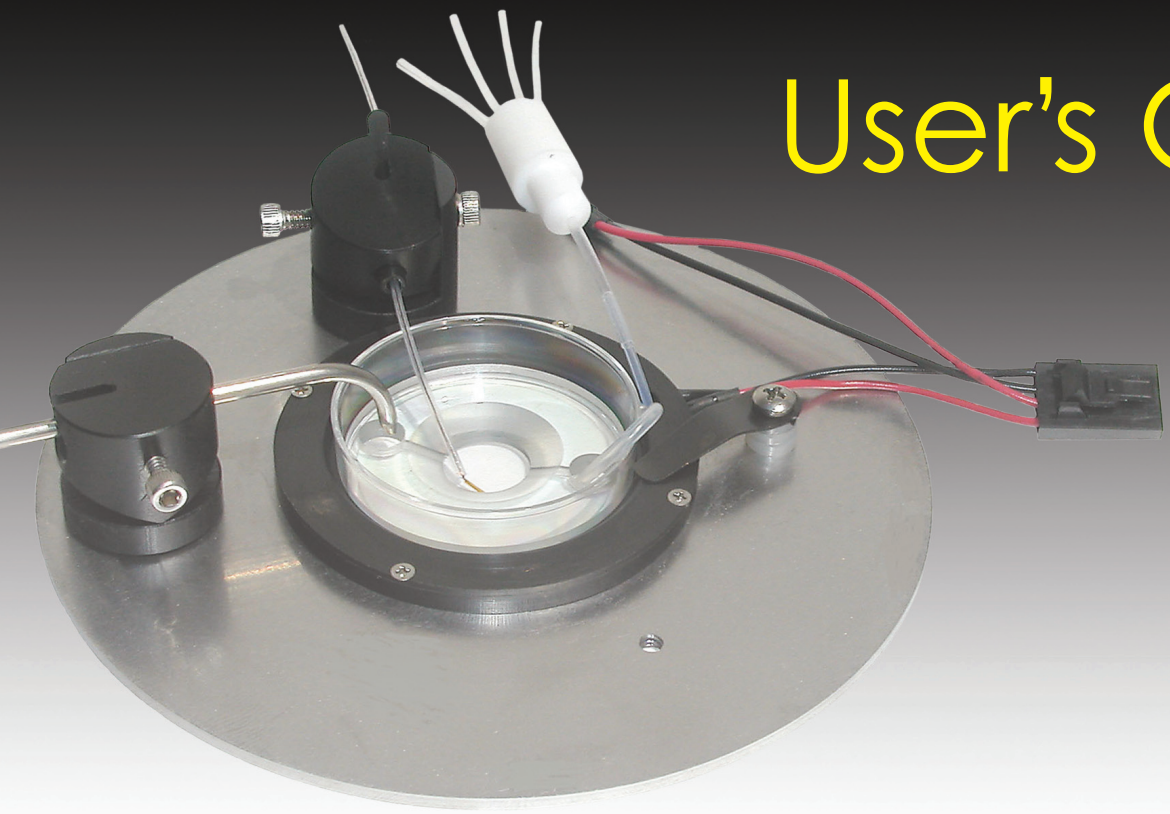
Temperature Control

User's Guide



Heated Microscope Stages & Objective Heaters

- **Precise Temperature Control throughout the experiment**
- **Conditions similar to** *in vivo*
- **Compatible with any perfusion system**
- **Heating stages for any microscope**
- **Compatible with Imaging systems**

Bioscience Tools

Ph: 877-853-9755
www.biosciencetools.com

Contents

CE

Specifications

Range up to 150ºC
Accuracy 0.1ºC
Stability 0.01ºC, required for sensitive applications: nano & piezo positioning, TIRF & AFM

No electrical noise suitable for electrophysiology
No vibrations no internal fan
Temperature sensors
built-in STAGE sensor
optional external probe BATH (0.87mm)
Feedback
from STAGE
adjustable DC and AC GAINs (self-adjusting)

Overheating protection
used for sensitive heating elements like objective haters;
regulated output from 0 to 96W to eliminate temperature overshoot;
adjustable temperature threshold
Output 12V 4A max (18V and 24V optional)
Size (Controller) : 8Wx4Hx9D in.
Power Supply
100-240VAC min 35W

Introduction

The complete temperature control system includes a controller, an external temperature probe (optional), and a connecting cable to a heating element. All heating elements include a temperature sensor built inside the element - STAGE sensor. This internal sensor is used for FEEDBACK. It is also used to prevent overheating of the sample. The new features of TC-1-100s controllers allow settings adjustment to prevent accidental overheating of OBJECTIVE HEATERS, small CUSTOMER self-made heaters, and other SENSITIVE heaters. The features also can be used with glass heaters and high temperature combination - to prevent glass damage if heating is done too fast (TC-HP65x75 glass plate and TC-GSH slide heater). Most heating elements can be used as inline pre-heaters, if connected to a perfusion systems. If used with a microscope stage, a microscope adapter might be required to fit the heating elements to your microscope table. The following are an illustrated installation guide and example configurations of temperature controlled setups.

Installation Guide

1 Connect power cable. Plug the power cable into wall outlet. Plug the heating stage cable into the output connector on the back of the controller - DB-9 female connectors

