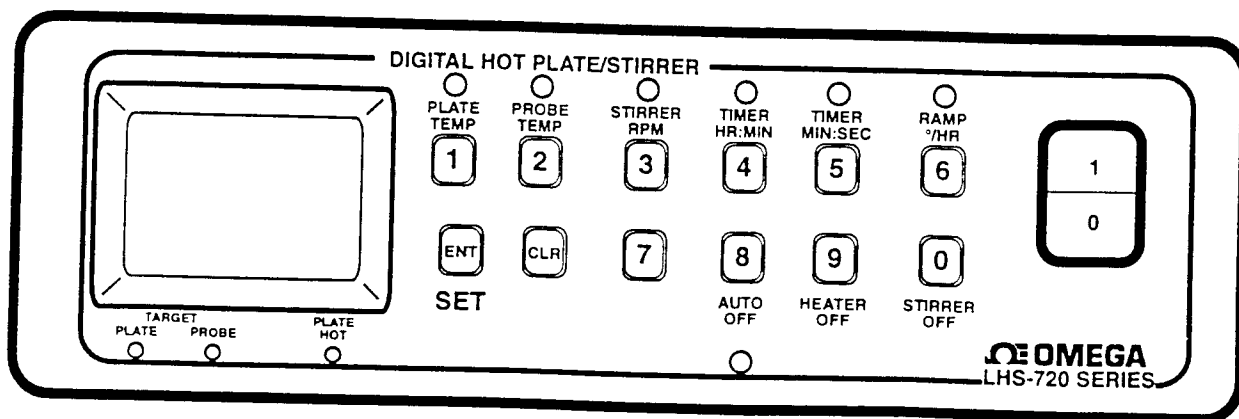


Figure 3-1. LHS-730 Front Panel

NOTE

Keyboard labels which refer only to programmed operation are omitted from the illustration for clarity.

The display is a four-digit vacuum fluorescent type with a colon between the middle two digits. It displays the temperature, stirrer speed and timer value. The keyboard has 12 push button keys used both for selecting the display function and for entering numerical values for the temperature, stirrer speed and timer.

- A number of LED indicator lamps also are located on the front panel. These are described in SECTION 3.3.2.
- A thin plastic membrane which fits over the front panel is supplied with the unit to protect it from dust, dirt and possible chemical spills. You may use the keyboard with the membrane in place. Replacement membranes are available.

Rear Panel

The AC power connector jack and fuse holder combination is located on the left side of the rear panel. The °C/°F display switch is to its right, followed by the I/O port, the remote temperature sensor jack and the four temperature calibration pots on the right side of the panel. See Figure 3-2.

