*t*2

Temperature-Controlled Cuvette Holder for UV/Vis Spectrophotometry

Manual & Product Overview

*t*2 Cuvette Holder

TC 1 Temperature Controller

QUANTUM
N·O·R·T·H·W·E·S·T

22910 East Appleway Avenue, Suite 4, Liberty Lake, WA 99019-8606
Tel: (509) 624-9290 • Fax: (509) 624-9488 • E-mail: quantum@qnw.com • Web: www.qnw.com

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1. GETTING STARTED

Thank you for purchasing a Quantum Northwest ***t***2! We want you to enjoy many years of faithful service from your instrument. If you have any questions, feel free to contact us directly through our web site: www.qnw.com.

A. YOUR PACKAGE WILL CONTAIN:

t2 package

1. ***t***2 cuvette holder
2. **TC 1** Temperature Controller
3. power cable
4. USB cable
5. magnetic stir bar
6. vinyl tubing to connect water and gas

B. DEPENDING ON YOUR ORDER, THE PACKAGE MAY ALSO CONTAIN:

Installation package

Installation packages are available for a number of spectrometers. If you purchased such a package, it will contain instructions for installation, including how to mount the unit and how to connect utilities (electrical cable, circulating water for the Peltier unit and dry gas) to the cuvette holder.

BATH 10

1. submersible pump adapted to 1/8-inch ID tubing
2. plastic bucket

T-App software

T-App, provided on a CD, is a program that permits external computer control of the **TC 1** Temperature Controller. The temperature of the sample holder and a temperature sensed by an external probe may be plotted vs time. Simple text scripts may be used to automate multiple operations.

C. SYSTEM SETUP

1. Install the ***t***2 in your spectrometer. (It may have been already installed by the manufacturer.) If you purchased an installation package from us, follow the enclosed directions.

2. Supply circulating water to the Peltier unit. If you purchased the **BATH 10**, then attach tubing from the submersible pump to either one of the water hose barbs on the ***t***2. Attach another piece of tubing from the ***t***2 back to the bucket. Put water in the bucket, turn on the pump by plugging it into an outlet and check to be sure that water is flowing back into the bucket. Check for leaks. Unplug the pump until you have completed the remainder of the system set up.

3. If you plan to work at low temperatures, connect a source of dry gas (typically nitrogen) to release on the cuvette windows. Attach a length of tubing with 1/16-inch inside diameter, to the small hose barb on the base of the ***t***2. (A 1/8 to 1/16-inch barbed reducer fitting is included with the ***t***2, to prevent any difficulty connecting to this unusually small size tubing.) Set the dry gas flow rate to about 50 cc/min.

4. Connect the ***t***2 electrical cable to 15-pin connector labeled "Sample" on the back of the **TC 1** Temperature Controller.

5. Plug the power cable into the back of the **TC 1** Temperature Controller and into a wall socket. (The **TC 1** will accept AC voltages from 85 to 264 at 50 or 60 Hz.)

D. SOFTWARE INSTALLATION

1. If you purchased the **T-App** program for external control of the ***t***2, insert the CD into the drive. If the installation does not start automatically, locate the Setup.exe file in the root directory and run it. The installation process starts with a small black window that is shown during installation of the drivers needed to control the ***t***2 through a USB connection. This window will then be replaced by the software installation window. Follow the onscreen prompts to complete the installation.

2. Connect the ***t***2 to your computer using the USB cable provided. The New Hardware installation process will begin automatically and take a few moments to finish.

E. SYSTEM OPERATION

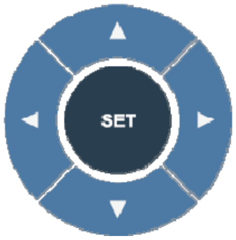
1. Use a liquid sample in a standard 1 x 1-cm square cuvette and place the cuvette in the ***t***2.

2. Place the magnetic stir bar in the cuvette.

3. If you wish to monitor the temperature inside the cuvette, plug a standard Series 400 or Series 500 thermistor probe (not provided) into the ¼ - inch phone jack labeled "probe" in the back panel of the **TC 1**. Place the end of the probe in a region of the solution, where it will not occlude the spectrometer light beam.

