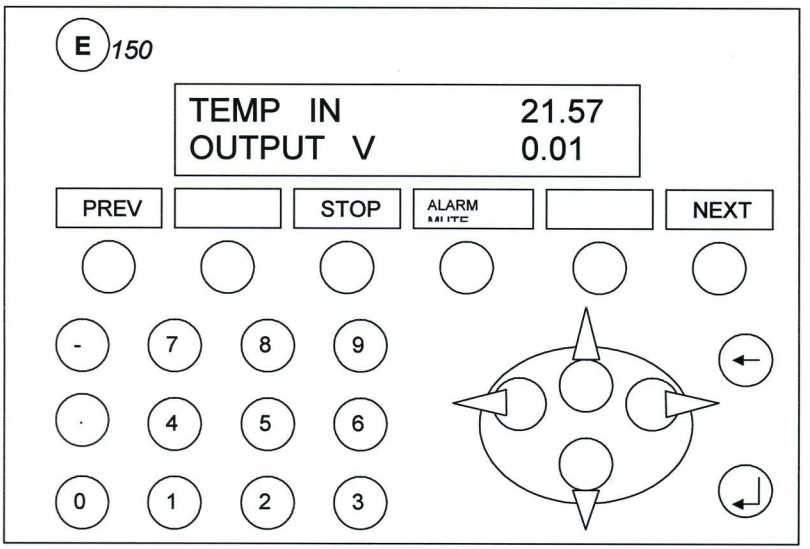
Diacell PS-02 Programmable PSU - User Guide

Issue 1.0, November 2009 (P00970)

easyLab Technologies Ltd
Science & Technology Centre
The University of Reading
Earley Gate, Whiteknights Road
Reading, Berkshire, RG6 6BZ, UK
ph: +44(0)118 935 7272
fax: +44(0)118 935 7271
email: support@easyLab.co.uk
URL: www.easyLab.com

Alan Bradley E150 Programmable Controller
Programmed RMA / BJ Controls
Displays / Instructions

Control Panel



Display

The rectangle at the top of the control panel, showing the lines "TEMP IN 21.57 OUTPUT V 0.01" is a display panel which will show two lines of text and figures.

Three displays are available, being selected by the "NEXT" and "PREV" buttons (these are the round buttons beneath the labels).

First Display (shows automatically when the controller is switched on):

TEMP IN	measured temperature
OUTPUT V	voltage output to power heater
PRED TEMP Tp	interim target temperature (to be explained later)
INCREMENTS V	number of voltage increments to present output

The lower lines of the display can be scrolled round by use of the downward pointing triangle of the four. The upward pointing triangle scrolls the display back to the upper lines.

The figures in the first display cannot be changed by the user. They are measured or calculated by the controller and are shown for information.

Second Display:

TARGET TMP	Ts=800.0	Target Temperature
MAX TMP	Tm=1050.0	Temperature to switch off power
TIME STEP	R=2.0	No of seconds between voltage increments
MAX VOLTS	Vm=16.0	Maximum permitted output voltage
OUTPUT INCR	I=0.01	Increment of output voltage
TMP STEP EQ	P=0.8	Temperature step to interim equilibrium
TIME STEP EQ	L=3.0	Time step between readings at equilibrium
RANGE TARG	D=0.8	Temperature range for equilibrium
detection		
NO STEPS	C=10.0	No of steps for equilibrium detection
TIME TARG	T1=120	Time at target temp before time-out
LOWER LIMIT	V=0.05	Tolerance limit for voltage detection
UPPER LIMIT	V=0.05	Tolerance limit for voltage detection

All the figures to the right of the second display can be changed by the user. The default values are shown above. The up and down triangles are used to select the line, and the right triangle moves the cursor to the figure to be changed. The number keys then change the figure, which is confirmed when correct by pressing the key with the angled arrow. Probably only the first two lines should need to be changed.

Third Display:

0=FINISH	2=RAMPDOWN
1=CONTINUE	1

The only changeable figure in this display is the isolated "1" on the second line. This display allows the user to choose what happens when the counter times out at equilibrium. If "0" is chosen, the power is switched off at time-out. If "1" is chosen, nothing happens at time-out (except that a warning buzzer sounds). If "2" is chosen, the output voltage decreases by 0.01 volts per second until 2.5 volts or 200 deg C is reached, when the power is switched off. "2" can only be chosen when the measured temperature is above 200 deg C, because, below this temperature, the system immediately switches off. Also, "2" can only be used manually, because the ramp-down starts as soon as the choice has been confirmed.

