

Delta T4 Heated Slide Carrier Instructions

Caution: Read Carefully Before Use!

The System is comprised of two main components: a temperature controller, and a thermally controlled microscope slide carrier. It is designed to be used on an upright microscope typically when observing cells such as yeast plated on a 25mm X 75mm slide. The prepared yeast slide is placed on this optically transparent, temperature-controlled surface during microscopy and time lapse image acquisition. It utilizes a new and improved technology that is much faster and more accurate than traditional peripheral stage warmers. The controller has a fast response capability that enables control features previously not possible with conventional peripheral heating systems. Therefore, it is highly recommended that you read and fully understand these instructions before use.

Before You Begin:

- Check to make sure there is no visible damage in shipment and save all packing materials.
- The Controller box should contain; controller, power cord, 2.5mm screwdriver, 6' BNC cable, 1/8" jack, and 3 pin mini DIN connector.
- Check the packing list and call your supplier if there are any discrepancies.

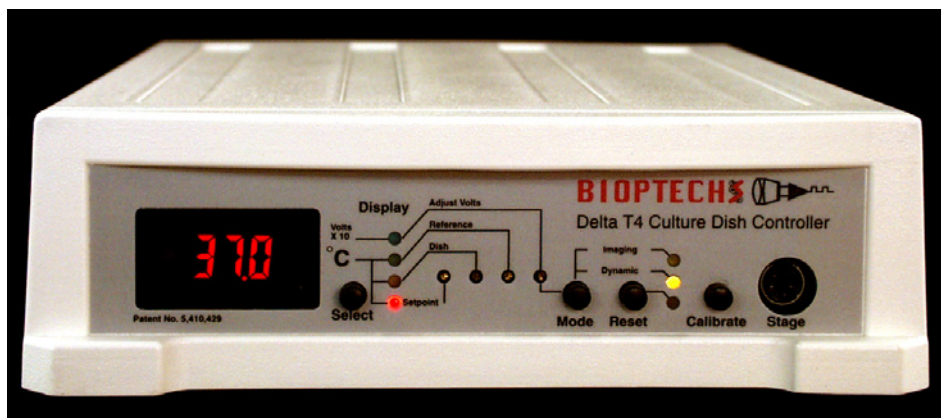


Figure 1

Control Interface Descriptions:

Numeric Display should be illuminated when the controller is turned on. If it does not light, check the main power source then the fuse block located in the power input module where the AC power cord plugs in.

Display Selector is the black button adjacent to the display. It selects the source of the information displayed. When the controller is turned on, the default condition is to display the setpoint value indicated by the light adjacent to the word **Setpoint**. The button selects one of a sequence of display options. This button can be pressed at any time and has no effect on the temperature regulation functions of the controller.

Display Lights indicate the source of the value displayed on the numeric display.

Setpoint is adjusted by a potentiometer accessible with the 2.5mm screwdriver provided. To adjust the setpoint make sure the numeric display is set to **Setpoint**, and then adjusts the setpoint potentiometer to the desired value. See adjusting setpoint value. If you need to change the setpoint value during your experiment on a routine basis there is a remote setpoint jack on the back of the controller. See Remote Setpoint.

Dish is the location where the calibration of the channel one-thermistor reading circuit can be adjusted.

Reference is the location where the calibration of channel two or reference thermistor reading circuit can be adjusted.

Adjust Volts is the location where the non-dynamic voltage adjustment is made. This is the energy value sent to the dish when the controller is in **Imaging Mode**. **Adjust Volts** must be selected for the display and the **Mode** switch must be pressed for this value to appear. The display will show a number that is 10 times the actual voltage value being sent to the dish. Adjustments can be made to this value by turning the small screw located in the hole corresponding to Imaging Volts.

Mode button changes the mode of operation of the controller from dynamic feedback control to a fixed voltage set by the **Adjust Volts** setting. When the controller is in Dynamic mode, the amber LED will be lit next to the mode switch. When the controller is in Imaging mode, the green LED will light. If the controller is in Imaging mode as a result of pressing the mode switch, only the green LED will light. If the controller is in Dynamic mode and a TTL voltage is applied to the BNC jack on the back of the controller, both the amber and the green LEDs will light. **Caution!** Make sure that the controller is not left in the Imaging mode for longer than 30 seconds. This will not damage the controller but if the temperature in the dish deviates more than the error margin during this time, the alarm will sound and the controller will ignore all the safety interrupts. The controller will continue to supply the constant voltage to the dish until the controller is returned to the Dynamic mode.