4. Turn on the circulating water.

5. Turn on the **TC 1** controller using the switch on the back panel.



Menu Button

6. Use the left or right arrows on the Menu Button to cycle through the four pages of options. To turn on stirring and set a temperature, go to the **Set Stirrer** page, use the up and down arrows to set a speed, say 1200 rpm, press **SET** to start the stirrer. Then go to the **Set Temperature** page and use the up and down arrows to set a target temperature, say 37.0 °C. Press **SET** to initiate temperature control. Watch the temperature rise and stabilize.

7. When temperature control is running and the **Start** page is being displayed, press **SET** to turn off temperature control.

8. After measurements are completed, turn off power on the back of the **TC 1** controller and turn off the water source.

2. USING THE MENU BUTTON

Use the right and left arrows to cycle through four pages:

– Start – Set Temperature – Set Stirring – Set Ramping –

```
Holder =  20.0 °C
Target = 100.0 °C
Probe  =  20.0 °C
Ramp Off Stir On
```

Start: This main page shows the actual cuvette *Holder* temperature, the *Target* temperature and a *Probe* temperature (if a probe is present). The page will also show whether the magnetic stirrer or ramping function are turned on or off. After a few seconds of inactivity, all other pages will switch back to the **Start** page.

When seeking or ramping to a temperature, the green led on the front panel will flash slowly. When it has locked onto a new target temperature, the green led will remain lit. A rapidly flashing red led usually means a loose electrical cable or inadequate water flow for the Peltier unit.

```
Set Temperature

Target =  37.0 °C
Current=  20.0 °C
```

Set Temperature: To set the *Target* temperature, use the up and down arrows. Press **SET** to retain this new *Target* and initiate temperature control.

```
Set Stirring

Stir Speed = 1200rpm
Current = 0rpm
```

Set Stirring: To turn on magnetic stirring, use the up and down arrows to choose an approximate stirring speed. Press **SET** to turn on stirring at this speed.

```
Set Ramping

Ramp = 0.55 °/min
Current = 0 °/min
```

Set Ramping: To perform a ramp, set the Ramping rate using the up and down arrows, and press **SET**. With ramping set, turning on temperature control will generate a linear ramp to the target temperature. The TC 1 controller will remember this ramping rate. Unless you set the ramping rate back to 0.0, any time you set a new target temperature, the controller will generate a linear ramp to the new temperature.

The fastest possible ramp is determined by how fast the cuvette holder could reach the target temperature without ramping. If you attempt to ramp to quickly, especially at high and low temperature extremes, you will obtain a non linear ramp. The slowest ramp that may be set on this page is 0.01 °C/minute. (If needed, much slower ramps may be set through software commands.)

3. *FEATURES OF THE t2*

A. GENERAL DESCRIPTION

The ***t***2 is constructed of two molded parts surrounding a metal tower to hold the cuvette. A thermoelectric (Peltier) device is mounted to one side of the tower for temperature control. A heat exchanger mounted to the thermoelectric device uses a flow of water to drain off excess heat. A small electric motor turns a magnet under the tower for stirring, using a delicate neoprene belt. Dry gas may be directed next to the cuvette windows to minimize condensation when working below the dew point temperature.

