OceanOptics



Qpod 3 User Guide

Installation and Operation Manual

Document Number
000-10000-201401

Locations



Americas

Manufacturing & Logistics
3500 Quadrangle Blvd.,
Orlando, FL 32817, USA

Sales: info@oceanoptics.com
Orders: orders@oceanoptics.com
Support: support@oceanoptics.com

Phone: +1 727-733-2447
Fax: +1 727-733-3962

www.oceanoptics.com

Europe, Middle East & Africa

Sales & Support
Geograaf 24, 6921 EW Duiven,
The Netherlands

Logistics
Maybachstrasse 11,
73760 Ostfildern,
Germany

Email: emeasales@oceanoptics.com

Netherlands: +31 26-319-0500
Netherlands Fax: +31 26-319-0505
Germany: +49 711-341696-0
UK: +44 1865-819-922
France: +33 442-386-588

Asia

Ocean Optics China
3F, Building 16, No. 155
Yuanke Road, Minhang District
Shanghai 200336
People's Republic of China

Email: asiamkt@oceanoptics.com

China: +86 400-623-2690
China Fax: +86 21-6295-6708
Japan & Korea: +82 10-8514-3797
Ocean Optics India: +91 81 7847-0108
Prestige Shantiniketan, Gate No. 2,
Tower C, 7th Floor, ITPL Main Road,
Whitefield, Bengaluru, Karnataka 560 048, India

Copyright © 2026 Ocean Optics.
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission from Ocean Optics.

This manual is sold as part of an order and subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out or otherwise circulated without the prior consent of Ocean Optics, Inc. in any form of binding or cover other than that in which it is published.

Trademarks
All products and services herein are the trademarks, service marks, registered trademarks or registered service marks of their respective owners.

Limit of Liability
Every effort has been made to make this manual as complete and as accurate as possible, but no warranty or fitness is implied. The information provided is on an "as is" basis. Ocean Optics shall have neither liability nor responsibility to any person or entity with respect to any loss or damages arising from the information contained in this document.

Table of Contents

1. General Information	**1**
1.1 User Documentation	1
1.2 Modules, Covers and Panels	1
1.3 Other Precautions	1
1.4 Warning and Other Symbols	2
1.5 CE Compliance	2
2. Specifications	**3**
2.1 Introduction: qpod 3 Cuvette Holder	3
2.2 Measurement Categor	4
2.3 Pollution Degree	4
2.4 Overvoltage Category	4
2.5 Environmental Conditions	4
2.6 Electrical Specifications	4
2.7 Computer Requirements	5
3. Setup, Optics, Operating the qpod 3	**6**
3.1 Setting up the qpod 3	6
3.2 Operating the qpod 3	10
3.3 Computer Control of the qpod 3	11
4. Q-Blue Program Commands	**15**
5. Maintenance and Spare Parts	**18**
5.1 Maintenance	18
Appendix	**19**
A.1 Example Script	19
A.2 Temperature Ramping	21

CAUTION

A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

1. General Information

Thank you for purchasing the Ocean Optics **qpod 3.** 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 website, https://www.oceanoptics.com/contact-us/, or by email at info@oceanoptics.com.

Your Ocean Optics cuvette holder and accessories have been carefully designed so that when used properly, you have an accurate, fast, flexible and safe temperature control system.

Information about safety practices appears throughout the documentation provided with your instrument and accessories to help you safely operate the instrument and accessories. Before using the instrument or accessories, you must thoroughly read these safety practices. ALWAYS operate the instrument and accessories in accordance with these safety practices.

1.1. User Documentation

You have been provided with the following documentation to help you set up and operate your Ocean Optics **qpod 3** cuvette holder:

- This manual, with safety practices and hazards information, instructions for installing and maintaining the components of the **qpod 3** and troubleshooting information.
- The **T-App** Help file, located on the **T-App** program (Ocean Optics>**T-App** Help), if purchased.

1.2. Modules, Covers and Panels

The spectrophotometer module that operators and other personnel will routinely access is the instrument's sample compartment, which is designed to contain Sample Holders. Customers may insert cuvettes and cuvette accessories into the Sample Holder while the sample compartment is open.

Any other panels or covers that are retained by screws on the cuvette holder and accessories may be opened ONLY by Ocean Optics service technicians.

1.3. Other Precautions

Do not block any ventilation grills present on the **qpod 3** Sample Holder.

Use of the **qpod 3** system and accessories may involve materials, solvents and solutions that are flammable, corrosive, toxic or otherwise hazardous. Careless, improper, or unskilled use of such materials, solvents and solutions can create explosion hazards, fire hazards, toxicity and other hazards which can result in death, serious personal injury, and damage to equipment and property.

ALWAYS ensure that laboratory safety practices governing the use, handling and disposal of such materials are strictly observed. These safety practices should include the wearing of appropriate safety clothing and safety glasses.

1.4 Warning and Other Symbols

The following is a list of symbols that may appear in conjunction with warnings on the cuvette holder and accessories. The hazard they describe is also shown.