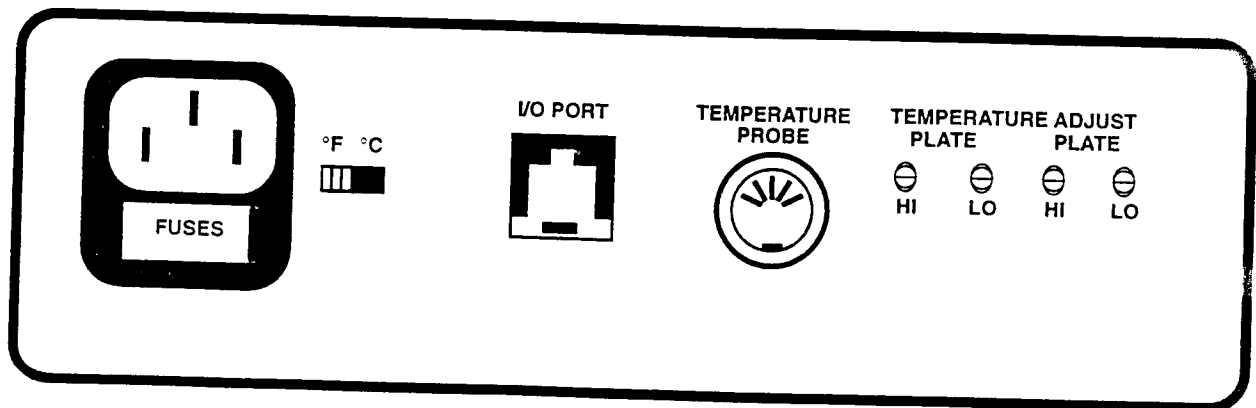


Figure 3-2. LHS-730 Rear Panel

- The AC power jack is a three-prong, international-style jack combined with a dual, snap-in fuse holder. The type of fuse used in the unit is shown on the rear panel. Both neutral and high lines are fused.

CAUTION

If the fuse blows repeatedly, contact the OMEGA Engineering Customer Service Department.

- The position of the slide switch (to the right of the power jack) controls the °C/°F display. The front panel display will reflect the temperature units by displaying a °C or °F after the temperature readout.

- The I/O port will, when used with the proper cable, allow for remote control of the unit either by the LHS-740 multicontroller or an IBM compatible PC with a Model LHS-750 plug-in printed circuit board.
- The remote temperature sensor input is a DIN jack which is used with a three-wire, platinum RTD temperature probe. The probe pinout arrangement is as follows:

Pin 1 - Positive
Pin 2, 3 - Negative

- The two calibration potentiometers on the left are for calibrating the plug-in temperature probe. The two on the right are for calibrating the heater plate temperature readout.

3.3.2 Display Functions

The display can show any one of five different functions. The function currently being displayed is indicated by a small LED lamp located above the corresponding display function key (top row of keys).

Heater

PLATE TEMP
1

Press this key to display the temperature of the heater plate surface. The temperature will appear in °C or °F, as selected by the rear panel C/F switch. This selection is indicated by a "C" or "F" on the right portion of the display. If a target plate temperature has been set into the unit, the display will toggle at brief intervals to display the target temperature. The PLATE TARGET lamp will turn on during the time the target temperature is shown. The red PLATE HOT lamp located to the right of and below the display will blink as a safety reminder if the plate temperature is above 50 °C (122 °F).

PROBE TEMP
2

Press this key to display the temperature measured by the probe. The temperature will appear in °C or °F as selected by the rear panel C/F switch and indicated as above. If a target probe temperature has been set, the display will toggle at brief intervals to display the target temperature. The PROBE TARGET lamp will turn on during the time that the target temperature is shown. If the probe is unplugged, the display will show all dashes. Dashes will also appear if the temperature is out of range (0-409°C).

Stirrer Speed

STIRRER RPM
3

Press this key to display the speed of the stirrer. The speed is shown to the nearest ten RPM. On multi-position stirrer models, the speed is taken from the center stirrer position.

Timer



Press this key to display the hours and minutes left on the timer.



Press this key to display the minutes and seconds left on the timer.

3.3.3 Setting Temperature, Ramp Rate, Stir Speed and Timer

The heater, stirrer and timer all may be set using the SET/ENTER key. The functions which may be set are listed below, followed by an explanation of how values are entered for those functions.

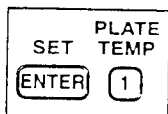
Heater

The heater may be set to control either the plate surface or the sample itself. This is done by entering a “target” temperature from the front panel keyboard. The control electronics in the hot plate will automatically apply power to the heater plate to reach the desired target temperature.

The user may enter either a target plate temperature or a target probe temperature. Only one target temperature is allowed at a time. Setting a target plate temperature erases any target probe temperature that may have been set previously, and vice versa.

Target temperatures may be set anywhere in the range of 0 to 400°C (32 to 752°F).

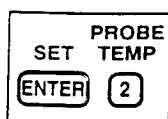
To set a target plate temperature, follow the steps below:



1. Press the SET key, followed by the PLATE TEMP key.
2. Enter the temperature value desired and press the ENTER key. The target temperature is entered in °C or °F, depending on the current mode set by the C/F switch on the rear panel.