If "1" is chosen for time-out, it is possible to re-set the target temperature to a different value (higher or lower than the previous one) and carry out a new experiment continuing from the previous one.

Control Buttons

The "PREV" and "NEXT" buttons have already been mentioned, as selecting the three possible displays. This is their only function.

The "START" button is used to start the controller after all the required settings have been made. This is used to start each experiment when the target temperature has been changed in the "CONTNUE" mode.

The "STOP" button is used for emergency shut-down. It will immediately cut off the output power.

The "ALARM MUTE" button will silence the alarm buzzer. A second press, if the buzzer has been silenced, will re-start the buzzer.

The "PAUSE" button will hold all counters and outputs at their current level until it is pressed a second time.

The triangle and number buttons have already been mentioned.

The angled arrow button is pressed for each line of Display 2 (or 3) when the number on that line has been changed to a new value.

The button showing a right-pointing straight arrow has no function in the present program.

Parameter Values and Control Procedure

"Target Temperature" is the temperature at which the experiment is to be run (degrees Celcius). 800 is the recommended maximum in normal circumstances. The heaters supplied with cells will often go higher than this, but the heater life will be shortened if this temperature is exceeded. It is recommended that trials be carried out at much lower temperatures (200 to 300 deg) to gain familiarity with the system.

"Maximum Temperature" should be set to slightly above (say, 50 deg) the maximum temperature required for any experiment in a session. This is the emergency cut-off temperature, in case the system goes out of control. The system should not go out of control, but it is important to have a safety cut-off.

"Time Step" at 2 seconds is a compromise between speed of achieving target temperature and avoiding over-shoot of this temperature. The default value gives a rise of 1 volt in 200 seconds or 3 1/3 minutes. Thus the full voltage range takes 53 1/3 minutes if there are no interruptions to the climb. It may be possible to use a faster rate, but experience needs to be gained with the system first.

"Maximum Volts" limits the voltage output of the controller. 16 V is the practical limit for the equipment, but a lower value can be set to give greater protection to the heater if temperatures well short of 800 deg are being aimed at.

"Output Increment" is the voltage step used in conjunction with "Time Step" in the ramp up to the target temperature. 0.01 V is the practical lower limit for this increment. Larger increments may be used, but are not recommended.

"Temperature Step to Equilibrium" is a feature to prevent over-shoot of the target temperature. Its value must never be greater than 1.0. It defines an interim target temperature below the actual one. The voltage ramp flattens when this interim target is

reached, to allow the cell time to heat up so the overshoot in temperature will occur at less than the required final target. The interim target temperature is shown as "Pred Temp Tp" on the First Display. The calculation is as follows.

Suppose the starting temperature is 20 deg C, with target temperature 800 deg C. The difference is 780 deg C. "Tmp Step Eq" of 0.8 multiplies the temperature difference to give 624 deg C. This is added to the starting temperature to give "Pred Temp Tp" 644 deg C. When the measured temperature reaches this value, the system attempts to stabilize this reading for a specified time. Then a new interim target is calculated by the same method (800 – 644.4 = 155.6; 155.6 x 0.8 = 124.48; 644 + 124.48 = 768.48) and the process continues. So long as the step fraction is above 0.5, the process converges quite quickly to the final target temperature. Notice that 644.4, not 644, was used as the starting temperature. This is because the measured temperature, and not the interim target, is taken to be the starting point.

"Time Step at Equilibrium" allows a different time interval to be used in controlling the equilibrium, from the interval used in the ramp.

"Range around Target" is the temperature range in deg C, centred on the target temperature, within which the controller will calculate that the measured temperature is the same as the target. +-0.8 deg C is the smallest practical value for this range, because the temperature measurement is made in discrete steps of about 0.6 deg. If the range is made too small, the controller will sometimes not detect that the target has been reached, and will continue to ramp past the required value. This may also happen if too high a ramp rate is used.