A triangular symbol indicates a warning. The meanings of the symbols that may appear alongside warnings in the documentation or on the instrument itself are as follows.

	When used on a warning label, the user is in danger of electrical shock.
	When used on warning labels attached to the instrument, refer to the relevant operation or service manual for the correct procedure referred to by that warning label.
CE	When attached to the rear of the instrument, it indicates that the product complies with the requirements of one or more EU directives.

1.5 CE Compliance

Your **qpod 3** cuvette holder has been designed to comply with the requirements of the Electromagnetic Compatibility (EMC) Directive and the Low Voltage (electrical safety) Directive (commonly referred to as the LVD) of the European Union. Ocean Optics has confirmed that each product complies with the relevant Directives by testing a prototype against the prescribed EN (European Norm) standards.

Proof that a product complies with these directives is indicated by:

The CE marking appearing on the rear of the product, and the following Declaration of Conformity. The Declaration of Conformity is the legal declaration by Ocean Optics that the product complies with the directives listed above and shows the EN standards to which the product was tested to demonstrate compliance.

2. Specifications



Figure 1. qpod 3 cuvette holder.

2.1 Introduction: qpod 3 Cuvette Holder

Overview

The **qpod 3** is a complete sample compartment for fiber optic spectroscopy, including an air-cooled, or water-cooled, Peltier-controlled cuvette holder with magnetic stirring, and fused silica lens systems with SMA fiber optic connectors. The **qpod 3** housing contains a PID temperature controller that is operated via USB using the computer program Q-Blue.

The qpod 3 is available in three different packages. The **qpod 3**-ABSKIT provides collimating optics to pass light straight through for absorbance, transmittance or turbidity measurements. The **qpod 3**-FLKIT provides imaging lens systems for excitation and detection of fluorescence emission at right angles. The **qpod 3**-MPKIT is a multipurpose kit with a combination of optics that may be used for either absorbance or fluorescence measurements.

The **qpod 3** is constructed of a 2 piece 3D printed housing. An air-cooled or water-cooled Peltier-controlled cuvette holder in the center provides temperature control and variable speed magnetic stirring and holds optical slits for limiting light access to the cuvette as needed. A dry gas purge may be used to minimize condensation when working at low temperatures. SMA fiber optic connections and high-quality fused silica optics may be inserted in different combinations into optical ports in the walls surrounding the cuvette holder. Accessories such as polarizers and filter holders may be inserted in the light paths. Spherical mirrors may be used to enhance excitation or emitted light. All optics provide focusing and position adjustments for maximizing signal throughput.

- Temperature range -30* to +110 °C*
- Temperature precision ±0.01 °C
- Temperature accuracy ± 0.15 °C from 0 °C to +80 °C
- Temperature reproducibility better than ±0.07 °C
- Cuvette size (outside dimensions) 12.5 x 12.5 mm
- Optical port dimensions 10 mm diameter
- Probes accepted Probe 10/k-qX
- Cuvette z-height 15 mm

*Working below 0 °C requires pre-cooled circulating fluid, usually an ice water bath.

Note: 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.

2.2 Measurement Category

The measurement category is IEC 61010:I. Do not to use this equipment for measurements within measurement categories II, III and IV.

2.3 Pollution Degree

The pollution degree is IEC61010:2. Pollution degree “2” applies to a normal indoor atmosphere.

2.4 Overvoltage Category

The overvoltage category (installation category) is CAT II. See IEC 664 & IEC 61010.

2.5 Environmental Conditions

The area should have a dust-free atmosphere with minimal drafts, vibrations, and corrosive fumes. For optimum performance, the ambient air is recommended to be between 20 and 25 °C, but can be from 5 to 40°C. Relative humidity should be less than 80%. The instrument is designed for operation at 2,000 m elevation or less.

To avoid damage through spillage of solutions and samples being analyzed, the worktops should be covered with a material that is corrosion resistant and impervious to liquids.

Allow at least two inches of space on both sides, and six inches at the rear of the instruments to permit free air circulation. The power cord and all other connections are located at the front of the instruments.

2.6 Electrical Specifications

Mains Supply

A standard AC power cable is provided based on the user’s country requirements (18 AWG/115 V AC US/Canada; 1.0 mm/220 VAC international). The required supply voltage is 100-240 VAC (frequency 50 or 60 Hz). The mains voltage fluctuations must not exceed 10% of the nominal voltage.

The installation of electrical power supplies must comply with the rules and/or regulations imposed by local authorities responsible for the supply of electrical energy to the workplace.

All power cables must be single-phase, AC voltage, three-wire system (active, neutral, earth) and should be terminated at an appropriate power outlet receptacle that is within reach of the power cord. For safety reasons, a separate power outlet receptacle should be provided for each unit in the system. The use of extension cords or outlet adaptors is not recommended.

WARNING



Shock Hazard - Danger of electrocution. Good electrical grounding is essential to avoid potentially serious shock hazards. A 3-wire outlet with ground connection must be provided for the **qpod 3**. Make certain that power outlets are earth-grounded at the grounding pin.

CAUTION



Caution - Never connect or disconnect any cables while the **qpod 3** is powered on. Damage to the printed circuit boards may occur.