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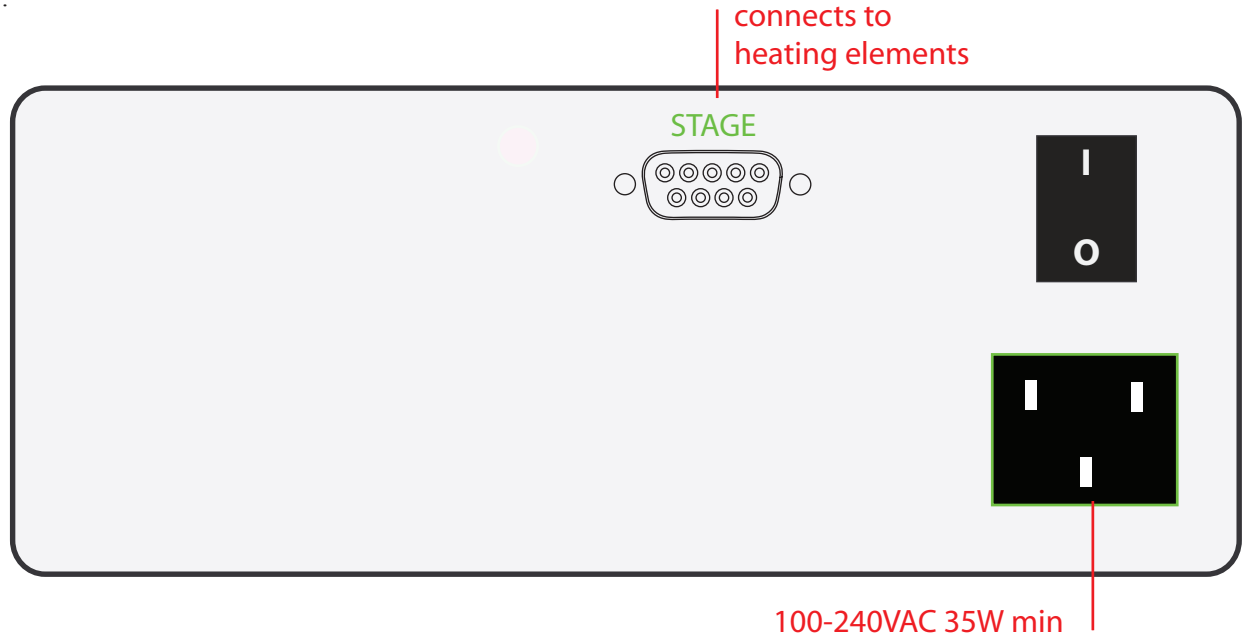
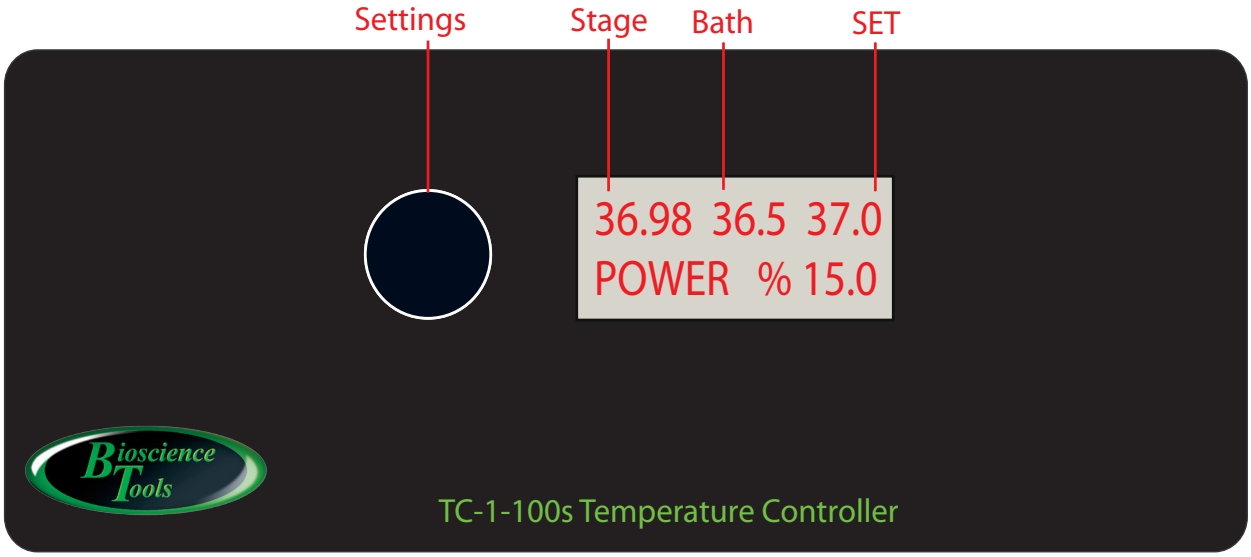
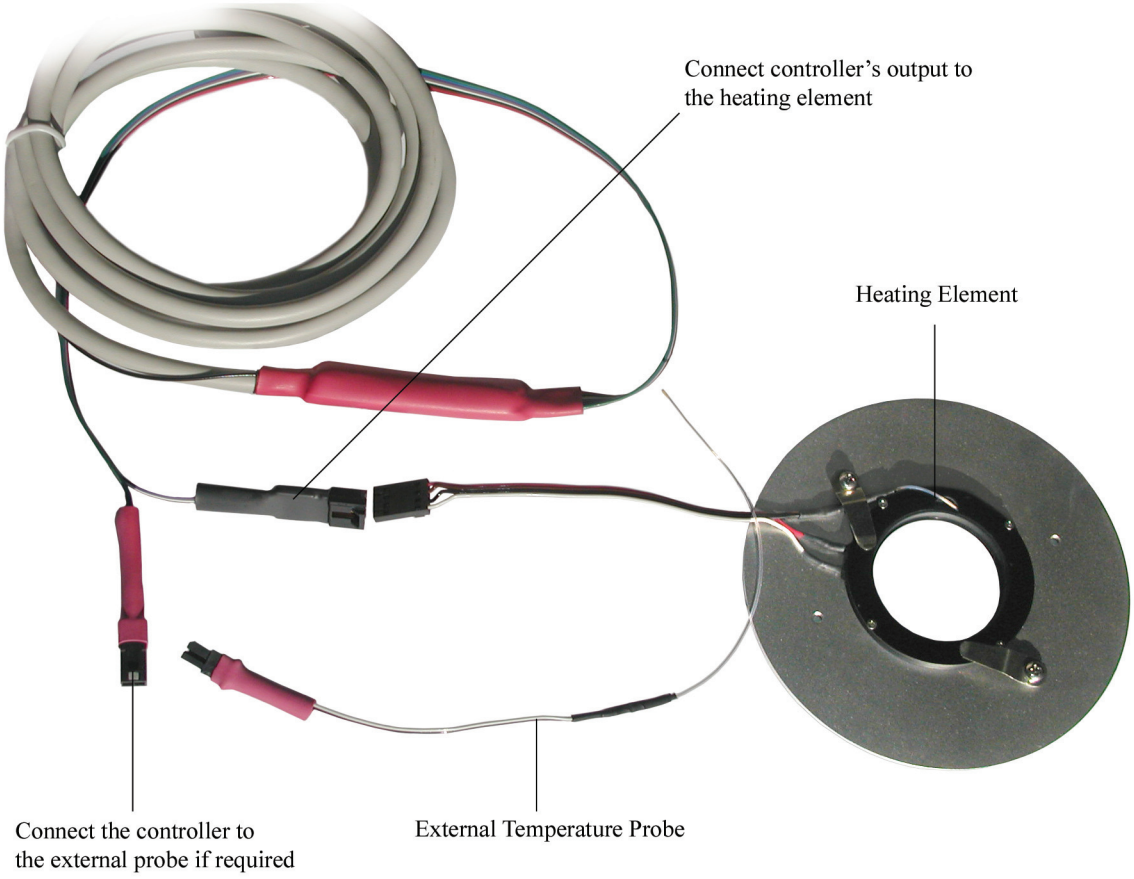
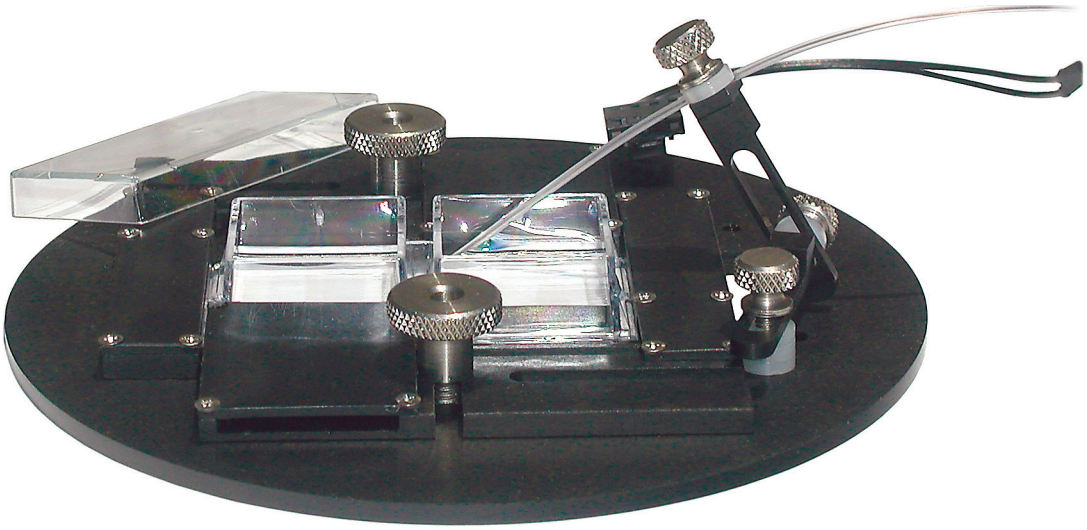




2 Connect the output cable to the heating element/stage and external temperature probes, if used.



3 Prepare the sample chamber, petri dish for example, by filling the chamber with water. Using optional adjustable holder, position the external temperature probe inside the chamber - optional BATH probe. You do not have to do this initial setup procedure while the heating stage is on the microscope. Use a desktop instead. You can transfer the heating stage on the microscope after you are familiar with the system. Turn the controller ON - power switch on the back of the controller.



4a The controller has one LCD display, and SET dial, which allows you to adjust the reference temperature by rotating the dial - BLACK knob on front. The same knob is used to switch the controller from STANDBY mode to ACTIVE CONTROL mode. The controller ships with setting adjusted to provide stable operation at 37 C. The controller can store settings for two different heating elements/environments or temperature levels. These two sets can be selected by rotating the knob on the front panel: the display will show:

"Settings-------->1/2"

By pressing the knob, you will select either number 1 settings or number 2 settings. This can be done while the controller is in ACTIVE mode, to generate fast temperature steps by switching from first setting with lower temperature to another with higher temperature (from SET temperature 35ºC to 45ºC for example).

To switch the controller from STANDBY state into ACTIVE state and observe on the temperature monitor how the controller regulates the temperature of the heating stage: press the knob once and rotate clock-wise to switch CONTROL ON.

24.5 37.0
CONTROL ON

The display will show POWER provided to the heating element.

36.9 37.0
POWER % 2.5

Push the knob twice to adjust SET temperature. The display will show:

24.5 37.0
SET tºC

rotate the dial to change the settings. After a few seconds after selecting SET level, the display will return to the original screen.