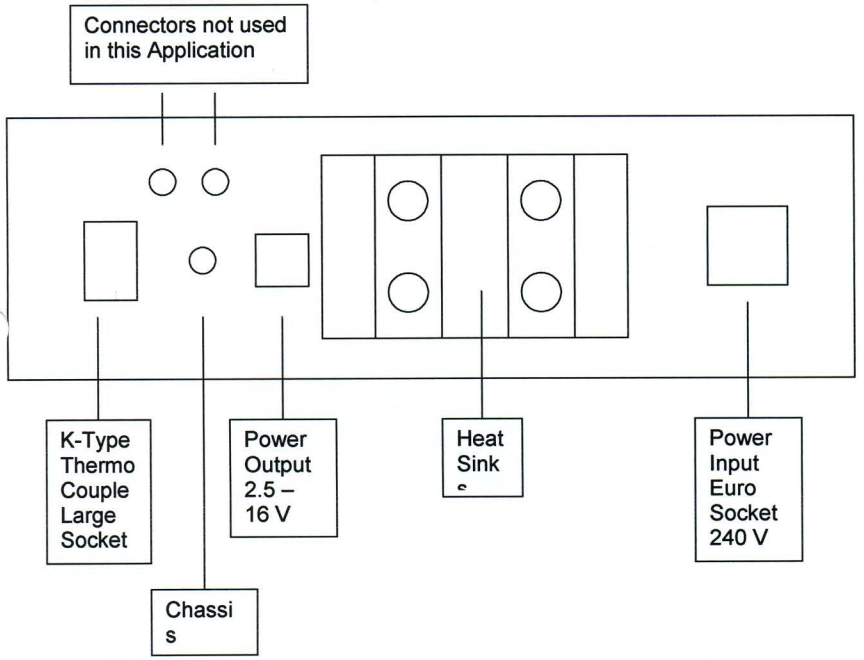
"Number of Steps" times "Time Step at Equilibrium" gives the length of time for which an intermediate equilibrium will be held before a new intermediate is aimed for. 30 seconds (3 x 10) seems to be just long enough, at the default ramp rate, to prevent major over-shoot at the final target temperature.

"Time at Target" is the length of time (seconds) at which the final target temperature will be held within the equilibrium range before the time-out procedure (Third Display) begins. The default value of 2 min is adequate for testing the system, but usually a much longer time would be needed for an experiment. If "1=Continue" is chosen on the Third Display, the "Time at Target" parameter becomes irrelevant, since no action is taken on time-out in this condition.

"Lower Limit" and "Upper Limit" give the range within which a set voltage is calculated to be the same as a measured voltage. These are necessary because, like temperature, the controller measures voltage in discrete steps, even though it can increment in smaller steps.

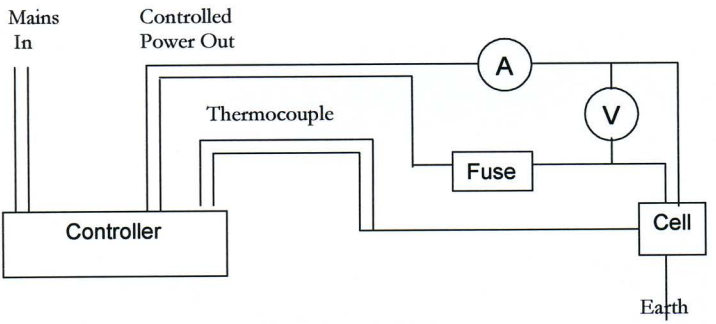
The minimum voltage that can be output by the controller is about 2.5 volts. This will bring the measured temperature from a heater up to about 60 degrees, if the voltage is left at this level for a long period. Thus, a temperature less than 60 degrees cannot be controlled with this system. As soon as the "Start" button is pressed, the controller outputs 2.5 volts. The ramp, though, starts from 0 volts and takes about 4 minutes to reach the existing level of 2.5 volts (at a set rate of 0.01 V per sec) before the chosen parameters become effective and the output voltage begins to ascend at the chosen rate.

Connections



The diagram shows the back of the control box. The Chassis Screw should not be moved. This holds a component inside the box. The heat sinks with their attached components should also not be touched. Suitable plugs will be supplied for the three sockets – thermocouple, power output and power input. For U.S. use an external transformer will be needed to convert the power input from 110 V.

Suggested Wiring



It is helpful to have readings of current and voltage separate from the reading on the controller, because this is not always visible if other aspects of the control are being shown. The reading from the voltmeter will be lower than that indicated on the controller because of the voltage drop in the wires, ammeter and fuse. If high temperatures (above 800 deg C) are required, it is important to have the wires as short and as thick as possible, to minimize the voltage drop.

Instability in the measured current and voltage will often be the first indication that a heater is reaching its limit of performance and should not be pressed further.

The expected limits are 16 Volts and about 8 Amps. Ranges on the meters should be set accordingly, and a suitable fuse should be chosen. It is good practise to earth the cell in case of the (very slight) possibility of short-circuiting between a power wire and the cell body. Such a short-circuit will then blow the fuse without further damage to the cell.