2.7 Computer Requirements

The **Q-Blue** software used for external control of the Ocean Optics **qpod 3** requires a personal computer using a Microsoft Windows™ operating system (XP, Vista, 7, 8, 10 or 11). The **Q-Blue** software is normally provided on a USB drive when ordered, requiring a USB port to be part of the computer.

Contact should you wish to obtain the application via the Internet.

3. Setup, Optics, Operating the qpod3

3.1 Setting up the qpod 3

Unpacking

After accepting delivery, take the equipment to the installation site. Ocean Optics instruments are inherently robust, and the packaging is designed to prevent internal damage. However, the contents form part of a precision measuring system and all packages should be handled with care. In transit, sharp jolts must be avoided, and the packages should not be inverted or tilted unnecessarily. Markings on the shipping cartons generally indicate which side of the package should be kept on top.

Unpacking the equipment is your responsibility. As the packages are opened, ensure that you have received everything you ordered. If there are any discrepancies, notify the supplier. If any items are found to be damaged, immediately notify the carrier and supplier.

You should have received:

- 1x qpod 3 Cuvette Holder
- 1x opaque lid with cap
- 12 VDC Power Adapter
- 1x AC power cord
- 1x USB cable (A to B mini)
- 1x USB drive containing Q-Blue software, the Calibration Certificate and manual
- 1x Accessory Kit containing 1x 5/64 hex wrench, 1x Slit Set, 2x blank window caps and 1x stir bar
- 1x 1/16-inch internal diameter tubing with adapter for dry gas

Optics Packages Available

ABSKIT-Absorbance Kit: 2x QCL3-UV collimating lenses

FLKIT-Fluorescence Kit: 2x QIL3-UV imaging lenses, 2x QMP mirror plus

MPKIT-Multipurpose Kit (absorbance and fluorescence): 2x QCL3-UV collimating lenses, 2x QIL3-UV imaging lenses and 2x QMP mirror plug

Note: Each kit provides spectral coverage over the 250 nm to 800 nm wavelength range.

qpod 3 System Setup

- If desired, fasten the **qpod 3** down to a table or optical breadboard. The holes in the corners of the base are located and sized such that it will attach via ¼-20 screws to a table with 1-inch centers or with M-6 screws to a table with 25 mm centers.
- Plug the AC cord into the power supply and the output of the power supply into the “power” port on the **qpod 3**. Next, connect the usb cable from the **qpod 3** to the computer being used, then plug the AC plug into wall power.

- Run program Q-Blue. When you start the program, it will automatically search for and connect to the instrument. Basic functions of the program may be controlled through the status panel at the left of the application window. If you plan on working at temperatures below 0 ºC you must use a source of cooling water or use our optional **BATH 10** to connect 1/8" ID tubing into the "water" connections to enable greater cooling of the Peltiers. We also recommend connecting a source of dry gas (typically nitrogen) using a length of tubing with 1/16" inside diameter, to the hose barb labeled "gas" on the side of the **qpod 3**. A flow of gas must be used to prevent condensation on the faces of the cuvette when working below the dew point temperature. Set the dry gas flow rate to 50 - 200 cc/min.

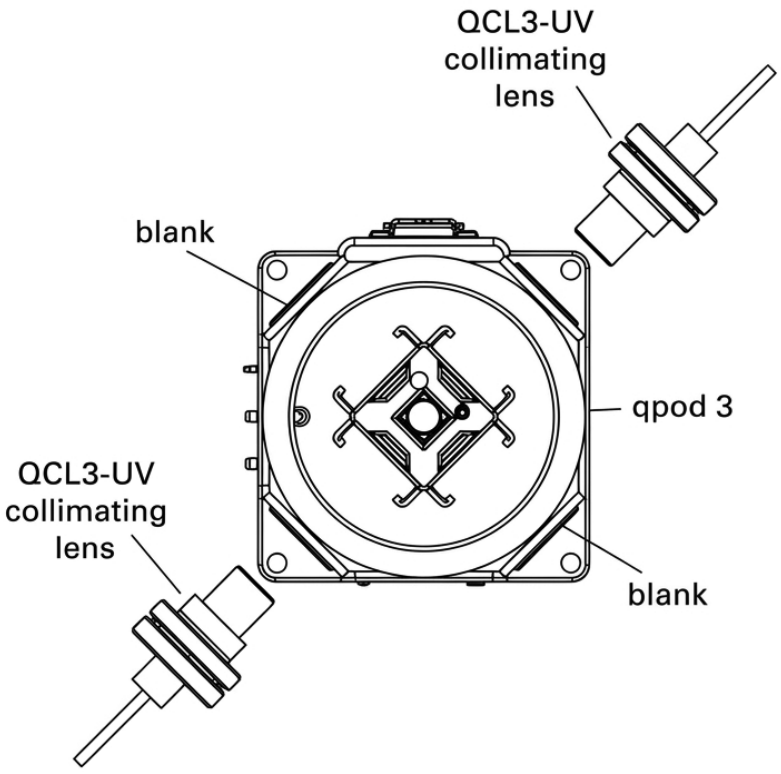


Figure 2. Absorbance configuration

OPTIONAL - If a gas such as nitrogen is to be used as dry gas for minimizing condensation at low temperatures, secure the tank to a solid object in the vicinity of the bench.