Setting the target plate temperature enables the heater plate. This means that the heater plate will turn on as necessary to heat the plate surface to the target temperature. If the target is below the actual plate temperature, the heater plate will not turn on until the plate cools to near the target temperature.

To set a target probe temperature, follow the steps below:



1. Press the SET key, followed by the PROBE TEMP key.
2. Enter the temperature value desired and press the ENTER key. The target temperature is entered in °C or °F, depending on the current mode (as above).

Setting the target probe temperature enables the heater plate. The heater plate will turn on as necessary to heat the sample until the sample probe reaches the target temperature. If you unplug the probe, heating power will be disabled until the probe is plugged into the rear connector.

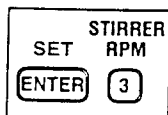
CAUTION

Be sure that the temperature probe is in the sample solution and plugged into the rear panel when heating. Failure to do so could damage your sample because the hot plate will drive to the maximum, seeking a temperature it cannot find.



To disable the heater plate and erase the plate or probe target temperature, press the HEATER OFF key.

Stirrer



Set the stirrer speed in a similar manner to the target temperature above, with one exception: press the STIRRER RPM key after the SET key. The target stirrer speed is rounded internally to a multiple of 10 RPM. You can set the stirrer to any speed within the range 0 to 1500 RPM. However, the unit is specified to operate from 100 to 1500 RPM.

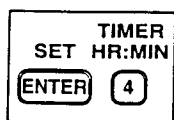


To turn off the stirrer, press the STIRRER OFF key. This is the same as setting the stirrer speed to zero.

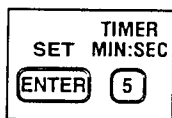
Timer

The timer counts in hours, minutes, and seconds. However, you may only display or set hours and minutes or minutes and seconds at a given time. Setting the hours and minutes also sets the seconds to zero. Setting the minutes and seconds sets the hours to zero.

You may set the timer to any count up to 99:99; however when the minutes or seconds roll over, they will be set to 59 (as on a clock). For example, 80 seconds may be set into the timer either as 1:20 or as :80 minutes/seconds. When the timer reaches zero, it will alarm with three, unique, audible chirps.



To set the timer in hours and minutes, press the SET key followed by the TIMER HR:MIN key. Enter the time value in hours and minutes and press the ENTER key. The seconds will be set to zero. Timing starts exactly when you press the ENTER key.



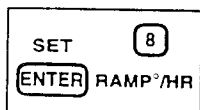
To set the timer in minutes and seconds, press SET followed by TIMER MIN:SEC (the hours will be set to zero). Enter the numerical value and press the ENTER key. Timing starts exactly when you press the ENTER key.

3.5.4 Ramp

The ramp setting controls the rate at which the temperature approaches the target temperature. The ramp values may be set within the range of 0 to 555°C/HR or 0 to 999°F/HR. The unit can ramp up or down depending on the target temperature.

- A target temperature above the sample temperature will make the unit ramp up at the specified rate.
- Likewise, a target temperature below the sample temperature will make the unit ramp down at the specified rate.

The thermal characteristics of the sample and hot plate determine the maximum rate at which the temperature can ramp toward the target setting. If the ramp setting is higher than this rate, it cannot be attained.



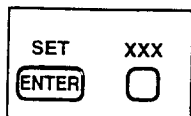
To set the temperature ramp, press the SET key followed by the RAMP °/HR key. Then enter the ramp value and press the ENTER key. To turn off the ramping, set the ramp value to zero. This will allow the heater to reach the target temperature as rapidly as possible.

CAUTION

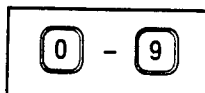
Be sure to enter a target temperature before entering a ramp rate.
The hot plate will not turn on if there is no target temperature.

Entering Values

To set a value into the heater, stirrer, timer or ramp, select the SET function, enter a numerical value, and press the ENTER key.



