
FLASH 300 Temperature-Controlled Cuvette Holder for Laser Spectroscopy

The FLASH 300 is a cuvette holder for transient absorbance, flash photolysis, fluorescence, pulsed-laser photoacoustics and a variety other spectroscopic experiments. It uses the Peltier effect to provide rapid and precise temperature control over a wide range of temperatures. It has magnetic stirring and a dry gas purge. A vertical adjustment brings the cuvette to the height of a laser beam or other light source and a horizontal micrometer adjustment permits a precise alignment of excitation light in the cuvette.

Features

- The cuvette temperature may be controlled from $-55\text{ }^{\circ}\text{C}$ to $+105\text{ }^{\circ}\text{C} \pm 0.02\text{ }^{\circ}\text{C}$. (page 4)
- Variable speed magnetic stirring maintains uniform temperature in the sample and removes photoproducts from the illuminated volume.
- Vertical adjustment can be used to match the beam height of typical lasers
- Micrometer-driven horizontal translation allows precise positioning of light beams in the cuvette.
- Optical ports on all four sides of the cuvette provide generous light access.
- An access plug can be removed for probes that make direct physical contact with the cuvette surface (not visible in photo).
- A dry gas purge may be used to reduce condensation on cuvette surfaces, when working at low temperatures.
- Each FLASH 300 comes with a calibrated and matched TC 125 Temperature Controller.
- The TC 125 Temperature Controller accepts a standard 400 or 500 series thermistor probe for direct measurement of the sample temperature.
- An optional software package, SER 2.2, is available for external computer control using text scripting. (page 3)
- An optional windowed cover is available for work at very low temperatures. (page 4)
- An optional submersible pump and fittings are available as an inexpensive source of circulating fluid to remove heat from the Peltier unit when the temperature is lowered. (page 4)
- An optional package is available for pulsed-laser photoacoustics. (page 2)



Figure 1 - photo of the FLASH 300

Description

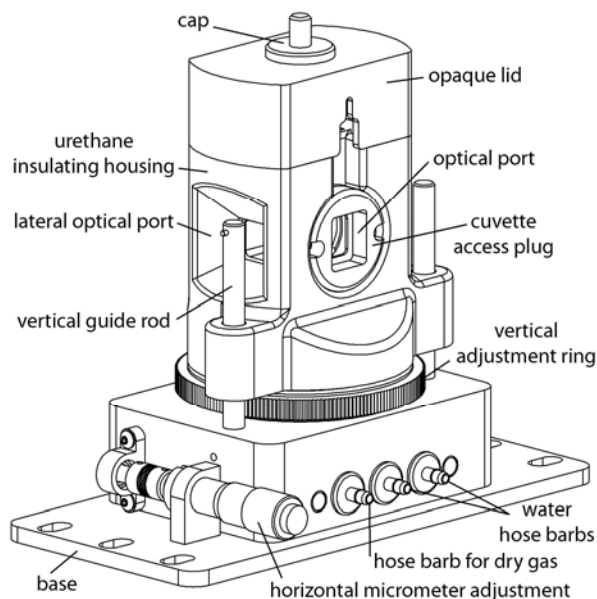


Figure 2 - The FLASH 300

The cuvette is surrounded by a temperature-controlled central metal tower and the tower is, in turn, surrounded by a plastic insulating housing. A temperature sensor used for PID temperature control is mounted in a corner of the metal tower at the height of one of the windows. To control the temperature, a Peltier unit is sandwiched between an internal metal base plate under the central tower and a brass heat exchanger. A small, Swiss, brushless motor is mounted within the heat exchanger and rotates a magnet under the sample for magnetic stirring.

A vertical adjustment ring raises and lowers the upper section of the FLASH 300. The height of the center of the cuvette window may be varied from 85 to 113 mm above the surface of the table.

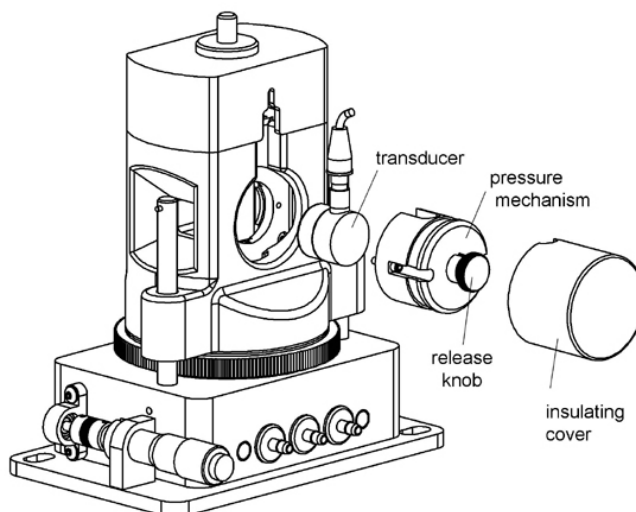
The user must circulate water through the heat exchanger to remove heat from the Peltier when the temperature of the cuvette holder is lowered. Two hose barbs for water accept $\frac{1}{8}$ -inch ID vinyl tubing for this purpose. A third hose barb may be used to provide dry gas to reduce condensation when working below the dew point temperature. When connected, dry gas passes through a labyrinth of holes in the base under the cuvette tower to first partially equilibrate to the temperature of the cuvette. It then blows up through holes in the metal tower into the four regions next to the cuvette faces.