To switch the controller back to STANDBY mode, push the knob for display to show

CONTROL ON

and rotate anti-clock-wise to switch CONTROL OFF. In a second the display will show:

35.1 37.0
STANDBY

In order to change the gains from feedback, push the knob three time to show AC% level:

AC % 10

and rotate to change feedback sensitivity from 0 to 100%: Push the dial again to show DC% level:

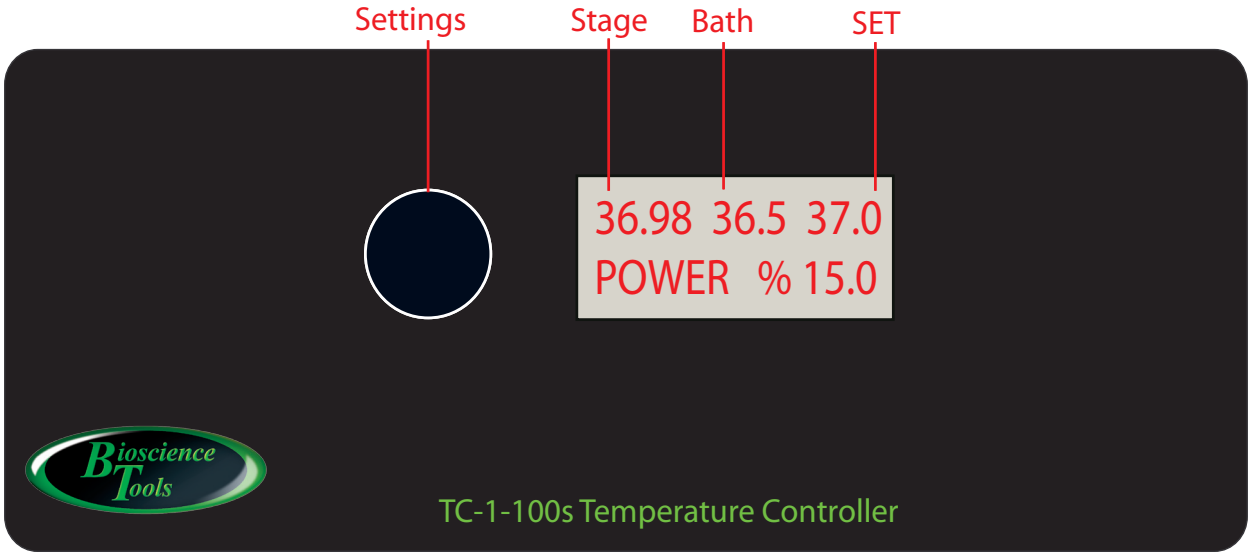
DC % 15.2

and rotate to change DC level, which is used to tune the controller for precise control. Although it is faster to adjust the controller by changing DC and AC levels manually, the controllers are self-adjusting to different environments if necessary: changing the heating elements for example, changing volume/mass of the sample or wide temperature fluctuations in the room. The controller can store settings for two different heating elements/environments. These two sets can be selected by rotating the knob on the front panel, after the controller is turned ON: the display will show “Settings-------->1/2”.

To prevent temperature overshoot and overheating, AC level can be adjusted to optional lower values, less than 1% (in 0.1-0.9% range, 0.9% is usually enough for the objective heaters TC-HLS). These low AC levels ensure slower temperature increase upon turning heating ON, in comparison to higher AC levels (up to 100%). These AC levels will also prevent overheating above SET temperature level, if the heater is not properly attached to the objective.

Additional built-in feature associated with low AC levels (<1%), is extra overheating protection if temperature gets above SET level more than 1ºC. This threshold can be always decreased even lower by adjusting HOT tºC level.

The low AC levels (0.1-09%) are optional to use, and can be changed to higher values if necessary.



You can set HOT temperature threshold level, if using AC above 1%, by pressing the dial to display:

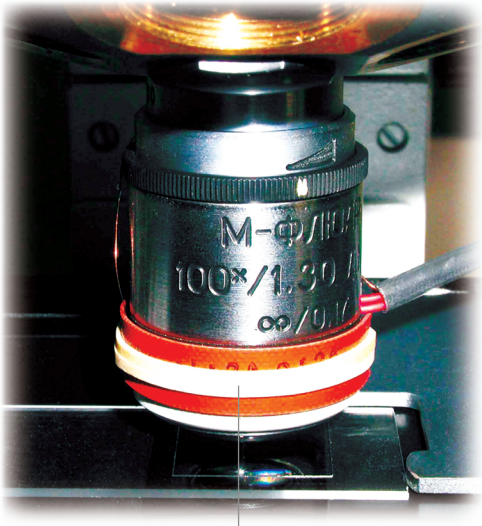
HOT tºC 45.0

After this, the controller will turn heating OFF, if STAGE overheats above the threshold.

Although the heaters tested and the controller is adjusted before shipment, the controller might need to be adjusted again after installation (attaching the heater to the objective):

First, turn heating ON with factory adjusted settings. Heating is turned ON by pressing the knob on the front panel (display will show “CONTROL1/2 OFF”) and rotating the knob clock-wise to show “CONTROL1/2 ON”. The controller starts self-adjusting (tuning) to stabilize around SET temperature level. If tuning takes too long, at the end of the experiment, press the front knob to display DC% level (this will put new DC% adjusted level into the controller memory and will shorten significantly tuning the next time the control is ON). DC% level can be adjusted manually, if temperature does not reach SET level fast enough, or stabilizes above SET level: increase/decrease gradually DC level in steps not more than 0.5% until temperature stabilizes at SET level.

This simple setting procedure will make systems with built-in temperature sensors functional within a few minutes. Setups with heating elements surrounding your sample, heaters for petri dish or chambers for coverslips for example, might require additional steps to achieve the correct temperature inside your sample.



Objective Heater

Uniformly Heated Bottom

Since samples in the petri dish are located at some distance from the heating element, the temperature inside the sample will be different from the temperature of the heating element - this is called “temperature gradient”. If you use an external probe to display BATH temperature, you will see this difference, provided the external temperature probe placed inside the sample chamber. You can achieve the required temperature in the sample chamber by increasing SET reference level to compensate the offset temperature difference between heating elements and solution inside sample chambers.

Using an objective heater with oil or water immersion objectives will eliminate this temperature gradient. The second channel of the controller (or another controller) is usually used to regulate the temperature of the objective heater, which has a built-in temperature sensor and does not require too much of fine tuning.

The chambers with uniformly heated bottom, TC-MWPHB, TC-HP75x65 or TC-HPQ75x50 for example, usually do not generate undesirable temperature gradient.

The controller can also minimize temperature fluctuations measured by the external BATH probe located/placed remotely from the internal STAGE sensor. The fluctuations are observed sometimes due to room temperature changes, during overnight experiments for example. The new tracking feature will report observed fluctuations and suggests recommended changes in compensation level (from 0 to 10 ºC/per ºC room).

Press the front knob to show TRACK OFF, and rotate to switch tracking ON:

TRACK ON

Press again, and make sure that dt/ ºC value is set to 0.0 vale:

dt/ ºC 0.0

After working for long time, the controller will detect any fluctuations in ROOM and BATH temperatures (ºC if

any), which can be displayed by pressing the front knob several times:

MIN dBATH -0.1
MIN dROOM -0.2

After pressing the knob again, you can see MAX fluctuations during the experiment (ºC):

MAX dBATH 1.5
MAX dROOM 1.2

In order to compensate the changes in BATH temperature, that happened due to fluctuations in ROOM temperature: press the front knob several time until the display show

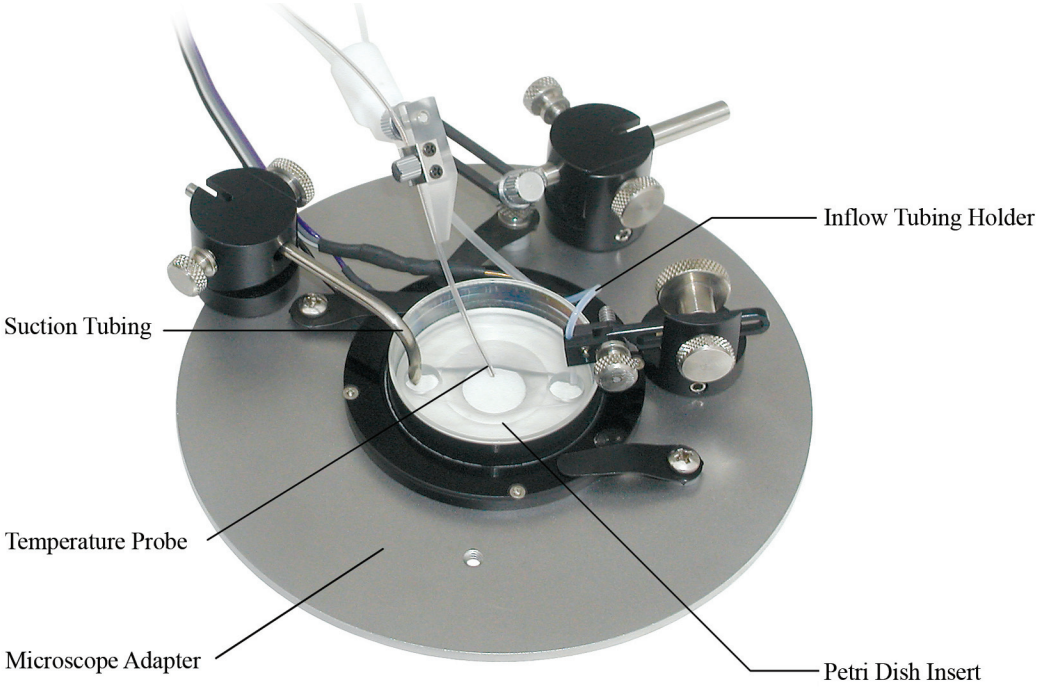
dt/ ºC 0.9
TRACK ON

And make a note of the suggested value of 0.9 for dt/ ºC parameter. Then, press the knob again and adjust the value for dt/ ºC:

