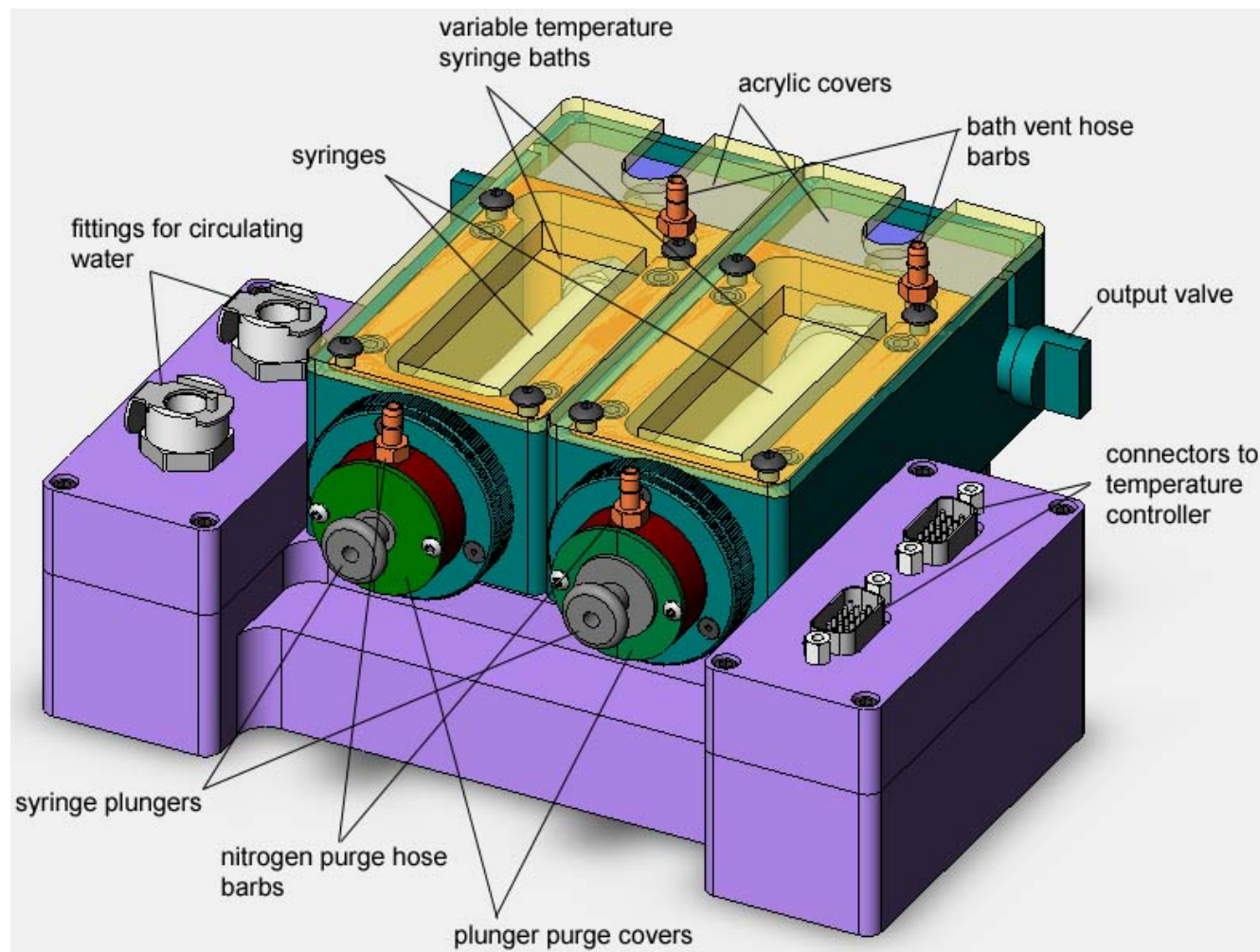


TITRATOR

Temperature-Controlled Bath System



The Titrator Bath System illustrated above consists of two temperature-controlled baths in which syringes containing experimental solutions requiring precise temperature control can be installed. The two variable temperature baths have a normal operating range of 0 °C to 80 °C. The Titrator Bath System is provided with the TC 200 Dual Temperature Controller, a microprocessor-based controller using a modified PID algorithm that independently controls the temperature of each bath. This system was developed as a joint effort between Olis and Quantum Northwest.