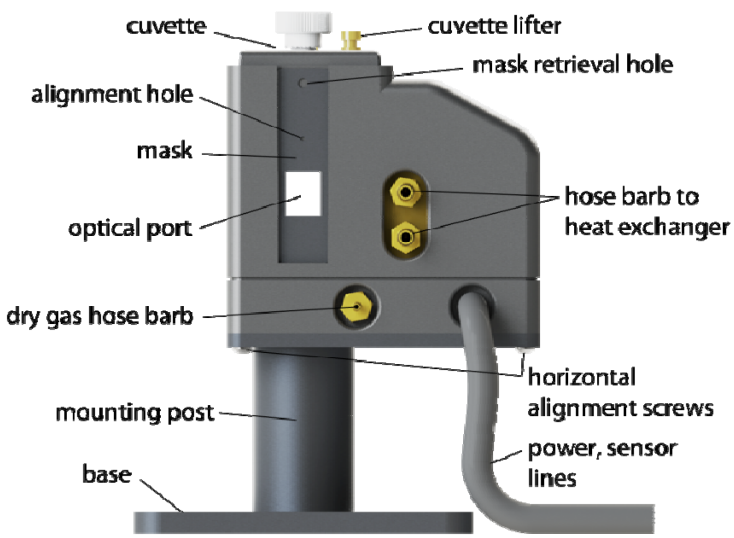


Figure 1. ***t***2 mounted on a post and a base

An optical mask is placed on each side of the ***t***2 to create and optical port. Two 1/8-inch hose barbs for water provide access to the heat exchanger. A 1/16-inch hose barb is used for the dry gas. These hoses and the power and sensor cable must be brought out of the sample compartment by a means that does not interfere with the spectroscopic measurement. Access for these utilities may need to be light tight.

B. CUVETTE HOLDER

The ***t***2 holds a standard 10 x 10 mm cuvette with outside dimensions of 12.5 x 12.5 mm. A metal clip is used to push the cuvette into one of the corners for reproducible positioning and to favor temperature transfer. Walls of the tower are relieved to prevent scratching of the optical surfaces of the cuvette. The tower is tall enough to surround the full height of a standard size cuvette. A cuvette lifter will lift the cuvette out high enough to grab the top.

Cuvettes must be taller than 30 mm, or they will pass below the metal clip and become stuck.

C. CUVETTE Z-HEIGHT

The "z height" of a cuvette is the distance between the bottom surface of the cuvette and the designed position for the optical center line, where the incident beam of light strikes the cuvette. The z height for the t2 is specified as either 8.5 or 15 mm when ordering.

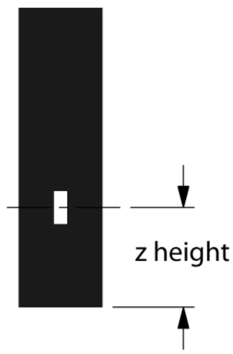


Figure 2. The z height of a typical microcuvette

Most spectrometers are designed for a z height of either 8.5 or 15 mm, although the Agilent Cary line of spectrometers usually uses 20 mm. For most standard cuvettes, z-height does not matter, since light can pass anywhere through the sides. Using these standard cuvettes, higher z height simply requires the use of a larger volume in the cuvette. On the other hand, many specialty cuvettes such as flow cells and microcells must be designed specifically for the z height. Such cells are typically made for a z height of 8.5, 15 or 20 mm.

For a 15 mm z height, the post is made shorter, so the beam will strike the cuvette higher. Masks are placed on each side of the cuvette providing light access at the correct height.

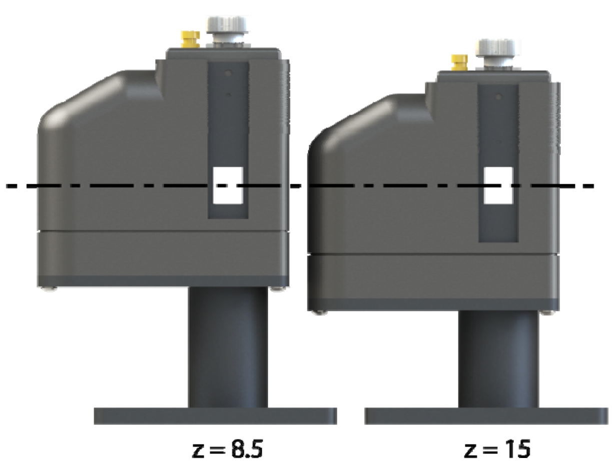


Figure 3. Mask and post height determine z height.

D. ALIGNMENT FOR MICROCUVETTES

It is quite possible that the spectrometer beam may not be in precisely the right position to pass light through the small window of a microcuvette, and a small horizontal adjustment of the ***t***2 may help. To do so, remove the mask from one side of the cuvette. The mask is firmly in place so it does not move during measurement, but by applying some force at the mask retrieval hole at the top it can be slid upward using the end of a paper clip or similar tool. Turn the mask upside down and reinsert it.

A 1 mm hole then marks the optical center line of the cuvette. Loosen the three horizontal alignment screws on bottom corners of the ***t***2 and slide back and forth until you get the alignment you desire. The ***t***2 will only move about a mm in each direction. If the spectrometer alignment is further off than this, then it should be aligned instead of the ***t***2. Alignment may not be important for spectrometers with large or poorly focused light beams.