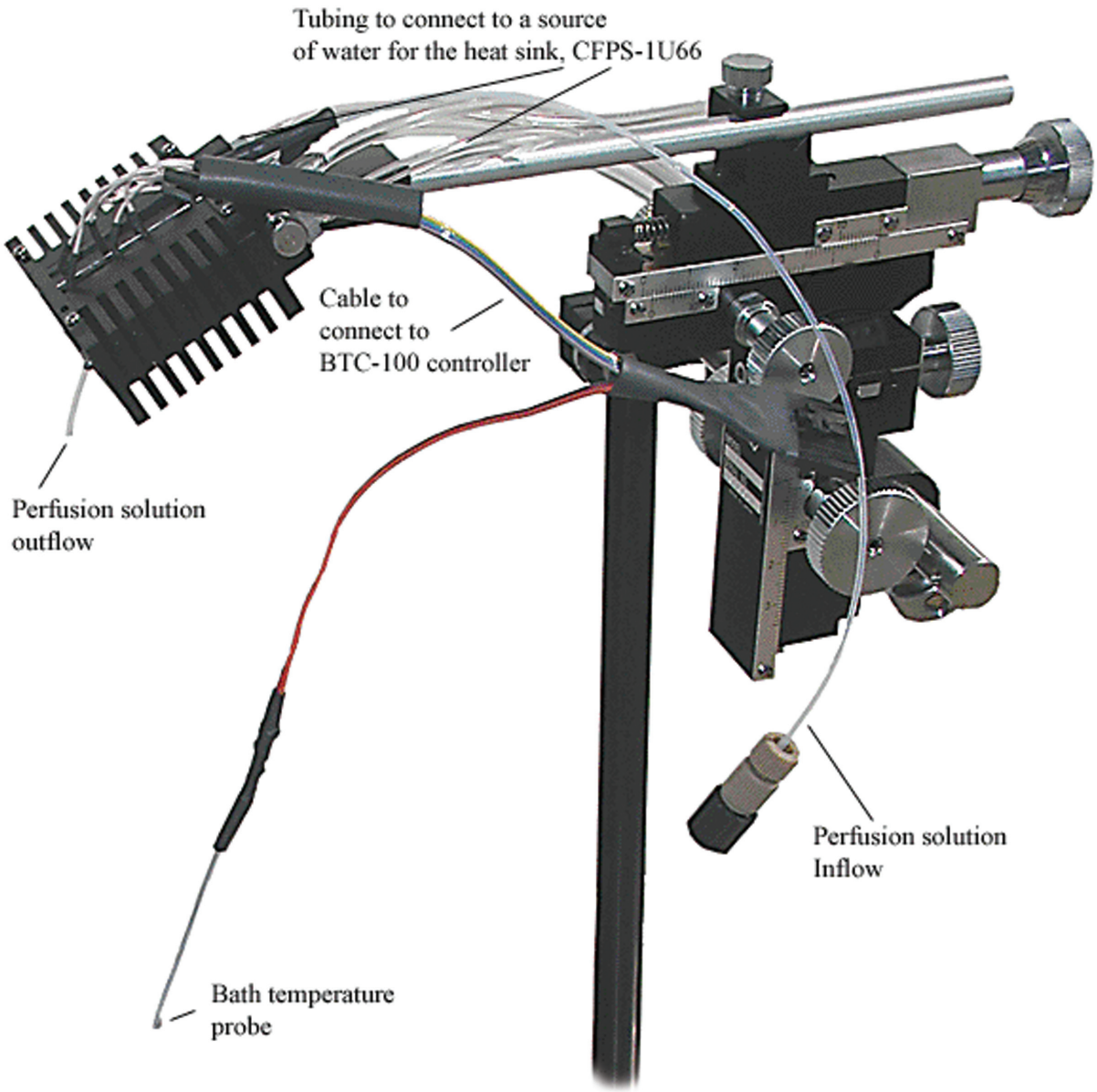
dt/ ºC 0.9

Note, that this is a suggested value, and might have to be adjusted after next experiment again. This new feature is similar to using feedback from BATH probe, but results in much more stable temperature control with minimal temperature fluctuations. This is also much safer in a sense, that it will nor result to overheating of your sample due to customer error - failure to position the external probe inside the sample for example.

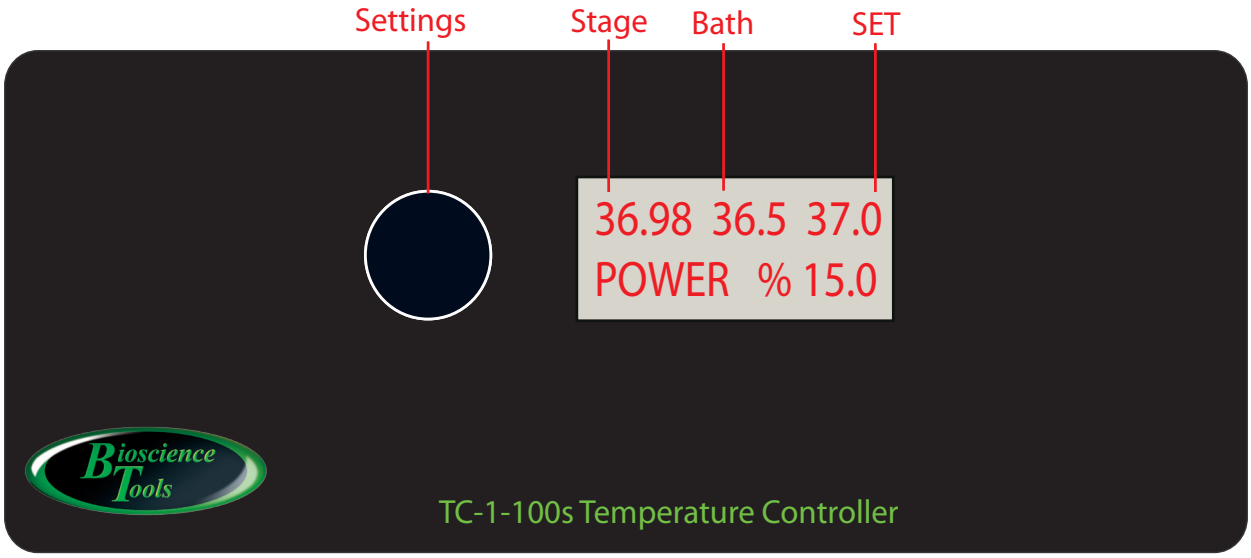
4b Using continuous perfusion of your sample helps to eliminate the undesirable temperature gradient in the system.



This miniature perfusion unit TC-RD (on the right) is used as a preheater or cooling unit during sample perfusion. It connects to the second channel, or another controller

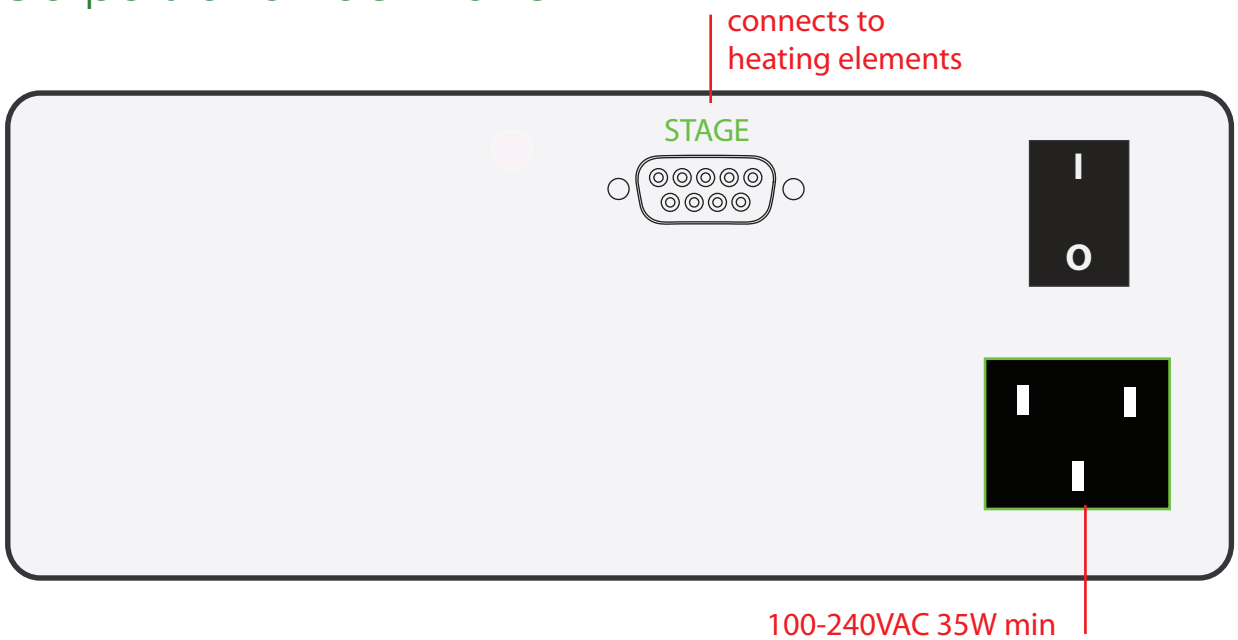


TC-1-100s Front Panel Controls



Front Panel Controls	
LCD monitor	Displays temperature readings from temperature probes, and shows SET temperature and other parameters.
Display Switch (knob)	Switches the display to show settings by pressing the knob: each click will switch the display to show/adjust different parameters in the following order: CONTROL ON/OFF, SET, AC %, DC % t ºC HOT, TRACK, dt/ ºC
SET dial (knob)	After display shows SET t ºC - sets the reference temperature
STANDBY dial (knob)	Provides POWER to the heating stages. After the display shows CONTROL, rotating clockwise, turns the controller into ACTIVE modes; anti-clockwise - into STANDBY mode when no power is provided to the heating stages.