SYSTEM SETUP

1. Attach a length of 1/8-inch (3 mm) inside diameter tubing from a water source to one of the quick disconnect fittings on the Titrator. Attach a second length of 1/8-inch ID tubing from the second quick disconnect fitting to a drain. Direction of the circulating water through the Titrator Bath System is not important.

Cooling water flows through heat exchangers and removes heat from the thermoelectric devices in each cuvette holder when the temperatures of the baths are being lowered. Insufficient flow will allow a heat exchanger temperature to rise. If the temperature of either heat exchanger exceeds a certain cutoff value, temperature control will be automatically shut down to protect the system.

Do not exceed an input water pressure of 25 psi (1.7 bar), as damage may occur inside the Titrator Bath System.

Filter tap water before use, if the quality of the water supply is suspect. Tap water supplies, particularly on older buildings, often contain substantial particulate matter such as rust. If the quality of the water to be used in the Titrator is questionable, you must filter the water before passing it through the unit or clogging may occur.

2. Place the clear acrylic covers over the baths and screw into place. The lower section of the cover should contact the bath fluid to permit visual inspection of the syringe.

3. As a precaution against oxygen entering an anaerobic sample, nitrogen may be flushed around the plunger of the syringe. Connect a source of nitrogen using a length of tubing with 1/8" (3 mm) inside diameter to the nitrogen purge hose barbs.

4. Connect the Temperature Controller to a power source and to the Titrator using the electrical cords

provided. See that the sample cable from the sample bath attaches to the sample connector on the rear of the temperature controller and the reference cable from the reference bath attaches to the reference connector on the rear of the temperature controller. (The two baths are referred to as sample and reference to correspond with the terminology on the temperature controller, which was initially developed for the sample and reference cuvette holders of a UV/Vis spectrophotometer. Both titrator baths have identical, independent function, and may be used in any appropriate manner by the experimenter.)

Note: It is very important to connect the **sample** bath to the temperature controller's **sample** connector and the **reference** bath to the temperature controller's **reference** connector. The baths and temperature controller are calibrated as pairs and must be properly matched for proper operation and correct readings.

SYSTEM OPERATION

1. Turn on the power to the Titrator system using the switch located on the left side of the rear panel of the temperature control unit. When the TC 200 is turned on, the display briefly indicates the software version number running in the microcontroller and an ID number that identifies the kind of sample holder that is being controlled (see further information in the later section of serial control).

2. Set the target temperatures for both the sample and reference baths using the corresponding up/down buttons located to the right of the display window. The normal temperature range is 0 °C to 80 °C, although temperatures outside this range may be used if extra measures are taken (eg. Insulation or cooled circulating water).

3. To begin controlling the temperature, depress the corresponding run/stop button located beneath the

display. Depressing the run/stop button a second time will turn temperature control off.

4. While the baths approach the target temperature, the red light located on the upper left corner of the front panel of the temperature controller will flash slowly.

CAUTION: When the instrument is in operation the heat sink fins located in the back of the temperature control may feel quite warm to the touch. This is a normal characteristic.

5. When the baths reach within ± 0.02 °C of the target temperature, the red light will remain constant.

6. After measurements are completed, depress the run/stop button to stop temperature control and turn off power and water sources.

