

Software Specifications for Quantum Northwest Temperature Controllers

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With the exception of setting the rate of stirring, all functions of the temperature controller can be managed from a computer, using the command set described below and a program that communicates with the controller through a serial linkage.

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 and 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.

Some features of the system such as ramping at different rates from one temperature to another are available only through computer control.

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

The remainder of this section lists the serial commands understood by the temperature controller. For many of the commands the controller returns information in response to the command. All commands and replies are delineated by left and right square brackets ([]). In this document an ellipsis (.....) is used to distinguish replies from commands. Any text sent to the controller not enclosed within brackets will be ignored.

This is the software specification for Version 9.1 of the firmware on Quantum Northwest temperature controllers TC 125, TC 225 and TC 425. The version number and the ID (see below) are displayed briefly on the display when the temperature controller is turned on.

[command]	purpose of the command (sent to the controller)
.....[reply]	meaning of the reply (received from the controller)

Identify

[F1 ID ?] What is the ID number of the sample holder being controlled?
.....[F1 ID 31] Sample holder is a four-position turret with probe capability.

Assigned Identities:

ID =	10	single cuvette holder
	11	single cuvette holder with probe capability
	12	high temperature single cuvette holder
	20	dual cuvette holder
	21	dual cuvette holder with probe capability
	22	dual-controlled titrator
	30	4-position turret
	31	4-position turret with probe capability
	32	6-position linear cell changer

Identity Classes:

- (10 – 19) device using single temperature controller
- (20 – 29) device using dual temperature controller
- (30 – 39) multiple cell changer

Software Version

- [F1 VN ?] What is the version number of the software?
.....[F1 VN 9.1] The controller is operating software version number 9.1.

Stirrer

- [F1 SS +] Turn stirrer on (stir rate must be set manually).
[F1 SS -] Turn stirrer off.

Temperature Control

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

Target Temperature

- [F1 TT S 23.10] Set target temperature to 23.10 °C.
[F1 TT ?] What is the current target temperature?
.....[F1 TT 71.32] Target temperature is 71.32 °C.
[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

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 controller)
[F1 IS -] Stop periodic or automatic reports of instrument status.
.....[F1 IS R] The controller has been powered off and back on again.

Current Temperature

- [F1 CT ?] What is the current temperature of the holder?
.....[F1 CT 22.84] The current temperature is 22.84 °C.
[F1 CT +3] Automatically report current temperature every 3 seconds.
[F1 CT -] Stop periodic current temperature reports.
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Probe Status

[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]	Automatically 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 automatic probe temperature report.
[F1 PA S 0.5]	Automatically report probe temperature every increment of 0.5 degrees during a ramp. (Increment must be a positive value 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.
.....[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.

Error Reporting

[F1 ER ?]	Report the current error. For a more complete description, see "Error Codes" in the help system of the Serial Control Program.
.....[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). 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

Ramping

[F1 RS S 3]	Set the time increment to 3 seconds (must be a positive integer).
[F1 RT S 10]	Set the temperature increment to 0.1 °C (a positive integer, units are hundredths of a degree).
[F1 TL +]	Ramp the sample and reference identically (TC 225 dual controller only).
[F1 TL -]	Ramp the sample and reference separately (TC 225 dual controller only).

The ramp rate (°C/min) is calculated as $(RT / 100) / (RS / 60)$. Ramp rates corresponding to selected RS and RT pairs are given in the table below.

°C/min	0.05	0.1	0.2	0.5	1	2	5	10
RS	12	12	6	6	3	3	3	3
RT	1	2	2	5	5	10	25	50

Note: For the higher ramp settings, the observed rate may be lower than that calculated from RT and RS or it may be nonlinear over part of the temperature range because the maximum possible rate of heating or cooling is limited (and dependent on the temperature).

To Ramp the temperature:

1. equilibrate at the starting temperature,
2. set the time (RS) and temperature (RT) increments,
3. set a new target temperature.

The new target may be above or below the current temperature and, 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 RS and RT may be reset and a new ramp initiated by setting another target temperature.

Once you are done, terminate ramping by resetting both RS and RT to 0. Otherwise, setting a new target temperature later will initiate a ramp to that target temperature.

Cell Changing

[F2 DI] Device initialize: move to home position.
[F2 PI] Device initialize: move to home position and reply when done.
.....[F2 OK] Device is finished moving.
[F2 DL 3] Device locate: move to position 3. (Device must be initialized prior to using this command.)
[F2 PL 6] Device locate: move to position 6 and reply when done.
.....[F2 DL 6] Device is now in position 6.
[F2 ?] Report status of device.
.....[F2 OK] Device is ready to accept commands.
.....[F2 BUSY] Device is busy running commands.
[F2 PL ?] What is the device location (position)?
.....[F2 DL 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. (If reply is 0, then internal default value is being used.)

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. 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.