Typical Trial

It is suggested that initially runs should be made to very modest temperatures, to gain experience with the system. A run up to 250 deg C, followed by 300 dec C, followed by ramp-down, will be described.

1 Switch on. After a few seconds of setting-up displays, the small screen will show

TEMP IN	(measured room temperature)
OUTPUT V	0.01 (or 0.00)

2 Set Temperature. Press "NEXT" – the round button under the label. The screen will now show

TARGET TMP	Ts=800.0
MAX TMP	Tm=1050.0

The cursor will be on the first T of "TARGET TMP".
Press the round button at the base of the RIGHT Pointing triangle.
The cursor will move to the 8 of "800.0"
Type 2 5 0 using the number keys.
The screen will now show TARGET TMP Ts=250.0
If a mistake has been made, use the DOWN triangle to take the cursor to the line below, then the UP triangle to return to the top line. The RIGHT triangle will take the cursor to the incorrect temperature value. The correct value can now be typed in.
When the target temperature is correct, press the angled arrow button at the bottom right-hand corner of the control panel. This will confirm the temperature setting so the cursor may be moved to the second line and the TARGET TMP will stay at 250.0 until either it is changed or the system is switched off.

3 Set Max Temp. Press DOWN triangle to take the cursor to the second line, then RIGHT triangle to move the cursor to the 1 of "1050.0". Type in 3 5 0 using the number keys. Press the angled arrow to confirm this setting.

4 Set Time at Target On the default setting, the system will indicate by a buzzer when the temperature has been maintained at the target temperature for two minutes. This is suitable for testing the system, but probably a much longer time would be wanted in experiments. As part of the exercise, the time will be re-set to five minutes.
Press the DOWN triangle eight times (not too quickly). The display should read

TIME TARG	T1=120
LOWER LIMIT	V=0.05

Press the RIGHT triangle to move the cursor to "120". Type in 3 0 0 Press the angled arrow to confirm. This will give 300 seconds = five minutes at the target.

5 Check "CONTINUE" Mode. Press the NEXT button to bring up the third display. The single figure after "CONTINUE" on the second row should be "1". This should not be changed, since a second trial is to be performed after the first one.

6 Start the System. Press the PREV button to return to the first display. Press the DOWN triangle twice. The display should show

OUTPUT V	0.01
PRED TEMP Tp	0.00

Now press the START button. There will be a click. The indicator light will change colour. The display will show (approximately)

OUTPUT V	2.60
PRED TEMP Tp	204.0

(assuming 20.0 degrees C starting temperature)
Now press the UP triangle twice to see the measured temperature as it climbs toward the target. OUTPUT V will remain at (say) 2.60 for about 2.5 minutes, then will begin to increase by 0.01 every 2 seconds.

When the measured temperature reaches about 198, press the DOWN triangle twice to see the change in predicted temperature. After a minute or so the value should change to about 240.8. Then press the UP triangle twice, to continue tracking the measured temperature.

7 At Target Temperature The measured temperature should climb to about 250, over-shooting by no more than about 2 or 3 degrees. The output voltage will start to decrease and the temperature will fall back close to 250. After a minute or so, the buzzer will sound to indicate that stability near 250 deg has been detected. Exactly five minutes after this first buzzer, a different sound will be heard, to indicate that the specified time has been spent at the target temperature.

8 Changing the Target Press NEXT to obtain the second display. Change TARGET TMP to 300, and confirm by the angled arrow button. No other changes are needed. Press PREV to observe the first display, and press the DOWN triangle twice to see PRED TEMP. This should be close to 250.
Now press the START button. PRED TEMP should change to about 290. Press the UP triangle twice to monitor the measured temperature as it climbs.

9 At Target Temperature The events of paragraph 7 should be repeated, but with the new target of 300 degrees.

10 Ramping Down After the second buzzer has indicated five minutes at target, press the NEXT button twice. This will bring up the third display. Press the DOWN triangle then the RIGHT triangle to bring the cursor to the isolated 1. Type 2 on the keyboard, and confirm with the angled arrow. Press START.
Now press PREV to obtain the first display. The measured temperature and the output voltage should both be falling. When the measured temperature reaches 200, there will be a click, the indicator light will change colour, and OUTPUT V will show 0.00. The system is now inactive.

11 Finishing Touches It is good practise to leave the controller switched on and indicating the measured temperature, until that temperature has fallen sufficiently so the cell is safe to touch (say, no more than 50 deg C). Then, the STOP button should be pressed, to re-set the registers in the controller. The controller may now be switched off by the power switch.