5. Removal is the opposite procedure of installation.

SYRINGE INSTALLATION

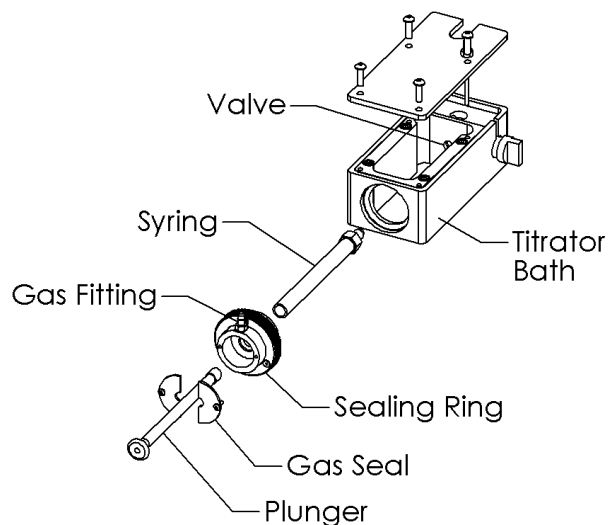
(See illustration at right)

1. Select the desired syringe for installation, as well as the proper Sealing Ring and Gas Seal plates for the syringe selected.

2. Insert the syringe from the back of the Titrator bath assembly and thread it into the valve at the front of the bath. Using the appropriate wrench, lightly tighten the syringe into the valve.

3. Install the threaded Sealing Ring (fitting at the back) into the back of the bath assembly by gently sliding it over the syringe and rotating it into the large thread on the bath assembly. Tighten the Sealing Ring into the bath making sure to seal against the o-ring.

4. Insert the plunger into the syringe, then install the Gas Seal plates on to the back of the Sealing Ring using the 2, 2-56 screws. The gas fitting can be rotated to any direction desired.



ERROR CONDITIONS

Rapid flashing of the red light indicates an error condition. The common errors that will display are:

Error conditions E5, E6 and E7 – Check Cables.

One or more of these error conditions is likely to arise if the electrical connection between the Temperature Controller and the Titrator is not secure. In this case, turn off the power to the unit, check the cable, turn on the power, and resume work.

Error condition E8 – Low water flow. This error condition indicates that the heat exchanger on the thermoelectric cooler is getting too warm. This heating will occur if insufficient cooling water is flowing into the device. Error condition E8 will automatically shut down temperature control to prevent damage to the unit. If this occurs, improve cooling water flow and re-start temperature control.

If correcting these problems does not solve the error messaging, or if other errors are displayed, contact Quantum Northwest by calling (509) 624-9290 or by e-mailing us at qnw@qnw.com.

Serial Control for the Titrator

While almost all operations may be manually controlled using the front face of the TC 200 controller, external computer control may also be accomplished through the Serial Control option. The Serial Control option consists of a Windows computer program, *Serial Control*, a cable and a special instruction set understood by the microcontroller.

The Serial Control program will permit you to connect to the controller, set temperatures, issue individual commands, run scripts of multiple commands, and plot temperature vs. time. One important function, ramping, is only available through external computer control.

SETUP AND SOFTWARE INSTALLATION

1. Use the provided cable to connect from the lower (9-pin) connector on the back of the temperature controller to a serial interface of your computer (typically COM1). For computers that do not have a 9-pin serial connector, a USB to serial adapter may be purchased at most electronics or office supply stores.
2. Place the installation CD in the computer's drive and follow instructions. All files will be placed in the directory specified during installation (default is C:\Program Files\QNW Serial Control), except for QnwSerial.DLL, which will be installed in the Windows' System directory.
3. To check the interface, run the program QNW Serial Control.exe. For instructions on how to use the program, use the program's Help system.

UNINSTALLING THE SOFTWARE

To uninstall the Serial Control Program files, use the "Add/Remove Programs" control panel by selecting "QNW Serial Control" from the list.

SERIAL CONTROL FROM OTHER PROGRAMS

ASCII commands may be issued to the temperature controller by any convenient program capable of doing so. Such programs include the HyperTerminal program provided with the Windows operating system or more elaborate systems such as LabVIEW.

The software specification providing the legal instructions and their responses is given on the following page.