As described previously, select the SET function by pressing the SET key followed by the key of the function desired. When you press the SET key, the display shows: LLLL. At this time, only the six settable function keys and the CLEAR key are active. Pressing the CLEAR key erases SET and returns the unit to the function displayed before you pressed SET. Press one of the function keys. The display will show all zeros. At this point, you may use the keys to enter the numeric value.



Key in the value you wish to set, one digit at a time, up to four digits. The digits enter the display from the right, calculator-style.



If you make a mistake, press the CLEAR key and the display will return to all zeros. If you wish to exit from the SET function without actually entering a value, press the CLEAR key again while the display shows all zeros.



After keying in the desired value, press the ENTER key. The new value will be entered at this time and the function that was just set will be displayed. If the value entered is out of range, however, it will not be accepted, and will be held on the display until you press the CLEAR key. Once the value is accepted, the keys return to their normal functions and no longer represent numeric data.

3.3.4 AUTO-OFF and HOLD Functions

Auto-Off

When the auto-off function is enabled, a time-out of the timer automatically turns off the heater and the stirrer. This provides a convenient way to preset the length of time a sample is to be heated without the need for anyone to be present at the end of the period.



To enable the auto-off function, press the AUTO-OFF key and the lamp under the key will turn on. To disable auto-off, press the key again and the lamp will go out.

Hold

When the HOLD function is enabled, the current settings of stirrer speed, target temperature and ramp are placed into battery backed-up memory. When the LHS-730 loses power or is turned off, these settings will be held in memory so that the unit will return to them when power is restored. This feature is very useful in case of a power failure during unattended operation.



To enable the HOLD function, press the HOLD key and the lamp under the key will turn on. To disable HOLD, press the key again and the lamp will go off.

3.3.5 Other Modes of Operation

You can also use the Digital Hot Plate/Stirrer as a temperature meter and laboratory timer. To use it either way, follow the instructions below:

Temperature Meter

To use the Digital Hot Plate/Stirrer as a temperature meter, bring the sample to the unit and place the temperature probe in the solution. Then press PROBE TEMP, and the temperature will be displayed.

Timer

To use your Digital Hot Plate/Stirrer as a laboratory timer, simply press SET, TIMER HR:MIN (or TIMER MIN:SEC), the time desired, then ENTER. As soon as you press the ENTER key, the unit will start to count down. It will beep three times at zero.

Infrared Remote Control

The Digital Hot Plate/Stirrer may be operated remotely via an infrared signal originating from the Model LHS-745 remote controller unit. The Model LHS-745 controller has the same functions as the Model LHS-730 front panel. Infrared remote control is recommended for situations in which the Hot Plate/Stirrer unit is used under a closed fume hood or in a sealed chamber due to toxic conditions.

The unit may be operated at distances up to 15 feet from the control unit. The infrared beam will operate through glass windows. The intensity of the infrared signal decreases as the distance from the source increases. The strength of the signal will also decrease as the viewing angle of the receiver varies from straight on. These factors are important if you wish to control more than one unit. Try experimenting with the placement of the controller module and the controlled units to find the optimum configuration for controlling multiple units.

3.4 PROGRAMMED OPERATION

Programs save you time on repetitive operations. They also free you to do other tasks while the Hot Plate/Stirrer is performing your program. Once a program is written and corrected for errors, it may be run uniformly time after time. The unit's program memory is backed by battery so the program will be retained indefinitely even during intervals when power is off. You can execute a program with just one keystroke. In the following sections you will find instructions on how to create and edit programs for unattended operation of the instruments in the LHS-730 Series.