E. COOLING WATER FOR THE PELTIER

The Peltier element (or "thermoelectric cooler") is a heat pump. When cooling, it transfers heat from the cuvette tower to heat exchanger; when heating, electrical polarity is reversed and it transfers heat from the heat exchanger to the tower. When cooling, it is particularly important to transfer this heat away from the Peltier. This is accomplished with flowing water through the heat exchanger.

A source of water (or other cooling fluid) must be connected to the ⅛-inch hose barbs on the side of the ***t***2. If you purchase the **BATH 10** from us, you will get an inexpensive submersible aquarium pump, the appropriate fittings for connecting tubing, and a plastic bucket. Connect the pump to the ***t***2, place it in the bucket with water, and run a return tube to the bucket. A more robust pump is available as the **BATH 100** for a higher price, although the larger pump has a higher Wattage and tends to heat the water when used for extended periods of time.

You may also provide the cooling water from another source, such as a refrigerated cooling bath or even a tap for brief use.

You will need a flow of 100 - 300 ml/minute. This flow should require a pressure of about 3 - 5 psi (0.2 - 0.3 bar). Do not exceed an input water pressure of 25 psi (1.7 bar), as damage may occur inside the ***t***2. The heat exchanger and hose barbs are brass, and the tubing inside the ***t***2 is vinyl. Be sure that any circulating fluid used, other than water, will not corrode these materials.

The temperature of the heat exchanger in the ***t***2 is monitored using a thermistor. If the temperature exceeds 60 °C, then temperature control is shut down to prevent damage to the Peltier element and the warning, "check coolant flow," displayed on the **TC 1** temperature controller. This will happen if the circulating fluid gets too warm and/or is restricted in flow. The heat exchanger temperature may be accessed by computer through the RS 232 or USB connections on the back of the **TC 1** Temperature Controller (see External computer control below).

Temperature increases will be faster when room temperature water is used in the circulator. Temperature decreases will be faster when ice water is used. Only water should be circulated using the **BATH 10**. When using a refrigerated bath, circulating pre-cooled fluids (such as 30% methanol or diluted ethylene glycol) at below 0 °C will permit measurements below the specified temperature range.

F. DRY GAS TO MINIMIZE CONDENSATION

Dry gas flows into the ***t***2 via the small hose barb in the base. It passes up through holes below the optical ports in the cuvette tower to fill the space between the cuvette and the optical mask, preventing condensation on the surface of the cuvette. A flow of dry gas is necessary any time the ***t***2 is controlled below the dew point temperature present on the inside of the sample compartment of the spectrometer. For ambient air, this would typically be about 5 °C.

G. EXTERNAL TEMPERATURE PROBE

A ¼-inch phone jack labeled “Probe” can be found on the back panel of TC 1 Temperature Controller. This jack will accept the plug on a standard Series 400 or Series 500 thermistor probe. When a probe is plugged into the jack, the probe temperature is presented on the display of the TC 1. Place the probe in the sample to measure the actual temperature of the sample, which will lag in time from the temperature of the cuvette tower.

We do not sell the probe, but there are many Series 400 and 500 probes on the market. Quantum Northwest’s preferred probe is the YSI 423 available from Cole Parmer. The YSI 423 is reasonably resistant to immersion and responds rapidly to temperature changes. Also, the fine, coiled wires of the YSI 423 conduct very little ambient heat to the thermistor at the end.

Excellent Series 500 probes can be obtained with diameters less than a mm, providing access to small volumes. A disadvantage of these probes is that they are not pre-calibrated.

H. EXTERNAL COMPUTER CONTROL

All functions may be accessed either through a Serial (RS 232) or a USB located on the back of TC 1 Temperature Controller. You may write your own program or purchase our application program T-App. T-App will plot temperatures of the probe, cuvette tower or even the Peltier element heat exchanger *vs* time. It will also permit you to set up temperature ramps. If you wish to do your own programming, please see the Appendix for communication instructions and the set of text commands that may be used and responses to the commands.

4. ERROR CODES

When errors occur, the line 1 of the display presents an error code. Line 3 of the display identifies the error and line 4 of the display presents possible solutions. The most common events that cause errors to be displayed are loose cables or inadequate coolant flow. For errors not easily solved, please contact us through our website, www.qnw.com.