Outputs and Back Panel



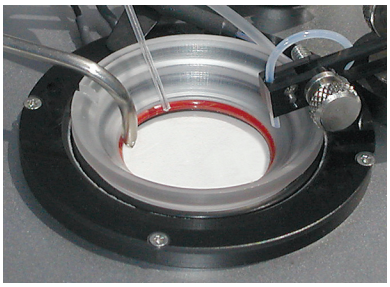
Outputs	
DB-9 Output	Connect to STAGE cables to provide power to the heating element and to provide temperature readings to the controller.

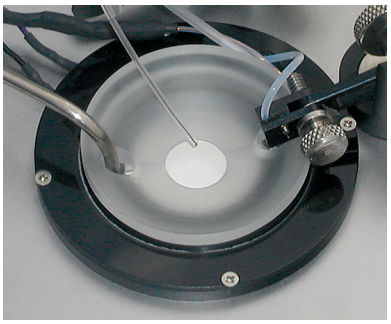
Back Panel Controls	
SWITCH	Turns the controller ON/OFF.
POWER jack	Connects 100-240VAC power outlet

Warranty

This product is warranted to be free from defects in material and workmanship for the duration of one year. Normal wear, or damage resulting from abuse, accident, alteration, misuse, service by an unauthorized party or shipping damage, are excluded from this warranty and are not covered. Bioscience Tools will repair or replace the defective product covered by this warranty free of charge if it is returned, postage prepaid, to Bioscience Tools, ph: 1-877-853-9755.

Heating Elements



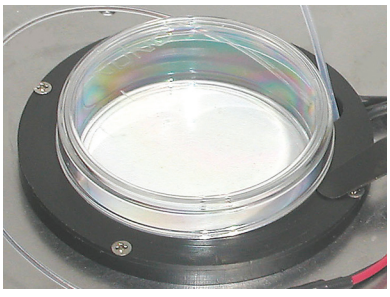


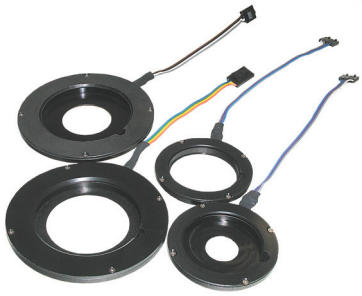
Heating element with 35mm aperture for Coverslip Chambers and Petri dishes TC-E35 Ready to use heated system for samples cultured/placed on coverslips. Used with bath chambers for replaceable coverslips CSC and UTIC. Replaceable coverslips allow to culture cells before performing experiments. The heater preheats perfusion solution before it enters the chamber. This keeps temperature stable even if used with perfusion systems. Inline heated tubing fits manifolds included with perfusion systems. Can be used for imaging and recording. Can be used with 35 mm petri dishes. Since some brands of petri dishes have different diameter, reducing adapters TC-PA might be required. Requires a microscope adapter (specify microscope model when ordering, ships installed inside the microscope adapter). Requires a temperature controller. Item# TC-E35

- **Dimensions:** 52mm diameter
- **Temperature stability:** 0.01°C, built-in sensor
- **Optical clearance:** 35mm
- **Use with:** Coverslips and Petri dishes, including 35mm glass bottom dishes
- **Solution Pre-heater:** Replaceable/Removable Teflon tubing, easy to wash
- **Microscope adapter:** Fits to 50mm cutout of standard microscope adapters MA and IMA

Heating Element with 15mm aperture TC-E35x15 Fits 35mm dishes. The whole bottom is heated to eliminate temperature gradient, which makes it ideal for petri dishes, including glass bottom dishes. Wide 15mm optical clearance to access your sample with immersion optics from the bottom. Built-in temperature sensor. Since some brands of petri dishes have different diameter, reducing adapters TC-PA might be required. Incorporates Teflon perfusion tubing, which makes the element to work as inline preheater. Requires a microscope adapters with 50mm mounting opening. Requires a temperature controller. This element is a part of TC-PCP-15 heating stages. If wider clearance is required, use TC-E35 with 35mm clearance. Item#: TC-E35x15

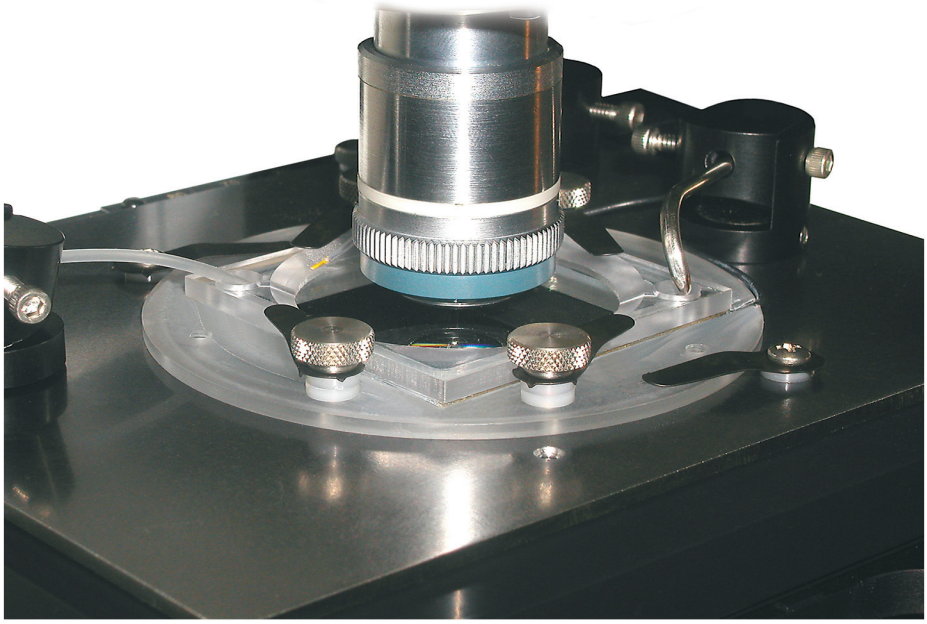
Heating Element with 11m aperture TC-E35x11 Fits 35mm dishes. The whole bottom is heated to eliminate temperature gradient, which makes it ideal for petri dishes, including glass bottom dishes with small optical clearance. Wide 11mm optical clearance to access your sample with immersion optics from the bottom. Built-in temperature sensor. Since some brands of petri dishes have different diameter, reducing adapters TC-PA might be required. Incorporates Teflon perfusion tubing, which makes the element to work as inline preheater. Requires a microscope adapters with 50mm mounting opening. Requires a temperature controller. This element is a part of TC-PCP-11 heating stages. If wider clearance is required, use TC-E35 with 35mm clearance. Item#: TC-E35x11





Uniformly Heated Bottom Chambers

Uniformly heated chambers incorporate glass heaters on the bottom to provide uniform temperature distribution without gradient. Below are different design chambers.



Introduction

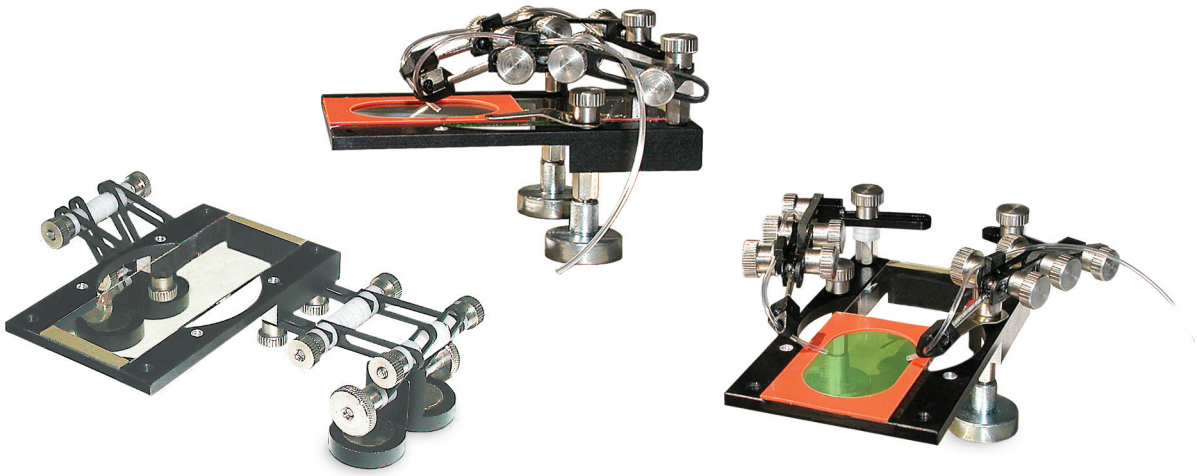
The transparent indium tin oxide (ITO) coated heated chambers can be used with inverted or upright microscopes. The electrically conductive coating is on one surface only, with opposite clean surface contacting your sample media.