3.4.1 Front Panel Controls

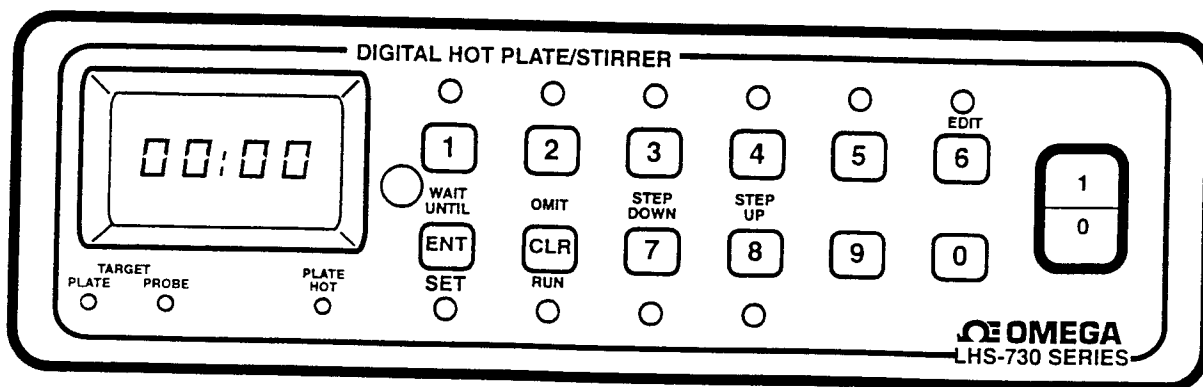


Figure 3-3. LHS-730 Front Panel Controls

NOTE

Figure 3.3 is similar to the figure in Section 3.3.1, except the key labels shown are those which refer to programmed operation only. The other labels are excluded for the sake of clarity.

3.4.2 Editing a Program

During the creation of a program, the display will show the programmed steps as they are entered. When a program is being edited, each step may be displayed and edited as the program is viewed in forward or reverse sequence. The modified program may then be displayed prior to execution.

EDIT

6

Press this key to enter or edit a program. When you press the EDIT key, the display will show two zeros to the left of a period. The zeros signify that you are at the beginning of a series of programmed steps. At this point, you may create a program or edit one which already exists. When the editing operation is complete, press this key to exit the EDIT mode and return to normal operation.

STEP
UP

8

Press this key to view a program in forward sequence. Each time you press the STEP UP key, the display will show the next step in the programmed sequence. When you have reached the last step in the program, pressing the key will have no effect.

STEP
DOWN

7

Press this key to view a program in reverse sequence. Each time you press the STEP DOWN key, the display will go from a higher step to a lower step in the programmed sequence. Pressing this key will have no effect when you have reached step 00.

OMIT

CLR

The OMIT key has a dual function which depends on the mode in which the unit is operating. In the edit or programming mode, the OMIT function is operative. When you press this key, the programmed step currently in the display will be erased. If step 00 is in the display, pressing this key will erase the entire program.

Placing a set of programmed steps into the memory of any of the models in the LHS-730 Series of Hot Plate/Stirrer units is a simple task once you are familiar with the functioning of the various programming keys.

NOTE

A maximum of 75 program steps is allowable.

There are four types of program steps. They are:

1. **DISPLAY**
Press a display key (PLATE TEMP, PROBE TEMP, STIRRER RPM, TIMER HR:MIN, or TIMER MIN:SEC) to enter a display step. When the program executes, this step will cause the display to indicate as instructed.
2. **SET**
Enter a target value as done normally. (EXAMPLE: SET, PROBE TEMP, 1, 0, 0, ENTER). When the program is run, the target value will be set.
3. **HEATER OFF/STIRRER OFF**
Press either of these keys to enter a step which will turn off the heater or stirrer when it executes.
4. **WAIT UNTIL**
A WAIT UNTIL step is similar to a SET step. When executed, it sets the target value just like the SET step, but the execution of the following program step is delayed until the target value is reached. WAIT UNTIL may only be used with a target temperature or a timer setting. It will not work with stirrer speed or ramp value. The operation of the WAIT UNTIL feature is described below.