For mounting on an optical table or breadboard, the slots in the base of the FLASH 300 are dimensioned to accommodate either standard $\frac{1}{4}$ -20 screws with tapped holes on 1-inch centers, or metric M6 screws on 25 mm centers.

A horizontal micrometer adjustment moves the entire body of the FLASH 300 back and forth on optical rails over a 1 cm distance. Thus, if a laser beam is passed through the lateral optical ports, turning the micrometer provides a fine adjustment of the position of the laser beam in the sample.

Quantum Northwest specializes in instrumentation for pulsed-laser photoacoustics, and the FLASH 300 is frequently configured for this application. If you are interested in photoacoustics, please request special literature on this product line.

Figure 3 - The FLASH 300 with the photoacoustics option



The FLASH 300 cuvette holder has optical ports on four sides of the cuvette. Since the structure is flattened in one dimension, collimated beams, such as those from laser sources, are typically passed through the lateral optical ports. Other light may be passed perpendicular to this dimension using the remaining two optical ports. These optical ports on the side accept light at a greater angle, and are thus good for arc sources or for efficient light collection using lenses.

The FLASH 300 accepts a standard 10 x 10 mm path length cuvette with outside dimensions of 12.5 x 12.5 mm. For small samples, many microcuvettes are available with these outside dimensions, or other smaller cuvettes may be used with adapters.

An access plug on one side provides access to the cuvette surface for special detectors such as the ultrasonic transducers used in pulsed-laser photoacoustics. Special inserts could easily be designed as needed to accommodate a variety of probes such as fiber bundles. An opaque lid and cap limit light from entering or leaving the top of the holder.

Performance

Each FLASH 300 is provided with a performance plot similar to that of Figure 4. Using the QNW Serial Control program (see below), a script is run that sets and holds a series of temperatures. The blue line is the temperature of the body of the cuvette holder. Note the rapid temperature changes both ascending and descending. The temperature in the cuvette itself lags behind this value. For many experiments it is desirable to use an external probe and measure the temperature in the cuvette.

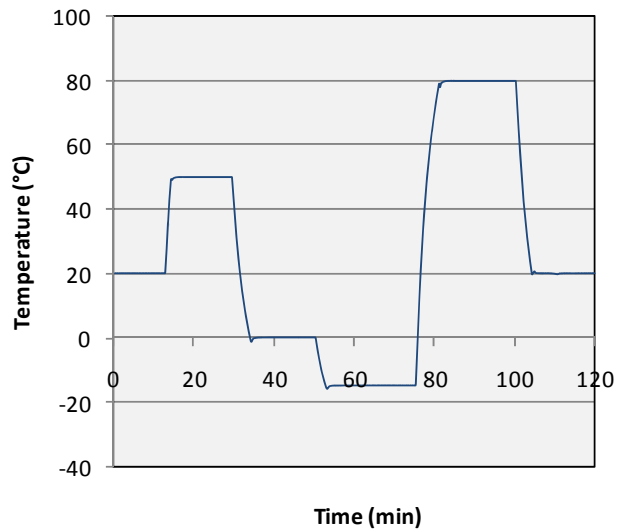


Figure 4 - FLASH 300 performance

Optional Serial Control

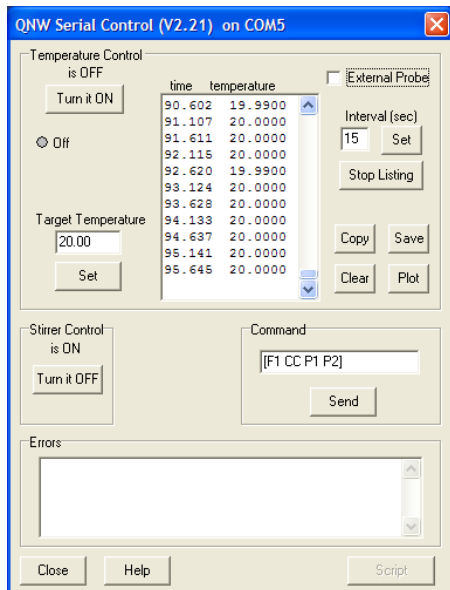


Figure 5 - SER 2.2 main window

If you purchase the additional SER 2.2 option, the TC 125 Temperature Controller may be controlled by an external computer via a USB. SER 2.2 includes a Windows program, QNW Serial Control, whose main window is displayed in Figure 5. From this window, you may set target temperatures, turn temperature control or magnetic stirring on or off, or collect time and temperature data in its main window for both the probe and sample holder temperatures.