Instructions for use of the Alan Bradley E150 Programmable Heater Controller

This module has been programmed for use with the Diacell Products gasket heater. It is shown in Figure 1. The chassis screw should not be touched as it holds a component inside the box.

Suggested wiring scheme.

The scheme of Figure 2 is suggested. Readings of current and voltage on the controller are not always visible if other aspects of the control are being shown. Hence we find it helpful to include an ammeter and voltmeter as shown in the circuit of Figure 2. The reading from the voltmeter will be lower than that indicated on the controller because of the voltage drop in the wires, ammeter and fuse. If very high temperatures (above 800 °C) are required, it is important to have the wires as short and as thick as possible, to minimize the voltage drop.

Instability in the measured current and voltage will often be the first indication that a heater is reaching its limit of performance and should not be pressed further.

The expected limits are 16 volts and about 8 amps. Ranges on the meters should be set accordingly, and a suitable fuse should be chosen. It is good practice to earth the cell in case of the (very slight) possibility of short-circuiting between a power wire and the cell body. Such a short-circuit will then blow the fuse without further damage to the cell.

The control panel.

This is illustrated in Figure 3.

Control Buttons

- The "PREV" and "NEXT" buttons are used to select the three possible displays (see below). This is their only function.
- The "START" button is used to start the controller after all the required settings have been made. It is used to start each experiment when the target temperature has been changed in the "CONTNUE" mode.
- The "STOP" button is used for emergency shut-down. It will immediately cut off the output power.
- The "ALARM MUTE" button will silence the alarm buzzer. If the buzzer has been silenced, a second press will re-start it.
- The "PAUSE" button will hold all counters and outputs at their current level until it is pressed a second time.
- The up and down triangles are used to select the display line. The right triangle moves the cursor to the figure to be changed. The number keys may then be used to change the value: when correct it must be confirmed by pressing the key with the angled arrow: ↵ [which we shall call "return" from now on].
- The button showing a right-pointing straight arrow: ← has no function in the present program.

[NB. Parameters are changed by pressing the black buttons below

the coloured function windows of the display.]

Display

The rectangle at the top of the control panel, showing the lines "TEMP IN 21.57 ; OUTPUT V 0.01" is a display panel which will show **two lines** (only) of text and figures. Three displays are available, being selected by the "NEXT" and "PREV" buttons (these are the round buttons beneath the labels).

First Display (shows automatically when the controller is switched on):

TEMP IN	measured temperature
OUTPUT V	voltage output to power heater
PRED TEMP Tp	interim target temperature (to be explained later)
INCREMENTS V	number of voltage increments to present output

The lines of this display can be accessed by use of the upward & downward pointing orange triangles. The figures in the first display cannot be changed by the user. They are measured or calculated by the controller and are shown for information only.

Second Display:

TARGET TMP	Ts=300.0	Target Temperature
MAX TMP	Tm=500.0	Temperature to switch off power
TIME STEP	R=1.0	No. of seconds between voltage increments
MAX VOLTS	Vm=16.0	Maximum permitted output voltage
OUTPUT INCR	I=0.01	Increment of output voltage
TMP STEP EQ	P=0.8	Temperature step to interim equilibrium
TIME STEP EQ	L=1.0	Time step between readings at equilibrium
RANGE TARG	D=0.8	Temperature range for equilibrium detection
NO STEPS	C=20.0	No of steps for equilibrium detection
TIME TARG	TI = 120	Time (in secs.) at target temperature before time-out
LOWER LIMIT	V=0.05	Tolerance limit for voltage detection
UPPER LIMIT	V=0.05	Tolerance limit for voltage detection

All the figures to the right of the second display can be changed by the user. The default values are shown above. The orange up and down triangles are used to select the line, whilst the right triangle moves the cursor to the figure to be changed. The number keys are then used to change the figure, when correct , may be confirmed by pressing the "return" key. In general, only the first two lines should need to be changed.

NB.The "return" key must be pressed for each line of Display 2 (or 3) when the number on that line has been changed to a new value.

Third Display:

0=FINISH	2=RAMPDOWN
1=CONTINUE	1

- The only changeable figure in this display is the isolated "1" on the second line. This display allows the user to choose what happens when the counter times out at equilibrium.
- If "0" is chosen, the power is switched off at time-out.
- If "1" is chosen, nothing happens at time-out (except that a warning buzzer sounds).
- If "2" is chosen, the output voltage decreases by 0.01 volts per second until 2.5 volts or 200 °C is reached, when the power is switched off. "2" can be chosen only when the measured temperature is above 200 °C because, below this temperature, the system immediately switches

off. Also, "2" can only be used manually, because ramp-down starts as soon as the choice has been confirmed.