In programmed operation this key will toggle between the SET and WAIT UNTIL functions. When you press the key once, it will be in SET mode. When you press it a second time, it will be in WAIT UNTIL mode.

If the WAIT UNTIL step sets the timer, then it will also introduce a time delay into the program. If the WAIT UNTIL step sets a target temperature, then program execution will be delayed until the target temperature has been reached.

To set a time delay into the program, follow the steps below:

1. Press the WAIT UNTIL key. The display will show: **LLLL**. Press the WAIT UNTIL key again. The display will show: **UUUU**. The **U**'s will be shown whenever the key is in WAIT UNTIL mode.
2. Press either the TIMER/HR:MIN or the TIMER/MIN:SEC key and set the time as described previously. Press the ENT key to indicate that the step is complete.

To cause the program to delay until a target temperature is reached, repeat step 1 (above). Then press either the PLATE TEMP or PROBE TEMP key and set the target temperature. Press the ENT key to indicate that the step is complete.

3.4.3 Running a Program

Once a program has been entered into the unit, you can run it at any time.



When the unit is not in EDIT mode, press this key to initiate the program which is currently in program memory. While the program is running, the lamp under this key will light. Pressing this key while the program is running will cancel any remaining steps in the program and turn off the RUN lamp.

All program steps take only an instant to execute with the exception of WAIT UNTIL steps. Compare the following program steps:

STEP	ACTION
SET PROBE 100°	Sets target temperature.
OR	Executes next step while unit begins to go toward target.
WAIT UNTIL PROBE 100°	Sets target temperature as above. Next program step does not execute until probe temperature reaches 100°
SET TIMER MIN:SEC 00:05	Puts 5 seconds on the timer then executes next step as timer begins to count.
OR	
WAIT UNTIL TIMER MIN:SEC 00:05	Waits 5 seconds before continuing program.

During the time that a program is running, you may press any key to change the display or to set new temperature, stir speed or time values. You may not, however, edit a program while it is running. Pressing the EDIT key while a program is running has no effect.

If the power fails while a program is running, the program is aborted. It must be run again from the beginning when power is restored. All of the stored program steps will be retained during the power failure.

3.4.4 Sample Program

Now that all of the key functions have been defined, it is time to place a program in memory and run it. We will begin with a very simple program. We wish to place the temperature probe in a liquid which will be heated to 105°C, held at that temperature for 30 minutes and then cooled back to room temperature. We will heat slowly at a predetermined rate and use the stirrer to spread the heat uniformly throughout the liquid. Here is the sequence of keystrokes along with the related display. (To enter EDIT MODE, remember to press the EDIT key).

SAMPLE PROGRAM

STEP NUMBER	KEYSTROKE SEQUENCE	EXPLANATION
01.	<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> SET </div> <div style="text-align: center;"> STIRRER RPM <input type="text" value="3"/> <input type="text" value="1"/> <input type="text" value="0"/> <input type="button" value="ENTER"/> </div> </div>	Set stirrer to 100 RPM
02.	<div style="text-align: center;"> STIRRER RPM <input type="text" value="3"/> </div>	Display stirrer RPM
03.	<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> WAIT UNTIL </div> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> WAIT UNTIL </div> <div style="text-align: center;"> TIMER MIN:SEC <input type="text" value="5"/> <input type="text" value="1"/> <input type="text" value="5"/> <input type="button" value="ENTER"/> </div> </div>	Wait 15 seconds
04.	<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> SET </div> <div style="text-align: center;"> RAMP°/HR <input type="text" value="8"/> <input type="text" value="5"/> <input type="text" value="0"/> <input type="button" value="ENTER"/> </div> </div>	Set ramp value to 50°/HR
05.	<div style="text-align: center;"> PROBE TEMP <input type="text" value="2"/> </div>	Display the probe temp
06.	<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> WAIT UNTIL </div> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> WAIT UNTIL </div> <div style="text-align: center;"> PROBE TEMP <input type="text" value="2"/> <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="5"/> <input type="button" value="ENTER"/> </div> </div>	Wait until probe temp=105°C
07.	<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> WAIT UNTIL </div> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> WAIT UNTIL </div> <div style="text-align: center;"> TIMER HR:MIN <input type="text" value="4"/> <input type="text" value="3"/> <input type="text" value="0"/> <input type="button" value="ENTER"/> </div> </div>	Set 30 minute time delay
08.	<div style="text-align: center;"> <input type="text" value="9"/> HEATER OFF </div>	Turn heater off
09.	<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> WAIT UNTIL </div> <div style="text-align: center; margin-right: 10px;"> <input type="checkbox"/> WAIT UNTIL </div> <div style="text-align: center;"> TIMER HR:MIN <input type="text" value="4"/> <input type="text" value="1"/> <input type="text" value="0"/> <input type="text" value="0"/> <input type="button" value="ENTER"/> </div> </div>	Wait another hour
10.	<div style="text-align: center;"> <input type="text" value="0"/> STIRRER OFF </div>	Turn stirrer off