CAUTION



Caution – When using dry gas to prevent condensation on the cuvette, ensure that the working area is adequately ventilated.

OPTIONAL - If you plan to work at temperatures below 0 °C, our BATH 10 supplies circulating water to the Peltier unit to enable the **qpod 3** to go down to as low as -30. If using the circulating water, attach tubing from the submersible pump to either one of the water hose barbs on the **qpod 3**. Attach another piece of tubing from the **qpod 3** back to the bucket. Put water in the bucket, turn on the pump by plugging it into an AC 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.

Optics Setup

There are two basic optical configurations for the **qpod 3**: one to measure absorbance and the other to measure fluorescence.

Optics to measure absorption

Figure 2. Absorbance configuration

As shown in Fig. 2, to set the **qpod 3** up for absorbance measurements, insert the collimating lenses on any two opposite sides of the **qpod 3**. Put black plastic blanks from the **qpod 3** accessory kit in the other two optical ports. One lens collimates the output from the source fiber into a beam about 5 mm in diameter. The beam passes through the sample and is then focused on the collection fiber. A collimating lens assembly contains a single 6 mm diameter, 18 mm focal length, broadband AR- coated, fused silica lens whose principal point is located 18 mm from the end of the fiber.

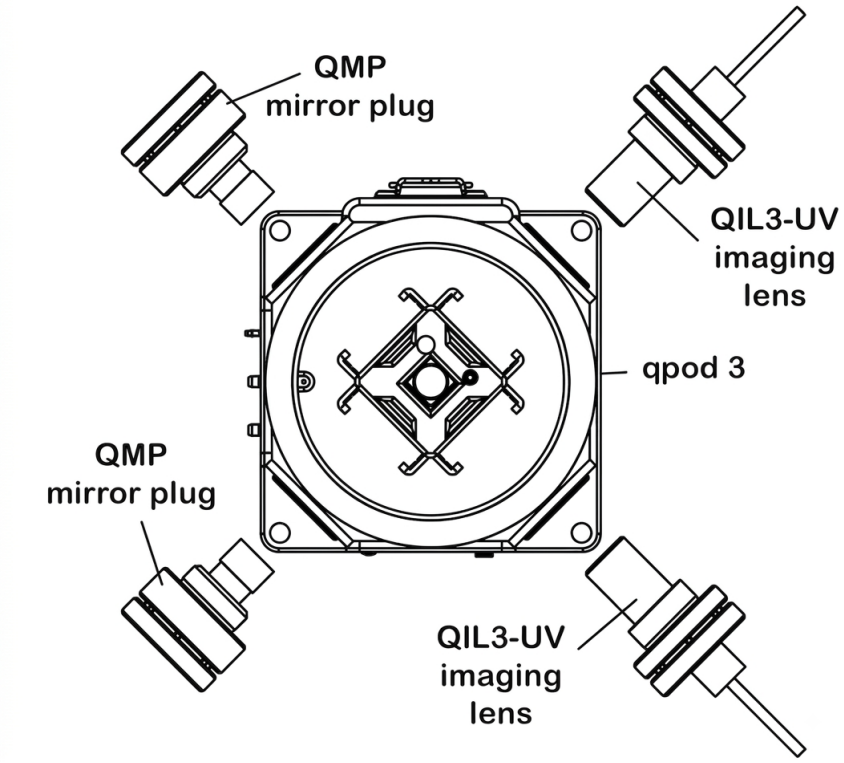


Figure 3. Fluorescence configuration

As shown in Fig. 3, to set the **qpod 3** up for fluorescence measurements insert an imaging lens to focus light from a source fiber into the center of the sample cuvette. Place another imaging lens at 90° to the source lens images the illuminated volume onto a collection fiber. To enhance collection efficiency, spherical mirrors may be placed on the remaining positions of the **qpod 3**. One opposite the excitation fiber focuses the excitation source back through the sample and another opposite the collection lens focuses extra emitted light back through the sample to roughly double the amount of emitted light collected.

An imaging lens assembly contains two ½-inch diameter, 30 mm focal length, broadband AR- coated fused silica lenses. The principal point of one lens is located 30 mm from the fiber, and the principal point of the second lens is located 30 mm from the center of the cuvette. Thus, the imaging lens pair creates an image of the fiber end, without magnification, in the center of the cuvette, or images the illuminated volume on a collection fiber.