E5– cell out of range

warnings: loose cable, sensor failure
The temperature controller is not receiving a reasonable response from the sensor on the cuvette tower. Either the sensor has failed or a cable is not making a good connection.

E6 – cell out of range

warnings: loose cable, check cable
The temperature controller is not receiving reasonable responses from either the cell tower or heat exchanger sensors. Since it is very unlikely for both to fail, probably a cable is loose.

E7 – heat exchanger error

warnings: loose cable, sensor failure
The temperature controller is not receiving a reasonable response from the sensor on the heat exchanger. Either the sensor has failed or a cable is not making a good connection.

E8 – inadequate coolant

warnings: inadequate coolant, water temperature
The sensor on the heat exchanger is reading a temperature above 60 °C. Temperature control has been shut down to prevent damage to the Peltier element. Either the water was too warm or the rate of flow was inadequate to draw sufficient heat from the heat exchanger.

*5. t*2 *SPECIFICATIONS*

temperature range	-20 to +110 °C
temperature precision	±0.05 °C
cuvette size (outside dimensions)	12.5 x 12.5 mm
minimum cuvette height	30 mm
magnetic stirring speed	400 to 1700 rpm
cuvette z height	8.5 or 15 mm (specified when ordering)
optical port dimensions (mask)	10 mm high x 8 mm wide

APPENDIX: SERIAL COMMUNICATIONS FOR THE TC 1 TEMPERATURE CONTROLLER

7/25/11

This document provides the serial communications protocols for version 1.0 of the firmware on the **TC 1** family of controllers used for the ***t*2**, ***t*2x2** and ***turret*6**

The version number and the ID (see below) are shown briefly on the display when the temperature controller is turned on.

All functions of the temperature controller can be managed from a computer, using the command set described below. If you purchased your unit as a component of a spectrometer from certain manufacturers, this feature may be implemented through traditional RS232 serial connectors on the computer or the spectrometer and on the controller. In this case they will be connected by a standard 15-pin serial extension cable (male connector on one end and female on the other). No driver installation should be needed.

Otherwise the serial linkage will be established through a USB connection between the computer and the controller. In this case the controller includes electronics which convert the USB connection to a serial communications port. However, for the port to be available to programs on the computer it will be necessary to load driver software. It is important that the driver software be loaded before connecting a USB cable between the controller and the computer. Contact Quantum Northwest for further information.

Quantum Northwest can provide a control program written specifically for control of all functions of the temperature controller. Ask for program T-App.

In programming for the **TC 1** controller, one must adhere to the conventional notation: 8/N/1.

Baud:	19200
Data Bits:	8
Parity:	None
Stop Bit:	1
Flow Control:	None

For many of the commands listed below the controller returns information in response to the command. All commands and responses are delineated by left and right square brackets ([ ]). Any text sent to the controller not enclosed within brackets will be ignored. In this document an ellipsis (……) is used to distinguish responses from commands.

`[command]`	Purpose of the command (sent to the controller).
`......[response]`	Meaning of the response (received from the controller).

1. <u>Identify</u>

`[F1 ID ?]`	What is the ID number of the sample holder being controlled?
`......[F1 ID 14]`	Sample holder is a **t2** or other single cuvette sample holder.

Assigned Identities:

ID = 00 – **specialty sample holder**

14 **– t2**

24 **– t2x2**

34 – turret6 or other multi-sample holder

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2. Controller Firmware Version

[F1 VN ?]	What is the version number of the controller firmware?
......[F1 VN 1.00]	The controller is operating firmware version number 1.00.

---

3. Stirrer

[F1 MS ?]	What is the maximum stirrer speed?
......[F1 MS 2500]	The maximum stirrer speed is 2500 rpm.
[F1 LS ?]	What is the lowest stirrer speed?
......[F1 MS 300]	The lowest stirrer speed is 300 rpm.
[F1 SS S 1000]	Set stirrer speed to 1000 rpm.
[F1 SS S 0]	Turn stirrer off and set the speed to zero.
[F1 SS +]	Turn stirrer on and set it to the most recent non-zero stirrer speed setting.
[F1 SS -]	Turn stirrer off.
[F1 SS ?]	What is the current stirrer speed setting?
......[F1 SS 1000]	Stirrer speed setting is 1000 rpm.