If "1" is chosen for time-out, it is possible to re-set the target temperature to a different value (higher or lower than the previous one) and carry out a new experiment continuing from the previous one.

NB.The "return" key must be pressed for each line of Display 3 (or 2) when the number on that line has been changed to a new value.

Parameter Values and Control Procedure

"Target Temperature" is the temperature (in°C) at which the experiment is to be run. 800 °C is the recommended maximum in normal circumstances. The heaters supplied with cells will often go to higher temperaturethan this but the heater life will be shortened if this temperature is exceeded. It is recommended that trials be carried out at much lower temperatures (200 to 300 °C) to gain familiarity with the system.

"Maximum Temperature" should be set to slightly above (say, 50°C) the maximum temperature required for any experiment in a session. This is the emergency cut-off temperature in case the system goes out of control. The system should not go out of control, but it is important to have a safety cut-off.

"Time Step" at 2 seconds is a compromise between speed of achieving target temperature and avoiding over-shoot of this temperature. The default value gives a rise of 1 volt in 200 seconds or 3⅓ minutes. Thus the full voltage range takes 53⅓ minutes if there are no interruptions to the climb. It may be possible to use a faster rate, but experience needs to be gained with the system first.

"Maximum Volts" limits the voltage output of the controller. 16 V is the practical limit for the equipment, but a lower value can be set to give greater protection to the heater if temp-eratures well short of 800 °C are being aimed at.

"Output Increment" is the voltage step used in conjunction with "Time Step" in the ramp up to the target temperature. 0.01 V is the practical lower limit for this increment. Larger increments may be used, but are not recommended.

"Temperature Step to Equilibrium" is a feature to prevent over-shoot of the target temperature. Its value must never be greater than 1.0. It defines an interim target temperature below the actual one. The voltage ramp flattens when this interim target is reached, to allow the cell time to heat up so the overshoot in temperature will occur at less than the required final target. The interim target temperature is shown as "Pred Temp Tp" on the First Display. The calculation is as follows.

Suppose the starting temperature is 20 °C, with target temperature 800 °C. The difference is 780 °C. "Tmp Step Eq" of 0.8 multiplies the temperature difference to give 624 °C. This is added to the starting temperature to give "Pred Temp Tp" °C. When the measured temperature reaches this value, the system attempts to stabilize this reading for a specified time. Then a new interim target is calculated by the same method (800 – 644.4 = 155.6; 155.6 x 0.8 = 124.48; 644 + 124.48 = 768.48) and the process continues. So long as
the step fraction is above 0.5, the process converges quite quickly to the final target temperature. Notice that 644.4, not 644, was used as the starting temperature. This is because the measured temperature, and not the interim target, is taken to be the starting point.

"Time Step at Equilibrium" allows a different time interval to be used in controlling the equilibrium, from the interval used in the ramp.

"Range Around Target" is the temperature range in °C centred on the target temperature, within which the controller will calculate that the measured temperature is the same as the target. +/- 0.8 °C is the smallest practical value for this range, because the temperature measurement is made in discrete steps of about 0.6 °C. If the range is made too small, the controller will sometimes not detect that the target has been reached, and will continue to ramp past the required value. This may also happen if too high a ramp rate is used.

"Number of Steps" X **"Time Step at Equilibrium"** gives the length of time for which an intermediate equilibrium will be held before a new intermediate is aimed for. 30 seconds (3 x 10) seems to be just long enough, at the default ramp rate, to prevent major over-shoot at the final target temperature.

"Time at Target" is the length of time (seconds) at which the final target temperature will be held within the equilibrium range before the time-out procedure (Third Display) begins. The default value of 2 minutes is adequate for testing the system, but usually a much longer time would be needed for an experiment. If "1=Continue" is chosen on the Third Display, the "Time at Target" parameter becomes irrelevant, since no action is taken on time-out in this condition.

"Lower Limit" and **"Upper Limit"** give the range within which a set voltage is calculated to be the same as a measured voltage. These are necessary because, like temperature, the controller measures voltage in discrete steps, even though it can increment in smaller steps.

The minimum voltage that can be output by the controller is about 2.5 volts. This will bring the measured temperature from a heater up to about 60 °C if the voltage is left at this level for a long period. Thus, a temperature less than 60 °C cannot be controlled with this system. As soon as the "Start" button is pressed, the controller outputs 2.5 volts. The ramp, though, starts from 0 volts and takes about 4 minutes to reach the existing level of 2.5 volts (at a set rate of 0.01 V per sec) before the chosen parameters become effective and the output voltage begins to ascend at the chosen rate.