Inserting a lens into the qpod 3

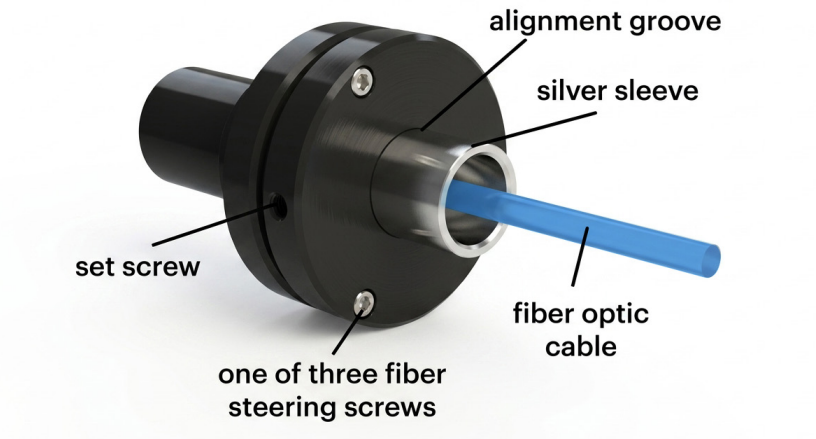


Figure 4. Components of a lens assembly

1. Use the 5/64-inch hex screwdriver from the **qpod 3** accessory kit to loosen the set screw (Fig. 4).
2. Remove the silver sleeve with a black end piece from the lens assembly. Set it aside.
3. Screw the empty optical assembly all the way into the appropriate position in the **qpod 3**.
4. Look for the location of the set screw. If it is in a difficult position to reac4 h, you may wish to remove the three fiber steering screws, rotate the end of the optical assembly until the set screw is accessible, and reattach the alignment assembly so the screw is more available. The steering screws compress an O-ring, permitting fine alignment of the end of the fiber relative to the lens.

5. Now, unscrew the silver sleeve from the black end piece revealing the SMA connector (Fig. 5).

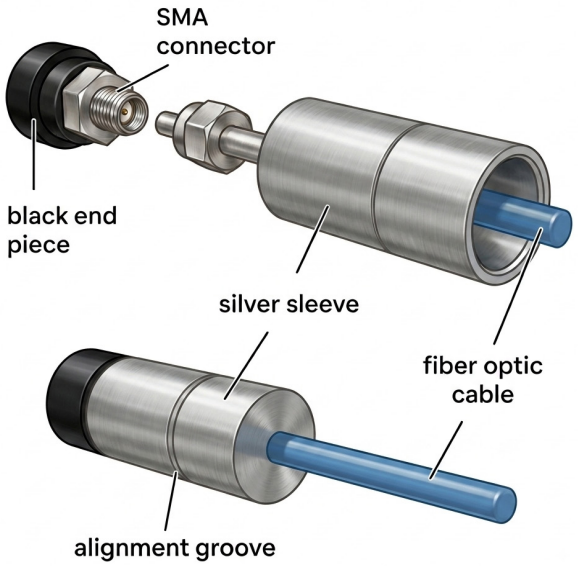


Figure 5. Attaching the fiber optic to the SMA connector

6. Slide the silver sleeve over the end of the fiber optic connector and cable, leaving the threaded end toward the end of the cable.
7. Attach the fiber optic cable to the SMA connector.
8. Holding the black end piece, screw the silver sleeve back into place.
9. Insert the SMA connector and silver sleeve into the hole in the optical assembly. For a first adjustment, insert the assembly until the alignment groove is even with the face of the lens assembly. Later, you can optimize the signal intensity by sliding the SMA connector and silver sleeve deeper. The alignment grove assumes visible light. For measurements in the UV, the silver sleeve should be inserted further. The calculated position of the alignment groove also assumes that the qpod will contain a standard 10 x 10 mm cuvette filled with water. Other cuvettes and samples may require minor adjustments to maximize throughput.

3.2 Operating the qpod 3

System Operation

1. Use a liquid sample of at least 1.5 ml and place it in a standard 1 x 1-cm square cuvette. Place the cuvette in the cuvette holder in the center of the **qpod 3**. Standard microcuvettes may also be used for smaller volumes. The **qpod 3** is designed to hold microcuvettes in which the "z" dimension (distance between the bottom of the cuvette and the optical center line) is 15 mm.

Note: The **qpod 3** is intended to hold a cuvette with a standard wall thickness of 1.25 mm and total width of 12.5 mm. Cuvettes with unusually thick walls will not properly fit and may damage the holder.

2. Place the magnetic stir bar in the cuvette. Stirring speed can be set by the **Q-Blue** program.
3. If you wish to monitor the temperature inside the cuvette, plug in our Probe/10k-qX thermistor probe into the 1/8 inch "PROBE" jack located on the **qpod 3** front panel. Run the probe through the **qpod 3** cap or underneath the lid and place it in the cuvette out of the way of the light.

4. Provide a source of light and a detector.

5. Use the 5/64-inch hex driver from the accessory kit to maximize the signal by adjustments of the three fiber steering screws (Figure 3). This adjustment will make small movements of the position of the fiber end relative to the lens. Also, loosen the set screw to insert the silver sleeve deeper into the lens assembly. Inserting the silver sleeve further into lens assembly moves the end of the fiber closer to the lens, altering the focus of the light. This adjustment is most important at UV wavelengths. Measurements can be made without these alignments. However, in the unaligned system the reference spectrum may change with temperature and must be re- measured each time the set temperature is changed. Careful alignment will minimize such artifacts.