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4. Temperature Control

[F1 TC +]	Turn temperature control on.
[F1 TC -]	Turn temperature control off.

---

5. Target Temperature

[F1 TT S 23.10]	Set target temperature to 23.10 ºC.
[F1 TT ?]	What is the current target temperature?
......[F1 TT 71.32]	Target temperature is 71.32 ºC.
[F1 TT +]	Turn on automatic reporting of manual changes to the target temperature.
[F1 TT -]	Turn off automatic reporting of manual changes to the target temperature.

`[F1 MT ?]`	What is the maximum target temperature allowed?
`......[F1 MT 110]`	The maximum target temperature allowed is 110 ºC.
`[F1 LT ?]`	What is the lowest target temperature allowed?
`......[F1 LT -30]`	The lowest target temperature allowed is -30 ºC.

---

6. Instrument Status

`[F1 IS ?]`	What is the current instrument status?
`......[F1 IS 0-+S]`	Response is four parameters: number of unreported errors is 0 (0 to 9) stirrer is off (+ is on, - is off) temperature control is on (+ is on, - is off) temperature is stable (S is stable, C is changing)
`[F1 IS +]`	Automatically report instrument status whenever it changes (e.g., due to manual changes at the controller)
`[F1 IS -]`	Stop automatic reports of instrument status.
`......[F1 IS R]`	The controller has been powered off and back on again.

---

7. Current Sample Temperature

`[F1 CT ?]`	What is the current temperature of the holder?
`......[F1 CT 22.84]`	The current temperature is 22.84 ºC.
`[F1 CT +3]`	Periodically report current temperature every 3 seconds.
`[F1 CT -]`	Stop periodic current temperature reports.

---

8. Error Reporting

`[F1 ER ?]`	Report the current error.
`......[F1 ER -1]`	No current error.
`......[F1 ER 05]`	Cell T out of range (Loose cable? Sensor failure?).
`......[F1 ER 06]`	Cell & heat exchanger T out of range (Loose cable?).
`......[F1 ER 07]`	Heat exchanger T out of range (Loose cable? Sensor failure?).
`......[F1 ER 08]`	Inadequate coolant (check flow). Temperature control has shut down.

`......[F1 ER 09<<bad command>>]`

Syntax error on a preceding command where <<bad command>> is the command that caused the syntax error.

`[F1 ER +]`	Automatically report errors when they occur.
`[F1 ER -]`	Stop automatic error reports.

---

9. Probe Status and Temperature

[F1 PS ?]	Is there an external temperature probe connected?
......[F1 PR +]	A probe is connected.
......[F1 PR -]	No probe is connected.
[F1 PS +]	Enable probe status to be sent automatically when a probe is installed or removed. This is the default.
[F1 PS -]	Disable automatic sending of probe status.
[F1 PT ?]	What is the current probe temperature?
[F1 PT +3]	Periodically report the probe temperature every 3 seconds.
......[F1 PT 22.3]	The current probe temperature is 22.3 degrees.
......[F1 PT NA]	Probe temperature is not available.
[F1 PT -]	Stop periodic probe temperature reports.
[F1 PA S 0.5]	Set the increment for automatic reporting of the probe temperature to 0.5 degrees during a ramp. (Increment must be positive, without sign in tenths between 0.1 and 9.9 degrees, and will work for ramps going up or down.)
[F1 PA +]	Start automatic reporting of probe temperature every temperature increment (set by the command above).
......[F1 PT 30.5]	The current probe temperature is 30.5 degrees.
[F1 PA -]	Stop automatic reporting of probe temperature every temperature increment.
[F1 PX +]	Change probe temperature returned to a precision of 0.01 degree.

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10. Temperature Ramping

[F1 RR S 2.10]	Set the ramp rate to 2.10 °C/minute.
[F1 RR ?]	What is the current ramp rate?
......[F1 RR 2.10]	Current ramp rate is 2.10 °C/minute.

For the following three commands, there are no corresponding reference commands ([R1 . . .], see command class 13).

[F1 TL +]	Ramp the sample and reference identically.
[F1 TL -]	Ramp the sample while the reference remains stable.
[F1 TL 0]	Ramp the sample and reference independently.