Reset (Red Button) resets the controller to the cold start condition and enters the energy value used in Adjust Volts as a starting regulation value.

It is to be used when any of the following conditions occur:

1. Immediately before placing a new dish into the stage adapter if you want to change dishes without turning off the controller.
2. Immediately after placing a new dish into the stage adapter. This is insurance that the controllers learning curve did not wonder during the few seconds it takes to insert a dish. Dish exchanges should not take more than 10 seconds.
3. When the alarm goes off and the red LED lights next to the Reset button. Note: If the alarm went off there must have been a reason. Check the dish before resetting the controller.

Calibrate substitutes precision resistors into the circuit that reads the thermistor so that calibration adjustments can be made to a known value.

Stage is a six pin mini DIN connector where the heated slide carrier is plugged in.

Back Panel of the Delta T4 Controller



Figure 2

AC Power line input, power switch, voltage selector, and fuses are all incorporated in the AC Power Input Module. The controller can operate between 90 - 260V 50-60Hz, or a 24V battery can be used as an alternate power supply. The fuse carrier contains two 0.5A slow blow fuses. The fuses can be accessed by prying the fuse block out of its socket with a small screwdriver wedged under the small slot in the opening of the AC line receptacle. When replacing the fuse block, make sure to align the arrow on the outside of the fuse block with the closest voltage value to your supply line voltage:

- For 90-130-supply line voltage place the fuse block with the arrow pointing to 110-120V.
- For 180-260 supply line voltage place the fuse block with the arrow pointing to 220-240V.

Heated Lid Adjustment is the adjustment for the voltage sent to the **Heated Lid**. Its range is from 0 to 5 V DC. The nominal voltage is 2.5 V. This voltage should be measured at the **Heated Lid** with an external meter. It should be adjusted to a value just above the condensation point. The heated lid is an option for Delta T users only.

Heated Lid is the location to plug in the Bioptechs Heated Lid. The heated lid is an option for Delta T users only.

Temp Out is a voltage output direct from two instrument amplifiers reading the thermistor from channel A and B.

The output from this socket is temperature /10. $37.0^{\circ}\text{C} = 3.70$ Volt DC. Left pin is channel A, center pin is channel B, and right pin is ground.

Remote Setpoint is an analog input that allows the user to set the controllers setpoint from an external DC source. The sleeve is earth ground. A DC voltage can be applied to the tip of this jack equal to temperature /10. i.e.: $28.5^{\circ}\text{C} = 2.85$ Volt. When the jack is inserted into the controller it will automatically switch to the jacks value. When removed it will default to the setting on the front of the controller. Use for programming or cycling operating temperatures.

Fixing Adjustment allows the user to adjust the voltage sent to the heated slide carrier when the **Fixing Switch** is depressed. Range from operating temp to 97°C .

Fixing Switch is provided so that cells can be fixed on the stage of the microscope. It can also be used for heat shock experiments. The switch is recessed so that it is not actuated by mistake. **Caution!** This switch should only be used when you intentionally want to overheat your cells. It provides a nearly instantaneous heat shock!

TTL is a BNC connection used to change the mode of operation of the controller from a remote source such as an image acquisition computer or slave from a shutter trigger. The default condition of the controller is dynamic control. To change to Imaging mode, apply a TTL logic high and hold to this BNC. The controller will remain in Imaging mode as long as the TTL condition remains high as indicated by the LED on the front panel.