Typical Trial

It is suggested that runs should be made initially to very modest temperatures, to gain experience with the system. A run up to 250 °C, followed by a further stage at 300 °C, followed by ramp-down, will be described.

1. Switch on. After a few seconds of setting-up displays, the small screen will show:

TEMP IN	(measured room temperature)
OUTPUT V	0.01 (or 0.00)

2. Set Temperature. Press "NEXT" – the round button under the label. The screen will now show :

TARGET TMP	Ts=800.0
MAX TMP	Tm=1050.0

The cursor will be on the first T of "TARGET TMP".
Press the round button at the base of the RIGHT Pointing triangle.
The cursor will move to the 8 of "800.0"
Type 2 5 0 using the number keys. The screen will now show : TARGET TMP Ts=250.0

If a mistake has been made, use the DOWN triangle to take the cursor to the line below, then the UP triangle to return to the top line. The RIGHT triangle will take the cursor to the incorrect temperature value. The correct value can now be typed in.

When the target temperature is correct, press the "return" key. This will confirm the temperature setting so the cursor may be moved to the second line and the TARGET TMP will stay at 250.0 until either it is changed or the system is switched off.

3. Set Max Temp. Press the DOWN triangle to take the cursor to the second line, then the RIGHT triangle to move the cursor to the 1 of "1050.0". Type in 3 5 0 using the number keys. Press "return" to confirm this setting.

4. Set Time at Target. On the default setting, the system will indicate by a buzzer when the temperature has been maintained at the target temperature for two minutes. This is suitable for testing the system, but probably a much longer time would be wanted in experiments. As part of the exercise, the time will be re-set to five minutes.

Press the DOWN triangle eight times (not too quickly). The display should read:

TIME TARG	T1=120
LOWER LIMIT	V=0.05

Press the RIGHT triangle to move the cursor to "120". Type in 3 0 0. Press "return" to confirm. This will give 300 seconds = five minutes at the target.

5. Check "CONTINUE" Mode. Press the NEXT button to bring up the third display. The single figure after "CONTINUE" on the second row should be "1". This should not be changed, since a second trial is to be performed after the first one.

6. Start the System. Press the PREV button to return to the first display. Press the DOWN triangle twice. The display should show:

OUTPUT V	0.01
PRED TEMP Tp	0.00

Now press the START button. There will be a click. The indicator light will change colour from red to green. Assuming 20.0 °C starting temperature, the display will show (approximately):

OUTPUT V	2.60
PRED TEMP Tp	204.0

Now press the UP triangle twice to see the measured temperature as it climbs toward the target. OUTPUT V will remain at (say) 2.60 for about 2.5 minutes, then will begin to increase by 0.01 every 2 seconds.

When the measured temperature reaches about 198, press the DOWN triangle twice to see the change in predicted temperature. After a minute or so the value should change to about 240.8. Then press the UP triangle twice, to continue tracking the measured temperature.

7. At Target Temperature. The measured temperature should climb to about 250, over-shooting by no more than about 2 or 3 degrees. The output voltage will start to decrease and the temperature will fall back close to 250. After a minute or so, the buzzer will sound to indicate that stability near 250 deg has been detected. Exactly five minutes after this first buzzer, a different sound will be heard, to indicate that the specified time has been spent at the target temperature.

8. Changing the Target. Press NEXT to obtain the second display. Change TARGET TMP to 300, and confirm by pressing "return". No other changes are needed. Press PREV to observe the first display, and press the DOWN triangle twice to see PRED TEMP. This should be close to 250.

Now press the START button. PRED TEMP should change to about 290. Press the UP triangle twice to monitor the measured temperature as it climbs.

9. At Target Temperature. The events of [7] should be repeated, but with the new target of 300 degrees.

10. Ramping Down. After the second buzzer has indicated five minutes at target, press the NEXT button twice. This will bring up the third display. Press the DOWN triangle then the RIGHT triangle to bring the cursor to the isolated 1. Type 2 on the keyboard, and confirm with "return". Press START.

Now press PREV to obtain the first display. The measured temperature and the output voltage should both be falling. When the measured temperature reaches 200, there will be a click, the indicator light will change colour from green to red, and OUTPUT V will show 0.00. The system is now inactive.