The default is to ramp the sample while the reference remains stable. Ramping both the sample and reference at different rates or to different target temperatures (see below) is not possible.

To Ramp the temperature:

1. equilibrate at the starting temperature,
2. set the ramp rate,
3. set a new target temperature (command class 5).

The target temperature may be above or below the current temperature; as soon as it is set, the ramp will begin, up or down, to that new target.

After reaching the target, the controller will hold at that temperature. At any time a new ramp rate and target temperature can be set to start a new ramp.

Once you are done, set the ramp rate to 0. Otherwise, setting a new target temperature later will initiate a ramp to that target temperature.

Notes:

The minimum settable ramp rate is about 0.0000001 °C/minute.

For higher ramp settings, the observed rate may be nonlinear over part of the temperature range because the maximum possible rate of heating or cooling is limited .

When the ramping process is completed the controller will send a response of the form [F1 TT #] as a notification of the end of the ramp. This response can be blocked at any time by previously sending the command [F1 TT -] (see command class 5).

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11. Heat Exchanger Temperature

`[F1 HL ?]`	What is the high temperature limit for the heat exchanger?
`......[F1 HT 60]`	The heat exchanger high temperature limit is 60 ºC.
`[F1 HT ?]`	What is the current temperature of the heat exchanger?
`......[F1 HT 39]`	The current heat exchanger temperature is 39 ºC.
`[F1 HT +3]`	Start periodic heat exchanger temperature reports every 3 seconds.
`[F1 HT -]`	Stop periodic heat exchanger temperature reports.

---

12. Cell Changing

These commands will have an effect only for a sample holder with multiple cuvette positions.

`[F2 MP ?]`	What is the number of positions (maximum position number)?
`...... [F2 MP 6]`	The sample holder has 6 positions.
`[F2 PI]`	Device initialize: move to home, then to position 1 and reply when done.
`......[F2 PL 1]`	Device is in position 1.
`[F2 PL 4]`	Device locate: move to position 4 and reply when done. (Device should be initialized prior to using this command for the first time.)
`......[F2 PL 4]`	Device is now in position 4.
`[F2 PL ?]`	What is the device location (position)?
`......[F2 PL ?]`	Device is moving.
`......[F2 PL 2]`	Device is in position 2. (If reply is 0, device is not initialized.)
`[F2 DD 2]`	Set speed to 2 (acceptable range 2-250 with 2 being fast, 250 being slow).

[F2 DD ?]	What is the current device speed?
......[F2 DD 2]	Device is set to speed setting 2.

---

13. Reference Cuvette

These commands will have an effect only for systems with two independently controlled sample holders.

[R1 ...]

To control and monitor the temperature and status of the reference cuvette using a Dual Temperature Controller, use any commands in classes 3-8, 10 and 11, substituting R1 for F1. There are no corresponding [R1 …] commands for command classes 1, 2, 9 and 12.

If you wish to ramp the temperature of the reference and sample cuvettes together, please note the linking command, [F1 TL +], in command class 10.

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14. Control of Automatic Reports

The TC 1 can be controlled manually using the buttons and the display on the front. When a computer program is in use, the TC 1 will automatically send reports to the program whenever a manual change has been made. The commands in this section are intended to allow the program to prevent the TC 1 from sending those automatic reports.

[F1 XX R(+/-)]	Stop (R-) or start (R+) reporting all manual changes, including those starting with [R1 and [F2. By replacing the XX with individual command codes, a program can selectively stop or start reporting of manual changes.
[F1 SS R-]	Stop reporting manual changes for the sample stirrer.
[F1 TC R-]	Stop reporting manual changes for the sample temperature control.
[F1 TT R-]	Stop reporting manual changes for the sample target temperature.
[F1 PR R-]	Stop reporting manual changes for the external probe connection.
[F1 RR R-]	Stop reporting manual changes for the sample ramp rate.
[F2 PL R-]	Stop reporting manual changes for the sample position.
[R1 SS R-]	Stop reporting manual changes for the reference stirrer.
[R1 TC R-]	Stop reporting manual changes for the reference temperature control.
[R1 TT R-]	Stop reporting manual changes for the reference target temperature.
[R1 RR R-]	Stop reporting manual changes for the reference ramp rate.