The program is now complete. Whenever you press the RUN key, the Hot Plate/Stirrer will execute the program steps in the order in which they were entered. It is now possible to leave the unit while it performs the task unattended.

Steps 2 and 5 were inserted as a check on program operation. The first will display stirrer RPM while the second displays the probe temperature throughout the remainder of the program operation. A 15 second delay was inserted after the "display stirrer RPM" command to allow time for the stir bar motor to reach target speed while the stirrer RPM is being displayed.

It is a good idea to do a test run before leaving the unit in unattended operation with a program which has not been previously run. After the RUN key is pressed, the display will show stirrer RPM for 15 seconds. Make sure that the value is the same as that set into the program to within ± 20 RPM. For the above example, this will be 100 RPM.

After the stirrer speed, the probe temperature will be displayed. Check to see that it ramps up at the programmed rate and then stops at the target temperature (105°C). If there have been no errors in entering the program, the temperature will remain at 105°C for 30 minutes before cooling down to room temperature. One hour after the cool down begins, the stirrer should stop rotating.

If the initial checkout does not yield all of the results described above, then the program has an error or omission in one or more steps. The next section describes how to correct or modify an existing program.

3.4.5 Modifying a Program

You can change any of the temperature, time, stirrer speed or ramp rate values in the editing process. For example, assume that we wish to change the target probe temperature in the above example from 105° to 100°C:

1. Use the STEP UP key to proceed to step 6 in the program. The display shows: 06.U2.
2. Press the OMIT key to erase the step. The display will now read 06.U4 as step #7 has now become step #6.
3. Press the STEP DOWN key to display step #5. Then press the SET and the PROBE TEMP keys, followed by the digits 1,0,0.
4. Press the ENTER key. The target temperature will now be 100°C for all subsequent runs of this program.

There are two rules to remember when deleting or inserting steps:

1. When a step is deleted, all of the steps which were entered after it move up one position in the program.
2. When a step is inserted, it is inserted after the step in the display. All subsequent steps are moved up one position. The preceding steps are not affected. For example, if you wish to insert a step between steps 8 and 9, step through the program until step 8 is in the display, then insert the key stroke sequence. When adding a step at the end of a program, step through the program until the last step is in the display, then add the step.

SECTION 4 TEMPERATURE CALIBRATION

The temperature readouts for both the plate surface and the probe may be calibrated by the user. Two rear panel adjustments are provided for each temperature channel.

4.1 PROBE READOUT CALIBRATION

Probe calibration is performed using an accessory calibration kit which precisely simulates fixed temperature points. The kit has a high temperature “dummy” probe which, when plugged into the probe connector, presents the same value of resistance to the internal temperature analyzing circuitry as the RTD probe at the temperature which is written on the calibrator case. There is also a low temperature plug-in which simulates the response at the temperature called out on the calibrator case.