A click on the Script button in the lower right corner brings up the Special Tools window shown in Figure 6. Use this window to load a script file, a series of text commands that perform complex temperature functions such as temperature ramping. Sample scripts are provided.

Copy data from the main window onto the clipboard so that it may be used in other applications, or click on the plot button on the main window to bring up a plot of the time and temperature data such as that shown in Figure 7.

Figure 6 - Special Tools window

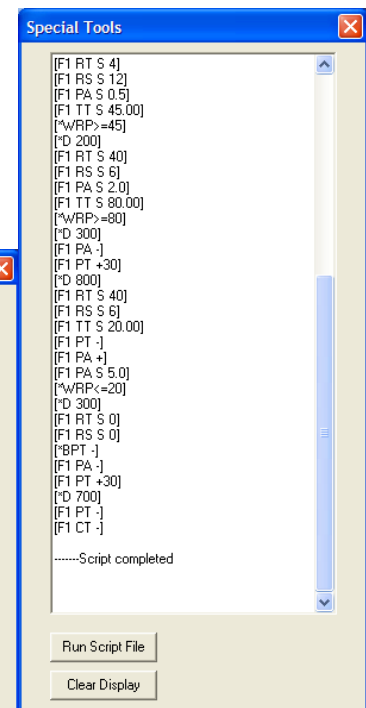
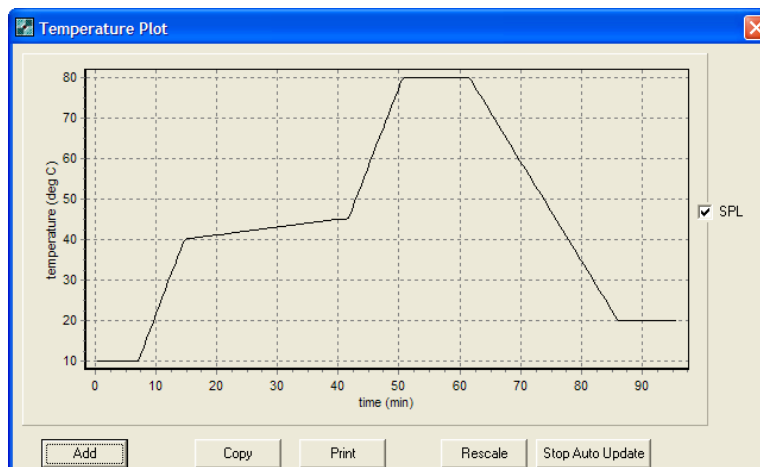


Figure 7 - temperature plot window

Use the SER 2.2 for ramping and other complex temperature functions.



Temperature Control



Figure 8 - TC 125 Temperature Controller

Temperatures achievable with the FLASH 300 depend on the way it is used. Please contact us for advice on how to use the FLASH 300 below -10 °C.

Each FLASH 300 includes a TC 125 temperature controller, matched to the FLASH 300 and calibrated against a NIST-traceable thermometer. Set a target temperature, control the stirring speed and turn temperature control on and off. The TC 125 accepts an external temperature probe that may be used to monitor the temperature of the sample. Standard 400 or 500 series probes are available from several sources.

Table 1 - Achievable Temperatures

highest operating temperature	105 °C
lowest temperature in the open, no dry gas flow	5 °C
lowest exposed but with dry gas flow	-10 °C
enclosed in dry environment, 0 degree circulating fluid	-25 °C
with windows, cold circulating fluid, some added insulation	-40 °C
with windows, very cold circulating fluid, lots of added insulation	-55 °C

Choices You Make on Ordering

- **Bath 100**, Water Circulator – The **BATH 100** is a submersible pump, plastic bucket and brass fitting that can be used as an inexpensive source of circulating water for the FLASH 300.
- **SER 2.2**, External Serial Control – To control your FLASH 300 from an external computer, include the SER 2.2 serial control option (page 3).
- **WJ 300**, Windowed Jacket – If you plan to operate your FLASH 300 below about -10 °C in the open or below about -25 °C in an enclosed purged space, the Windowed Jacket will provide added insulation and isolate the cuvette surfaces from the ambient environment, reducing the likelihood of condensation.
- **Custom Modifications** – The FLASH 300 is designed for research. We frequently make modifications to optimize the FLASH 300 to different applications. Some changes are as simple as a replacement of the base and some as complex as the addition of lenses and photomultiplier housings. Please contact us if you need something special.

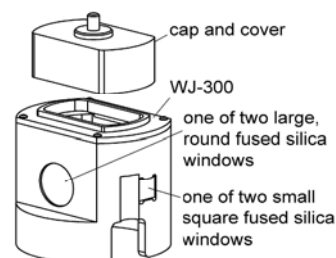


Figure 9 - Windowed Jacket for cold temperature operation of the FLASH 300

Two years parts and labor warranty on all equipment manufactured by Quantum Northwest

(see web site for details)



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