TC-WI Chamber This is a larger volume open chamber that provide optical clearance to accommodate water immersion objectives of upright microscopes. TC-WI chamber (top) for upright water immersion optics, and TC-GSH uniformly heated slides to form sealed chambers for inverted microscopes (bottom).

TC-HP... Heated Plates and TC-GSH Uniformly Heated Glass Slides These are transparent glass/quartz heaters with large working surface to accommodate large objects like standard glass slides, petri dishes, or our ultra-thin imaging chambers. The heater will provide uniform temperature distribution throughout the whole surface. A set of flat clamps will keep the samples in place. The imaging chambers can be formed directly on the glass surface of the heater using our ultra-thin silicone gaskets.

TC-DIS Miniature Water Bath/Dissecting Chamber is a large (54x54x8mm) volume chamber for different applications, including dissecting of tissue. Can be used as a miniature water bath. The chamber has glass bottom, which is used as a heater to provide uniform temperature distribution throughout the whole surface. Optical clearance is 42x42mm.

Heater for *in vivo* experiments



A temperature controlled heater to keep exposed organs at animal body temperature. This heater can be adjusted to position next to or above a small animal. Live attached organs can be placed into a silicone chamber attached to the glass surface of the heater. Easy to clean after use. Custom chambers of any shape are available. Adjustable miniature tubing holders can be used for solution exchange or to apply test compounds (the holders can be also used to fix electrodes and sensors). Magnetic stands provide solid support on the microscope table. The stands are adjustable for easy elevation change during experiments.

Specifications:

Dimensions: 1x 3 in. transparent glass heater

Temperature stability: better than 0.01°C, built-in sensor

Adjustable elevation: Flexible, up to 2in. Can be custom modified

Objective Heaters, TC-HLS

The Objective Heater is wrapped around a microscope objective. An incorporated temperature sensor is used to regulate and monitor the objective temperature. Flexible objective heaters can be used with any objective and are easy to install. Using objective heaters provide an effective way to stabilize the temperature around your sample.

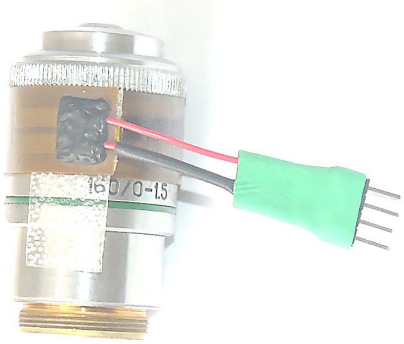
Attaching Heater to Lens

If possible remove the lens from the microscope. Use included Velcro tape to fix the heater securely around the objective, placing the sensor between the objective surface and the heating element.

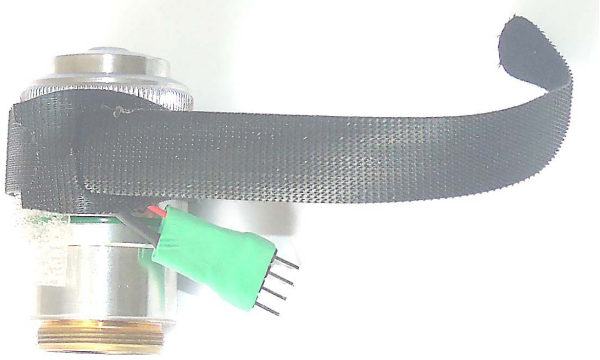
DIMENSIONS: 0.5x5 in. The heater should be long enough to cover the hole perimeter of the objective. The height of the objective can be limited by the space available on your objective. Usually the heater is attached to the end of the objective close to your sample.

Recommended procedure to mount the objective heaters:

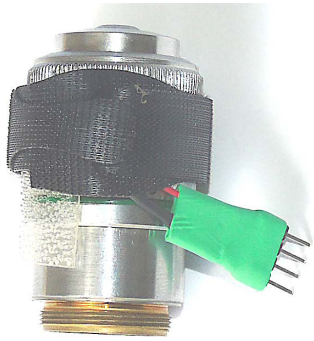
1. Position the heater on the objective closer to the sample plane, the sensor down touching the objective surface, and fix in place using a small piece of electrical tape.



2. Wrap the heater around the objective, and mark the point where the end of the heater with Velcro already attached will be placed. Adhere a piece of Velcro over the mark. It is recommended to put an excess of Velcro so it overlaps some surface of the objective for extra stability (some Velcro can be cut). Secure the end of the heater inside the Velcro piece. The end already has Velcro attached.



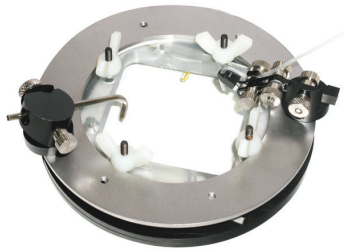
3. Make a loop using black Velcro tape, and tighten it around the heater so the connector is sticking outside from the tape.



4. Wrap black Velcro tape around the heater for extra stability and better heat conductance (to prevent heat dissipation to the air).

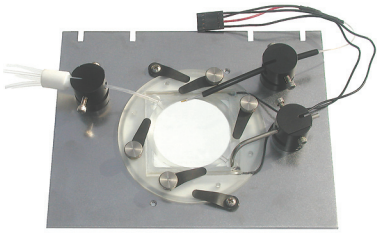
Large Volume/Bath/Dissecting Chamber for in vivo imaging TC-DIS

This is a large (54x54x8mm) volume chamber for different applications, including dissecting of tissue. Can be extended up by placing additional 8mm high chambers. The chamber has a glass bottom with transparent coating, which is used as a heater to provide uniform temperature distribution throughout the entire surface. Optical clearance and heated area is 54x54mm. Requires a microscope adapter. Built-in temperature sensor. An optional magnetic plate can be placed on top upon request. This will allow mounting optional magnetic holders for tubing, electrodes and suction: MTH-S, MTH, and MH-2. Can be upgraded with an objective heater TC-HLS-05/025. Item#: TC-DIS/-8



Open Heated Perfusion Chamber for Water Immersion Objective

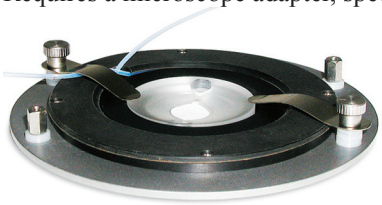
This chamber has uniformly heated glass bottom with large clearance of 42mm diameter. Separate compartments for inflow and outflow prevent bubbles from entering the chamber and provide smooth perfusion. Built-in temperature probe. Includes 2-channel temperature controller, microscope adapter, two magnetic holders for suction tubing (included), and perfusion manifold (optional). Can be used with controlled flow perfusion systems. Might need an objective heater (above) if water immersion optics is used. Specify microscope model when ordering. Item#: TC-WI

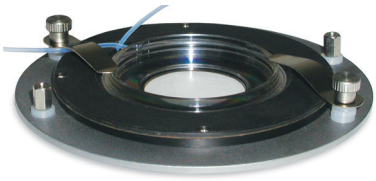


Low Profile Heated Stage, TC-E50x30

Larger diameter of this heating element allows you to form low-profile recording and perfusion setups, suitable for use even under upright microscopes. The heating element accepts dishes up to 52mm diameter. Can be used with smaller chambers and 35mm dishes, if combined with reducing adapter-rings. Heating happens from the bottom to eliminate temperature gradient. Optical clearance is 28.5mm. Can be used with PCCS1 and PCCS2 low-profile coverslip chambers, which are only 4mm high. Can be used with sealed thin chambers for high resolution imaging. Can be upgraded with an objective heater for immersion optics. Can be used with CSC coverslip chambers as well.