To calibrate the probe readout, follow the steps below:

1. Insert the high temperature “dummy” probe into the temperature probe DIN connector located on the rear panel.
2. Adjust the calibration pot marked PROBE HI until the front panel readout agrees with the temperature stamped on the “dummy” probe.
3. When the high temperature has been adjusted, repeat the procedure with the low temperature probe module by adjusting the potentiometer marked PROBE LO to agree with the temperature marked on the “dummy” probe.

The probe readout calibration is now complete. The calibration must be carried out in the order specified above (HI temperature; LO temperature).

4.2 PLATE CALIBRATION

To calibrate the plate temperature readout, obtain a calibrated surface temperature probe to be used as a calibration reference. This is available from OMEGA Engineering as an option. The surface temperature probe plugs into the external probe connector on the rear panel and is read by pressing the PROBE TEMP key on the front panel. If you are using the surface temperature probe, be certain that you have calibrated the probe readout before carrying out the procedure below:

1. Set the plate target temperature to a value between 300°C and 400°C using the procedure given in Section 3.3.3.
2. Wait until the plate temperature reaches the target value; then wait 5 minutes more.
3. When the temperature readout has reached a stable value, take a reading from the surface temperature probe, then adjust the PLATE HI potentiometer until the plate temperature reading agrees with the surface temperature probe.

4. Set a target temperature which is just above room temperature and repeat the procedure as above using the PLATE LO potentiometer.
5. When the last step is completed, the plate temperature readout is calibrated. The procedure must be carried out in the order given above (HI temperature/LO temperature).

4.3 PROBE CHECK

The optional probe supplied by OMEGA Engineering meets the following specifications:

PROBE TYPE - DIN 43760 "CLASS B"

PROBE ACCURACY

TEMPERATURE (°C)	TOLERANCE
0	±0.3°
100	±0.8°
300	±1.8°

If you want to adjust the unit to compensate for an error at a particular temperature, use the LO TEMP pot. Place the probe in the liquid which is at the required temperature and adjust the LO TEMP pot until the readout is correct. This procedure will introduce error into the system at other temperatures, so remember to readjust the probe readout when using a new probe or when you wish to have readout accuracy over a broad range of temperatures.

The probe may not be used at temperatures below 0°C, since the readout will not respond in that region.

SECTION 5 TROUBLESHOOTING

PROBLEM	WHAT TO DO/EXPLANATION
1. The sample temperature does not rise as rapidly as the programmed ramp value.	Try heating a smaller sample. The heating capacity of the Heater/Stirrer is probably not adequate to raise the sample temperature at the programmed rate.
2. The probe temperature does not display 100°C or 212°F when immersed in boiling water.	Check the boiling point correction table on page 6 if you are in a location which is 1000 ft. or more above sea level. or Perform the probe calibration procedure given in Section 4.
3. The probe temperature readout does not display 0°C or 32°F when immersed in an ice bath.	Check the purity of the water. Dissolved substances will usually lower the freezing point of water. or Perform the probe calibration procedure given in Section 4.
4. The sample temperature reading remains higher than the target temperature.	Check the ambient temperature. The target temperature may be below room temperature.
5. The probe temperature reads all dashes.	Check to see that the probe plug is seated tightly and making contact. If it is not making contact, the readout will default to dashes (----).
6. The stir bars are revolving erratically.	Check to see that the sample containers are centered over the stir bar motors. or The stir bars may not be able to maintain proper coupling with the motors due to the viscosity of the sample.
7. The unit or units do not respond to infrared remote control.	Move the LHS-745 controller closer. or Check the angle between the controller and units. or Clean the infrared windows on all units.
8. In programmed operation, the unit continues to execute commands after completing the program which has been entered.	Be sure that you have cleared the memory before entering the new program. If you have not, the extra steps may be erased with the unit in EDIT mode.
9. The unit does not hold the program in memory with the power off.	The battery needs to be replaced.

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