6. Use the optical slits or blanks (provided in the **qpod 3** accessory kit) around the cuvette in a manner that correctly limits the excitation and emission light. Then put the cover and cap on the **qpod 3**.

7. While the **qpod 3** is air-cooled, it is highly recommended to use water cooling when controlling temperature below 0 degrees Celsius. Turn on the submersible pump by plugging it in. Cooling water flows through a heat exchanger and removes heat from the thermoelectric device when the temperature of the holder is lowered. Insufficient flow will allow the heat exchanger temperature to rise. If the temperature of the heat exchanger exceeds a certain cutoff value, temperature control will be automatically shut down to protect the holder. Cooler circulating water can result in improved performance of the cuvette holder at low temperatures, whereas warmer water can improve performance at very high temperatures. Do not use warm or room temperature water when setting temperatures near room temperature, as temperature instabilities are likely to arise. Cool the circulating water by adding ice to the bucket.

8. A refrigerated circulating bath may be used to provide circulating fluid to the **qpod 3.** Using such a bath, temperatures well below the specified -30 °C lowest temperature may be readily achieved. Contact us for suggestions on how to achieve very low temperatures.

9. Plug power from the AC adapter into the **qpod 3** front panel.

10. Connect the **qpod 3** to your computer using the USB cable.

11. Run program Q-Blue. When you start the program, it will automatically search for and connect to the instrument. Basic functions of the program may be controlled through the status panel at the left of the application window. For a complete description of the program see the Help [click the Help>(Q-Blue Help) menu item].

12. Set the desired target temperature and turn on the temperature controller by checking the box under Sample Holder - Control Status.

13. After measurements are completed, turn off power to the **qpod** by unplugging the power cord and turn off the water source.

3.3 Computer Control of the qpod 3

The **qpod 3** responds to the same text commands as the other temperature controllers from Ocean Optics, although obviously some related to sample changing or reference controllers are not functional. This is the complete software specification.

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

Sample Holder ID Number

[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 8.0] The controller is operating software version number 8.0.

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 ºC.
[F1 CT +3]	Automatically report current temperature every 3 seconds.
[F1 CT -]	Stop periodic current temperature reports.

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]	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 ºC (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 (ºC/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.

4. Q-Blue Program Commands

In addition to the controller commands, Q-Blue provides the following functionality.

1. Enables generation of a temperature ramp at a user specified rate.
2. Maintains records of temperature as a function of time for the sample holder and for the thermistor probe (and also for the reference holder for the dual controller). The time interval between time/temperature entries is determined by the user.
3. Saves the time/temperature records to tab-delimited text files or copies the records to the Windows clipboard.
4. Displays a plot of the time/temperature records singly or together (an example can be found in Appendix 3). The plots can be copied to the Windows clipboard.
5. Has a setting that will notify the user that the holder temperature has been stable for a user specified time. This is useful because the sample temperature always lags behind the holder temperature. This capability is available only if the computer has a speaker.
6. Allows the user to send individual commands or short series of commands to the controller.
7. Permits the user to monitor all communications to and from the controller.
8. Enables the user to send a long series of commands by loading a text file (known as a controller script) that can be easily generated in a text editor such as Windows Notepad.
9. Provides several program specific script commands to help manage execution of the script. For example:
    - A command to delay a specified time before executing the next script command.
    - Various commands to wait for specified conditions such as holder temperature stability or the completion of a temperature ramp. Once the condition is satisfied, script execution proceeds to the next command.

The following list includes all of the program specific script commands for Q-Blue.

Delay and Wait commands

[*D #] - Delay # INTERVALS before running the next command. Example: [*D 120] will cause a delay of 120 of the INTERVAL units as defined in the first line of the script (see the example script in Appendix 3 where the second line sets INTERVAL to 0.6 seconds or 0.01 minutes).

[*WRP>=#] - Wait until the ramp parameter exceeds or equals a particular value (# as an integer).
[*WRP<=#] - Wait until the ramp parameter decreases to or below a particular value (# as an integer).

[*WCT>=#] - Wait until the current (holder) temperature exceeds or equals a particular value (# as an integer).
[*WCT<=#] - Wait until the current temperature decreases to or below a particular value (# as an integer).
The current temperature is the temperature of the metal body of the sample cuvette holder.

[*WPT>=#] - Wait until the probe temperature exceeds or equals a particular value (# as an integer).
[*WPT<=#] - Wait until the probe temperature decreases to or below a particular value (# as an integer).
The probe temperature is the reading of the standard 400 series or 500 series probe plugged into the temperature controller. Typically, the probe is used to monitor the temperature of the sample in the cuvette.

[*WRT>=#] - Wait until the reference temperature exceeds or equals a particular value (# as an integer).
[*WRT<=#] - Wait until the reference temperature decreases to or below a particular value (# as an integer).
The reference temperature is the temperature of the metal body of the reference cuvette holder (dual controller only).