Delta T4 Controller Operation

Instructions:

1. Without any peripherals plugged into the controller, turn the unit on using the main on-off switch located on the rear panel adjacent to the power cord.
2. Set the display to “**DISH**”. The temperature display will read a number between -3.7 and -4.2. Press and hold the black button labeled “**CALIBRATE**” and make sure the display reads 25.0°C. If adjustment is necessary, turn the corresponding screw in the adjustment hole with the enclosed screwdriver. CW = increase, CCW = decrease. Repeat this procedure with the display switch set to the “**REF**” position.
3. Set the display to “**SETPOINT**”. Insert the enclosed screwdriver into the opening marked “**SETPOINT**” and set the controller to read a value 2.0°C less than the desired setpoint. **Note:** The temperature probe reads is embedded in a cavity in the black epoxy end of the slide carrier it will respond faster than the cell surface. This is to your advantage.
4. Plug in the heated slide carrier. With the display set to **DISH** it will read the temperature of the slide carrier.
5. Allow the controller and slide carrier to stabilize for five minutes.
6. Fine tune the setpoint setting through the following procedure:
7. Plug the reference thermistor into the two-pin receptacle located adjacent to the four-pin plug at the end of the slide carrier connector cable.
8. Place the reference thermistor onto the slide carrier and read its temperature by setting the display to “**REFERENCE**”. Allow the thermistor time to equilibrate before reading its value. Compare the reference temperature to the regulated temperature and make the appropriate adjustments to the **SETPOINT** value. Alternate method if you are working at 37°C; place a Biopotechs liquid crystal temperature indicator dot into the dish and adjust the **SETPOINT** until it turns green.
9. After you have determined the appropriate setpoint setting the reference thermistor is no longer necessary. It can be unplugged and kept in a safe place.

Special Note:

If the slide carrier temperature deviates from setpoint more than the 0.9°C error window, an alarm will sound, current will be shut off to the slide carrier and a red light will come on next to the red reset button. To silence the alarm and resume heating, press the **RESET** button. This will return the controller to cold startup mode and it will ignore the error window until the temperature again reaches setpoint minus 0.9°C. You can use the **RESET** button at any time to reset the controller’s learning curve.

Use of the Delta T4 in Narrow Depth of Field Applications:

The **Dynamic** control characteristics of the Delta T4 enable it to almost instantaneously compensate for temperature changes that may occur at the slide carrier due to perfusion, surface evaporation or other ambient conditions. The sensitivity of the controller, 0.1°C, coupled with the speed and intensity of the controller’s response, may cause the slide carrier to flex a detectable amount during narrow depth of field imaging. The controller is equipped with a circuit that bypasses the dynamic temperature control mode and permits you to temporarily send a constant DC current to the slide carrier to eliminate the possibility of an abrupt change of energy from occurring as might happen in dynamic mode. This prevents Z-axis displacement of the specimen during imaging.

The controller can be switched from its default **Dynamic** control mode to **Imaging** mode by several means:

1. Pressing the mode button on the front of the controller
2. Pressing the optional footswitch
3. TTL communication from an external trigger such as a acquisition host or slave from a TTL shutter trigger

Operate the Delta T4 in the auto (dynamic) mode when you are not scanning or acquiring images.

When you intend to acquire an image activate the **Imaging** mode. The value of the DC current can be adjusted with the potentiometer labeled Adjust Volts. A good starting point is 2.7V shown as 27.0 on the display. After adjusting the **Adjust Volts** setting, return the display to the **Dish** position and check to see that the value you have entered is adequate to maintain the setpoint value for at least 15 seconds. Make sure the controller is returned to the auto mode immediately after the image is acquired.

Heated Slide Carrier

The Heated slide carrier is made of 1.1mm thick glass with a coating of Indium Tin Oxide on the bottom surface. This electrically conductive surface is held 200 microns away from the stage surface by Teflon tape adhered to the perimeter of the bottom of the slide carrier. The upper surface of the slide carrier is masked to accommodate a standard microscope slide. The end of the slide carrier has a four-pin header connector to attach the control cable. There is no polarity on this connector.

Note: If corrosion is present on the electrical contacts, it should be cleaned immediately. The contacts can corrode if exposed to media in the presence of an electrical current. Corrosion on the cable connectors is preventable and not covered under warranty.

Care and Cleaning:

The slide carrier and controller can be cleaned by hand wiping with mild soap and water or alcohol but do not immerse or autoclave. The slide carrier should remain dry at all times. If liquids are spilled on or into the stage adapter they must be cleaned and the stage adapter dried immediately!