Requires a microscope adapter, specify microscope model when ordering. Item#: TC-PD-50x30





- **Dimensions:** 76mm diameter
- **Temperature stability:** 0.01°C, built-in sensor
- **Optical aperture:** 30mm
- **Use with:** Coverslip chambers, 50mm dishes, Petri dishes, including 35mm glass bottom dishes
- **Solution Pre-heater:** Replaceable/Removable Teflon tubing, easy to wash
- **Microscope adapter:** Fits to 74mm cutout of standard microscope adapters

Heated chamber-incubator for replaceable coverslips, TC-CSC

Can be used for imaging and recording. Consists of a heated bottom base, and a silicone O-ring to seal the coverslip. The metal base facilitates heat transfer. There is no contact between solution and the chamber base to prevent ions leakage. The included top glass coverslip can be used to seal your sample from top as well - to from a micro-incubator. The top can be secured using the included metal ring, or using flat springs of microscope adapters. The bottom part has a recessed profile to fit round or square coverslips. The included O-rings allows you to use different thickness coverslips. Simply put the coverslip inside and seal it with silicone ring by a snap-in action, then secure with a top metal ring (the silicone ring can be also secured by flat springs of microscope adapters). For low-profile chambers, consider TC-CSC -L design, where no top clamps are required. Can be used as a perfusion chamber, if combined with miniature tubing holders. The heating element incorporates replaceable Teflon perfusion tubing inside, which makes the element to work as inline pre-heater. Requires a microscope adapter and a temperature controller. Item# TC-CSC

- **Dimensions:** 50mm diameter
- **Temperature stability:** better than 0.01°C, built-in sensor
- **Solution Pre-heater:** Replaceable/Removable Teflon tubing, easy to wash
- **Microscope adapter:** Fits to 50mm cutout of standard microscope adapters MA and IMA

- **Working volume:**

25mm coverslip - 21mm, approx. 350 microl
22x22mm coverslip - 19mm, approx. 280 microl
20mm coverslip - 16mm, approx. 200 microl
18mm coverslip - 14mm, approx. 150 microl
13mm coverslip - 9mm, approx. 50 microl
12mm coverslip - 8mm, approx. 50 microl
10mm coverslip - 6mm, approx. 30 microl

Heated Micro incubator with CO2 and hypoxia control for coverslips, TC-CSC-I

The incubator can be used with round replaceable coverslips for long-term time-lapse high resolution imaging. Comes with thin high optical quality glass cover to prevent evaporation (can be removed). Easy to use: simply drop the sample coverslip into the holder, seal with silicon chamber, and secure with the top ring. There is no contact between solution and the chamber base to prevent ions leakage. The bottom part has a recessed profile to fit round coverslips. The air-tight seal will prevent media evaporation for hours. Incorporates a temperature sensor and a heating element for temperature control TC2-80-150-C. Requires a CO2 controller. Requires a microscope adapter. Specify microscope model when ordering. Can be upgraded with an objective heater for immersion optics. Item# TC-CSC-I

- **Dimensions:** 50mm diameter
- **Height:** 30mm
- **Top Optical window:** 28mm
- **Temperature stability:** 0.01°C, built-in sensor
- **CO2 control:** x2 barbed ports
- **Microscope adapter:** Fits to 50mm cutout of standard microscope adapters MA and IMA

- **Working volume:**

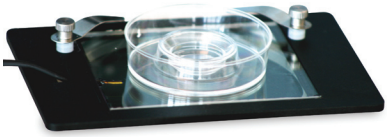
25mm coverslip - 21mm, approx. 350 microl
22x22mm coverslip - 19mm, approx. 280 microl
20mm coverslip - 16mm, approx. 200 microl
18mm coverslip - 14mm, approx. 150 microl
13mm coverslip - 9mm, approx. 50 microl
12mm coverslip - 8mm, approx. 50 microl

Heated Glass/Quartz Plates for Microscope Stages

Uniformly heated glass plate for stereo, upright microscopes, and long-distance objectives of inverted microscopes, TC-HP75x65

Large 75x65mm optical window. Allows you to heat your samples on 80x70mm glass surface. The heated glass plate provides thin profile and uniformly heated surface. Built-in temperature sensor. Flat glass top surface is flashed with the mounting frame, 128x86mm 5mm thick. The frame fits mot microscope stages. Can be used to heat custom devices, micro-fluidics chips, plates, flasks, slides and petri dishes. Open or sealed chambers can be formed directly on class surface, using self-adhesive gaskets for example. Might require a microscope adapter (specify microscope model when ordering). Can be upgraded with an objective heater and chamber-attachments (TC-DIS, TC-DIS-8, TC-WI). **Item#: TC-HP75x65**

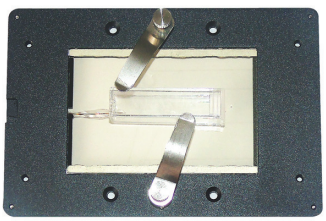
- **Optical window:** 75x65 mm
- **Glass thickness:** 1mm
- **Height (frame/adapter): 5mm**/3mm
- **Use with:** Petri dishes, chambers, including glass bottom dishes, fluidics devices
- **Temperature stability:** 0.01°C, built-in sensor
- **Microscope adapter:** specify microscope model



Uniformly heated quartz plate, TC-HPQ75x50

Fused quartz (1.1 mm thickness) for working in the UV or near infrared range of illumination, where regular glass cannot be used (because it is not transparent in these wavelength ranges of illumination). Quartz can also withstand high temperature applications without cracking. Allows you to heat your samples on 75x50mm surface. Large 70x45mm optical window. The heated quartz plate provides thin profile and uniformly heated surface. Built-in temperature sensor. Flat glass top surface is flashed with the 128x86mm mounting frame (5mm thick). The frame is the size of standard multi-well plates and fits most microscope stages. Open or sealed chambers can be formed directly on class surface, using self-adhesive gaskets for example. Might require a microscope adapter (specify microscope model when ordering). Can be upgraded with an objective heater. Requires a temperature controller (TC-1-100s-24V model for high temperature applications). **Item#: TC-HPQ75x50**

- **Optical window:** 70x45 mm
- **Glass thickness:** 1.1mm
- **Height (frame/adapter): 5mm**/3mm
- **Temperature stability:** 0.01°C, built-in sensor
- **Microscope adapter:** specify microscope model, ships mounted inside 128x86x5mm metal frame;



Uniformly heated glass plate for motorized and type K stages TC-HP108x72

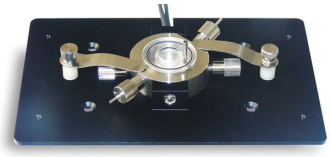
Uniformly heated glass plate provides thin profile and uniformly heated surface. Built-in temperature sensor. Large 108x72mm optical clearance allows you to heat slides and dishes samples on 118x74mm glass surface and to form open or sealed sample chambers. Electrodes and tubing can be fixed around your sample chamber using adjustable holders MH-MIS attached to optional inserts for slides, petri dishes and coverslip chambers. The holders can be used to position perfusion tubing for continuous media exchange, provided that optional inserts TC-I-100 or TC-I-4/3 are placed inside (see table below). Fits most motorized stages with 160x110mm cutout. Some larger stages might require an adapter extension. Can be upgraded with an objective heater.

Uniformly Heated Glass Slides TC-GSH

This is a standard size 3x1 in. glass slide used as a heater from the bottom of any sample. Ideal for use with upright microscopes. Long-distance objectives of inverted microscopes can be also used. A sealed imaging chamber can be formed on top of the slide using adhesive gaskets. Any chambers and bio-chips can be placed directly on the slide and clamped by provided flat springs. Threaded surface of microscope adapter allows you to attach custom accessories. Built-in temperature sensor. Can be used with an objective heater. Requires a microscope adapter (specify a microscope model when ordering; ships installed on the adapter) . Requires a temperature controller. Might require an objective heater if used with an immersion optics.

Heater for chambers from Culture Myograph Systems

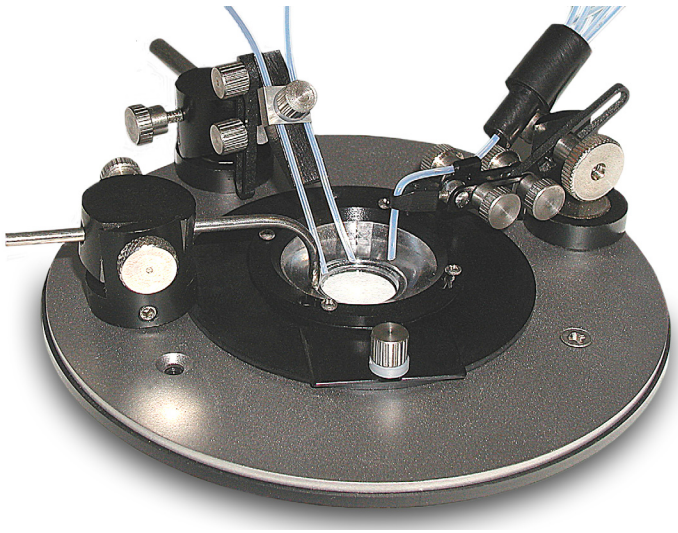
A heating element designed for 35mm culture myograph chambers. The mounting frame is 128x86mm, the size of standard multi-well plates to fit motorized stages and type-K mechanical stages. Two set screws and two clamps to fix the chamber from two sides and the top. Recessed area for connecting tubing. Bottom aperture is 25mm, with 1mm thick lip to hold the chamber. Requires a temperature controller. The controller stores two settings in its memory for different temperatures for easy temperature jumps. **Item#: TC-MYO**



Syringe heater with temperature controller

The syringe heaters are used to heat different sizes syringe barrels (or any other cylindrical surfaces) for degassing solutions or maintaining solutions at temperatures above ambient (up to 150°C). Includes a temperature controller. Can be used with perfusion systems or syringe pumps. Easy to install and remove. The replaceable flexible 0.25x10in. heaters are wrapped around syringes and fixed with included Velcro straps Item#: TC-SYR10x025

Chambers for replaceable coverslips - CSC



Example of using CSC chamber in a perfusion setup. Magnetic holders are arranged on a microscope adapter MA to provide solution inflow and outflow.