[*WT #] - This program command will cause the script to Wait until the Temperature is stable before continuing to the next script command in the list. Temperature stability is determined by an algorithm built into the controller. The parameter (#) determines how often the program sends a status query to the controller ([F1 IS ?], see Appendix 1 under Instrument Status). Each time this query is received, the controller returns a status message which includes information as to whether the temperature is still changing or has met the criteria for being stable (controlled). The time between status queries is the product of the parameter (#) and the script INTERVAL as defined in the first line of the script (see the example script in Appendix 3 where the second line sets INTERVAL to 0.6 seconds or 0.01 minutes).

[*WD #] - This program command will cause the script to Wait for an external Data Acquisition Program (DAP) to set a RESUME flag. The parameter (#) determines how often the program checks to see if the RESUME flag has been set (the time interval is the product of # and the script INTERVAL as defined in the first line of the script – see Appendix 3). The flag is the first letter contained in a specific text file (C:_SC.DAP). When the *WD command starts, the program opens or creates the file and replaces its contents with the word ACQUIRE. It is assumed that the DAP, provided by the user or by the instrument manufacturer, is running and periodically checking the file contents. When the DAP finds the flag set to ACQUIRE, it must do any data acquisition required then replace the contents of the same file with the word RESUME (actually, any word beginning with a capital R) and close the file. This latter action will then trigger the *WD command to end and the program will continue with the next command in the script.

Beep Control commands

[*BCT +] or [*BCT-] - Turn on(+) or off(-) beeping by the computer whenever a sample holder (current) temperature report is received from the controller.

[*BPT +] or [*BPT-] - Turn on(+) or off(-) beeping by the computer whenever a probe temperature report is received from the controller.

[*BRT +] or [*BRT-] - Turn on(+) or off(-) beeping by the computer whenever a reference holder temperature report is received from the controller.

Warning Control commands

[*E+] or [*E-] - When a script is running, attempting to use certain of the buttons or other controls in the main window will cause the appearance of a dialog box asking if you are sure you want to send the associated command (thus changing the series of actions defined by the script). The appearance of this dialog can be avoided at any point in the script by including the program command [*E-]. Alternatively, the appearance of the warning dialog can be reinstated by including [*E+] at any point in the script.

Listing Control commands

[*LIS +] or [*LIS -] - Enable (+) or Disable (-) listing of Instrument Status replies during running of a script.

[*LER +] or [*LER -] - Enable (+) or Disable (-) listing of Error Message replies during running of a script.

[*LCT +] or [*LCT -] - Enable (+) or Disable (-) listing of Current Temperature replies during running of a script.

[*LPT +] or [*LPT -] - Enable (+) or Disable (-) listing of Probe Temperature replies during running of a script.

[*LRT +] or [*LRT -] - Enable (+) or Disable (-) listing of Reference Temperature replies during running of a script.

These ten program commands can be used to control whether the indicated information, sent from the Serial Controller to the program, are to be listed (displayed) in a script monitoring window while the script is running. Disabling the listings may be useful to make progress of the script clearer since, under some conditions, large numbers of Instrument Status replies and Temperature replies may be generated while the script is running. Disabling affects only the listing of these various replies in the script monitoring window during the running of a script – the temperatures will be included in the time/temperature records.

Miscellaneous commands

[*R] - This program command is used only at the end of a script. It will cause the script to be repeated, starting at the beginning.

[*P] - If the plot window is displayed while a script is running, the data in the plot will not be automatically updated unless a delay (*D) or wait (*W) command is being processed. This program command will cause the plot window to update (replot to show all data collected to that time).

[*CTD] - This command will clear the time/temperature records. In addition, the time will be restarted at zero and a new record of time/temperature will be started.

[*MSG + message] or [*MSG - message] - This command will stop execution of the script and present a dialog box containing the second command parameter (“message”). Change this parameter to the wording you want the dialog box to display. The first parameter (+ or -) determines whether the computer beeps (+) or not (-) while the dialog box is visible. When the user clicks the “OK” button the dialog box closes and execution of the script continues.

5. Maintenance and Spare Parts

5.1 Maintenance

The **qpod 3** requires very little routine maintenance on the part of the user. For routine cleaning of exposed surfaces, use only a cloth dampened with water or diluted detergent. Do not use organic or abrasive solvents.

CAUTION



Caution – Any action which makes it necessary to open the t2 Sport or **TC 1** Temperature Controller units must be executed only by technicians or authorized personnel.

The water hoses and their attachments to the **qpod 3**, and submersible pump should be inspected prior to each usage to ensure that they are intact. Replace the nylon tubing when it becomes discolored or cracked. Periodically replace the water stored in the bucket to minimize the growth of microorganisms. When not in use, the pump, bucket, and tubing may be stored dry.

Appendix

A.1 Example Script

The following is an example of a script file. Scripts may be used to automate complex functions such as the three-old ramping illustrated here. Any text that is not enclosed by square brackets ([ ]) is completely ignored by the script processor, permitting the extensive commenting. When this script was executed by the Serial Control program (described in Appendix 2) the time/temperature data in the plot that follows the script listing was obtained.

Controller Script Interval = .6
Set the time interval between commands to .6 seconds.