Serial Commands and Replies

This is the software specification for QNW Temperature Controller Version 7.6 issued on 23 December 2004. The version number and the ID (see below) are displayed briefly on the temperature controller display when it is turned on. Controllers operating software versions earlier than 7.0 will not respond to the Identify and Software Version requests. Note that only single spaces must be used within the individual commands.

command class	command	reply	function
1. Identify	[F1 ID ?] [F1 ID 30]		What is the kind of sample holder being controlled? Sample holder is a four-position turret. single-cuvette holder (10-19) dual-controlled holder (20-29) four-position turret (30-39)
2. Software Version	[F1 VN ?] [F1 VN 7.6]		What is the version number of the software? The controller is operating software version number 7.6.
3. Stirrer	[F1 SS +] [F1 SS -]		Turn stirrer on (stir rate must be set manually). Turn stirrer off.
4. Temperature Control	[F1 TC +] [F1 TC -]		Turn temperature control on. Turn temperature control off.
5. Target Temperature	[F1 TT S 23.10] [F1 TT ?] [F1 TT 71.32]		Set target temperature to 23.10 °C. What is the current target temperature? Target temperature is 71.32 °C.
6. Instrument Status	[F1 IS ?] [F1 IS 0-+S] [F1 IS +] [F1 IS -] [F1 IS R]		What is the current instrument status? Response is four parameters: no unreported error (0 or 1) stirrer is off (+ or -) temperature control is on (+ or -) temperature is stable or changing (S or C) Automatically report instrument status whenever it changes (e.g., due to manual changes at controller) Stop periodic or automatic reports of instrument status. The controller has been powered off and back on again.
7. Current Temperature	[F1 CT ?] [F1 CT 22.84] [F1 CT +3] [F1 CT -]		What is the current temperature of the holder? The current temperature is 22.84 °C. Automatically report current temperature every 3 seconds. Stop periodic current temperature reports.
8. Error Report	[F1 ER ?] [F1 ER -1]		Report the current error. For a more complete description, see "Error Codes" in the help system of the Serial Control Program. 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). Control has shut down.
	[F1 ER 09]	Syntax error on a preceding command.
	[F1 ER +]	Automatically report errors when they occur
	[F1 ER -]	Stop automatic error reports

9. Ramping	[F1 RS S 10]	Set the time increment for the ramp to 10 seconds. (Ramping seconds is a positive integer.)
	[F1 RT S 10]	Set the temperature increment to 0.1 °C. (Ramping temp is a positive integer in hundredths of a °C.)

To Ramp the temperature, equilibrate at the starting temperature, set the time and temperature increments, and set a new target temperature. The temperature will ramp to the new target. After the completion of the ramp, the time and temperature increments will remain set. To return to normal operation, set the time and temperature increments to 0.

10. Turret control	[F2 DI]	Device initialize, move unit to home position
	[F2 DL 3]	Device locate, move device to position 3 (Device must be initialized prior to using this command.)
	[F2 ?]	Query: report status of turret
	[F2 OK]	Reply: device is ready to accept commands
	[F2 BUSY]	Reply: device is busy running commands
	[F2 PI]	Device initialize, move unit to home position and reply when done
	[F2 OK]	Reply: turret is finished moving
	[F2 PL 4]	Device locate, move to position 4 and reply when done
	[F2 LD 4]	Reply: turret is now in position 4
	[F2 PL ?]	What is the turret position?
	[F2 LD 2]	Reply: Turret is in position 2 (If reply is 0, turret is not initialized.)
	[F2 DD 2]	Change rotation speed to 2 (acceptable range 2-250 with 2 being fast, 250 being slow)
	[F2 DD ?]	What is the current turret rotation speed?
	[F2 DD 2]	Turret is set to speed setting 2 (If reply is 0, then internal default value is being used).

11. Reference cuvette [R1 ...]

To control the temperature of the reference cuvette of a Dual Temperature Controller, use any commands in classes 3-7, substituting R1 for F1.