1. Position the bottom part of the 2-parts chamber on a flat surface. Put a cover slip inside the groove in the bottom part. Put the top part inside the bottom part.

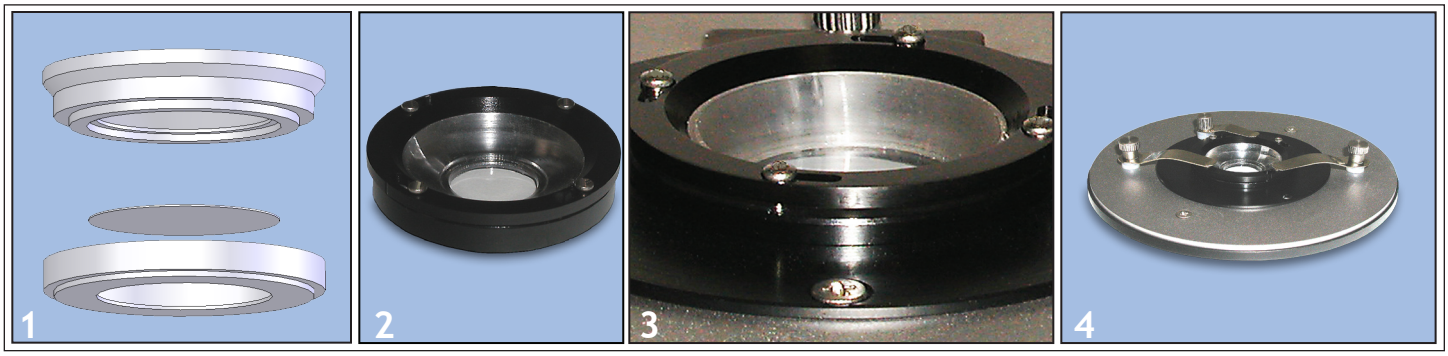
2. Fix the plastic insert with a metal ring from the top.

3. Put the assembled chamber inside microscope adapter or the temperature controlled stage.

4. Use provided clamps to fix the chamber in place, this is especially useful if oil immersion objective is used with an inverted microscope.

Arrange magnetic holders with inflow manifold and

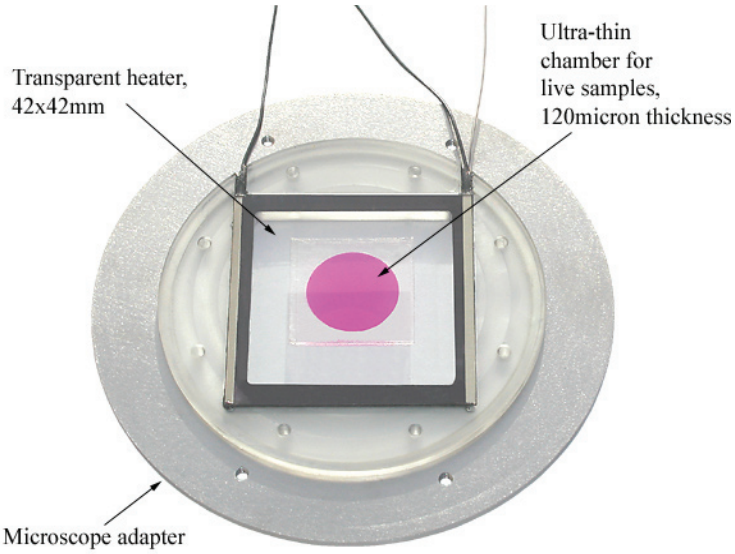
Catalog #	Features:
CSC	Chamber for replaceable round coverslips. Simply put a coverslip inside and seal by a snap-in action.
	Choose the right diameter to fit your coverslips.



suction tubing around the chamber. While using the cover slips with cultured cells, excess of solution on the cover slip might result in bad seal and cause leakage. Try to leave only a minimum amount of liquid on the cover slip before assembling the chamber.

Note: Although the plastic CSC-10P chamber is tight enough, you can further improve the seal against solution leak by putting a thin layer of silicone grease or mineral oil (or Vaseline) inside the bottom part of the chamber, especially along the edges of the groove for the cover slip. Using provided clamps helps to seal the chamber as well.

Ultra-thin imaging chambers - UTIC



Ultra-thin chamber formed on top of a heated glass plate TC-HP65x75. Heated slides TC-GSH can be also used.

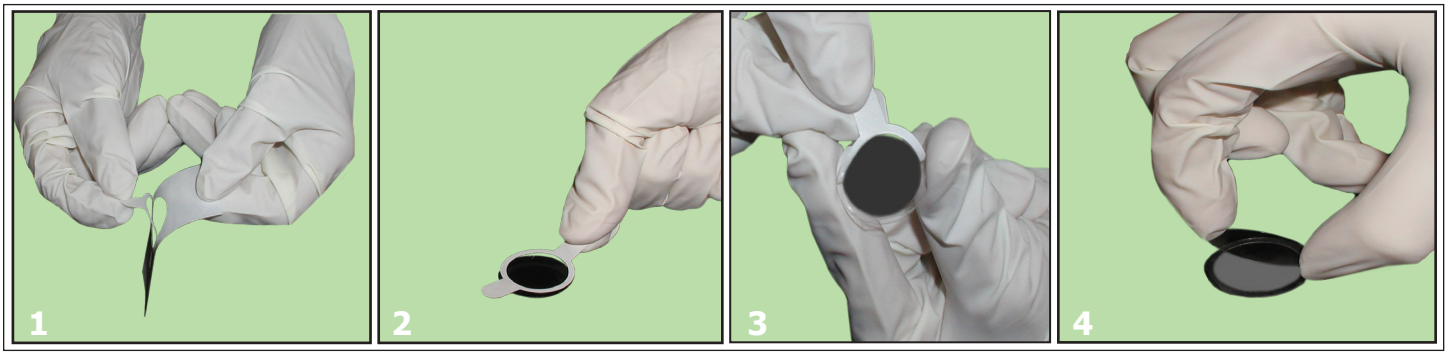
1. Remove protective liner from the bottom surface to expose the adhesive.

2. Apply the adhesive side down onto the surface of a coverslip, glass slide, or on the bottom of a chamber. Press gently to seal.

3. Remove the remaining protective liner. Aliquot a small amount of media into the chamber, or place your sample inside and fill the chamber with additional medium.

4. Place another coverslip on the top. Press gently but firmly to seal the chamber.

Catalog #	Features:
UTIC-21 UTIC-11D UTIC-13-24x24	Ultra-thin self adhesive chambers for high resolution imaging. Can be used with coverslips, and on any glass or plastic surface.
quantity	Pack of 100 layers.



5. Place the sealed chamber into metal holder UTIC-25, which fits microscope adapters MA and heating stages, TC-E35. An open chamber can be also formed using a plastic holder, PCCS1 for example.

6. The holder and glass surface can be cleaned after use by removing residual adhesive with a scalpel. Adhesive Removal solutions are also helpful.

Noise and Grounding

Noise

50/60-Hertz power line noise may be encountered because of:

1. Improper grounding of probes, micro electrodes, bath or instrument chassis.
2. Radiation from transformers of adjacent equipment.
3. Power noise from attached equipment, i.e., stimulators, etc.
4. Antenna effects of cable or wire.
5. Potential difference between various components of electronic set-up (due to the distance electronics are from one another, or different earth grounds).

50/60 Hz noise is not the only electrical signal likely to cause interference problems, some others are:

1. Remote switches, such as in refrigerators or heaters.
2. Voltage pulses emanating from adjacent micro electrodes.
3. Broadcast interference from TV/Radio.

Instrument Grounding and System Ground

The chassis ground and the output cable shielding are internally connected to the system (circuit) ground. You can access the shielding ground by attaching a shorting wire connecting your system ground either to the screws of one of the OUTPUT DB-9 connectors, or to a small wire showing from the inside the cable closer to STAGE connector. If ground loops are experienced (objectionable 50/60 Hz), try placing the shorting wire to a different point (one of these two). If TTL or analog signals are used, the controller might be already connected to the system ground through the shielding of the cables.