11. Finishing Touches. It is good practice to leave the controller switched on and indicating the measured temperature, until that temperature has fallen sufficiently so that the cell is safe to touch (say, no more than 50 °C). Then, the STOP button should be pressed, to re-set the registers in the controller. The controller may now be switched off by the power switch.

Warranty (v1.4)

This agreement is between easyLab Technologies Limited of Reading, Berkshire, United Kingdom ("easyLab Technologies") and the undersigned buyer ("Buyer") with respect to the sale of easyLab Technologies hardware to Buyer where such sale has been made by easyLab Technologies or by a distributor duly authorized by easyLab Technologies.

easyLab Technologies Ltd are not liable for damage or failure of the diamond anvils. Diamonds are a natural mineral and as such cannot be guaranteed.

easyLab Technologies warrants that, for a period of one (1) year from the date of delivery to Buyer (for products that do not require installation, and from the date of successful installation for items normally installed by easyLab Technologies), the hardware, instrumentation and/or equipment manufactured or designed by easyLab Technologies will be, under normal use, free from defects in material and workmanship. easyLab Technologies further warrants that the hardware, instrumentation, equipment manufactured or designed by easyLab Technologies will perform, under normal use, substantially in accordance with the specifications contained in published sales literature and data sheets. easyLab Technologies shall determine, at its sole discretion, when a successful installation has been completed.

The above warranty is given by easyLab Technologies subject to the following conditions: easyLab Technologies shall be under no liability in respect of damage to or failure of diamond anvils. Diamond is a natural mineral and therefore cannot be guaranteed.

easyLab Technologies agrees to assign to Buyer whatever rights easyLab Technologies may have under any warranty, express or implied, of any supplier or manufacturer of components used by easyLab Technologies but not manufactured or designed by easyLab Technologies.

easyLab Technologies' entire liability and Buyer's exclusive remedy under this warranty will be to repair, or at easyLab Technologies' option, to replace, without charge, any product or component manufactured or designed by easyLab Technologies which proves to be defective within the scope of this warranty. In the event easyLab Technologies is unable to repair or replace such a defective product or component within a reasonable time after receipt thereof, easyLab Technologies shall refund to Buyer the original purchase price of the defective product or component. If the loss of use of a component manufactured or designed by easyLab Technologies substantially impairs the use of the product, and easyLab Technologies is unable to repair the defect, easyLab Technologies shall refund to Buyer the original purchase price of the product.

All warranty claims must be made in writing to easyLab Technologies within the warranty period. Buyer shall not make any returns to easyLab Technologies without receiving prior authorization from easyLab Technologies, as evidenced by a return material authorization number (RMA). Any authorized returns must be made to easyLab Technologies' factory within thirty (30) days after discovery of a defect or non-conformity. The return shipping to easyLab Technologies shall be at the risk and expense of Buyer.

Products that are returned should be properly shipped to minimize further damage, and insured at their original purchase price. All returns to Buyer shall be at the risk and expense of easyLab Technologies.

EXCEPT FOR THE ABOVE EXPRESS LIMITED WARRANTIES, EASYLAB TECHNOLOGIES MAKES NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY SATISFACTORY QUALITY AND FITNESS FOR A PARTICULAR PURPOSE, IN ANY OTHER PROVISION OF THIS AGREEMENT OR IN ANY OTHER COMMUNICATION, STATEMENT OR REPRESENTATION, WHETHER ORAL OR WRITTEN, MADE BY ANY AGENT, DISTRIBUTOR, REPRESENTATIVE OR EMPLOYEE OF EASYLAB TECHNOLOGIES, UNLESS MADE IN WRITING, EXECUTED BY ONE OF EASYLAB TECHNOLOGIES' DIRECTORS, AND EXPRESSLY DESIGNATED AS A "WARRANTY." ANY SIMILAR WARRANTIES OR TERMS OR CONDITIONS THAT WOULD OTHERWISE BE IMPLIED BY OPERATION OF APPLICABLE LAW ARE HEREBY EXPRESSLY DISCLAIMED.

In the event that the terms and conditions of this Agreement conflict with the terms or conditions of any other agreement or representations between easyLab Technologies and Buyer with respect to the purchase of the products, the terms of this Agreement shall be deemed to control.

This Agreement shall be governed and construed in accordance with the laws of England and the Buyer agrees to submit to the jurisdictions of the English Courts.

Contacts

Please always quote your SOP number when contacting your local representative:
Please contact us and we will direct you to the appropriate contact in your Country.
For sales: sales@easyLab.co.uk
For support: support@easyLab.co.uk