Initial Setup:

[*E-]	Prevent appearance of a warning dialog that may block script execution if a main window button or control is used.
[F1 PX +]	Display probe temperature to 0.01 °C precision.
[F1 TT S 10.00]	Set Target Temperature to 10 °C.
[F1 TC +]	Turn on Temperature Control.
[F1 CT +30]	Report current cuvette holder temperature periodically.
[F1 PT +30]	Report probe temperature periodically.
[*LTT -]	Do not list target temperature returns in script window.
[*LCT -]	Do not list current temperature returns in script window.
[*LPT -]	Do not list probe temperature returns in script window.

[*MSG - This script requires pre-equilibration to 10 °C. Click OK when satisfactory equilibration has been achieved]

Waits for the user to respond

[*CTD]	Clear time/temperature displays and reset time to zero
[*D=500]	Collect temperatures for 5 minutes.

First Ramp to 40 at 4 °C/min:

[F1 RT S 40]	Set Ramping Temperature Interval to 0.40 °C.
[F1 RS S 6]	Set Ramping Time Interval to 6 seconds. Ramping rate will be 4 °C/min (0.4 °C/ 0.1 min).
[F1 PT -]	Stop reporting probe temperature periodically.
[F1 PA +]	Turn on Automatic Probe temperature report
[F1 PA S 2.0]	Set Automatic Probe temperature report to every 2.0 °C.
[*BPT +]	Turn on the option for computer to beep each time a probe temperature report is received.

[F1 TT S 40.00]	Set Target Temperature to 40 °C, to start ramping process.
[*WRP>=40]	Wait until the ramp parameter reaches 40 °C.

Second Ramp to 45 at 0.2 °C/min:

[F1 RT S 4]	Set Ramping Temperature Interval to .04 °C.
[F1 RS S 12]	Set Ramping Time Interval to 12 seconds. Ramping rate will be 0.2 °C/min (0.04 °C/ 0.2 min).
[F1 PA S 0.5]	Set Automatic Probe temperature report to every 0.5 °C.
[F1 TT S 45.00]	Set Target Temperature to 45 °C to start ramping process.
[*WRP>=45]	Wait until the ramp parameter reaches 45 °C.
[*D 200]	Wait 2 minutes for probe temperature to catch up.

Third Ramp to 80:

[F1 RT S 40]	Set Ramping Temperature Interval to .40 °C
[F1 RS S 6]	Set Ramping Time Interval to 6 seconds Ramping rate will be 4 °C/min.
[F1 PA S 2.0]	Set Automatic Probe temperature report to every 2.0 °C.
[F1 TT S 80.00]	Set Target Temperature to 80 °C to start ramping process.
[*WRP>=80]	Wait until the ramp parameter reaches 80 °C.
[*D 300]	Wait 3 minutes to allow the probe temperature to catch up
[F1 PA -]	Stop automatic probe temperature reporting
[F1 PT +30]	Start periodic probe temperature reporting (current temperature reporting is already running)
[*BPT -]	Turn off the computer beep each time a probe temperature report is received.
[*D 800]	Wait 8 min to allow temperatures to stabilize.

Ramp back to 20:

[F1 RT S 25]	Set Ramping Temperature Interval to .25 °C.
[F1 RS S 6]	Set Ramping Time Interval to 6 seconds. Ramping rate will be 2.5 °C per minute.
[F1 PT -]	Stop periodic probe temperature reporting.
[F1 PA +]	Turn on Automatic Probe temperature report.
[F1 PA S 5.0]	Set Automatic Probe report to every 5.0 °C.
[F1 TT S 20.00]	Set Target Temperature to 20 °C to start ramping process.
[*WRP<=20]	Wait until the ramp parameter reaches 20 °C.
[*D 300]	Hold 3 minutes to allow the probe temperature to catch up.

Clean up:

[F1 RT S 0]	Stop ramping. (If this is not done, the next target temperature
[F1 RS S 0]	that is set will generate a ramp using the previous settings.)
[F1 PA -]	Stop automatic probe temperature reporting.
[F1 PT +30]	Start periodic probe temperature reporting. (Current temperature reporting is already running.)
[*D 700]	Wait another 7 minutes for final equilibration.
[F1 PT -]	Stop periodic probe temperature reporting.
[F1 CT -]	Stop periodic sample holder temperature reporting.
[*E+]	Enable appearance of a warning dialog if a main window button or control is used while a script is running.
[F1 PX -]	Reset display of probe temperature to 0.1 °C precision.
[*MSG +	The multiramp script run is complete] Notify user, with beeping.

A.2 Temperature Ramping

The script sets a target temperature of 10 degrees and then turns temperature control on and waits until the user is satisfied with the state of equilibration. During this time the probe temperature is reported every 30 seconds (the sample holder temperature is reported every 30 seconds throughout the run). The script then initiates the first ramp from 10 to 40 degrees at 4 degrees/min with the computer beeping each time a probe temperature is reported at 2 degree intervals. The second ramp from 40 to 45 degrees is slower (0.2 degrees/min), with the computer beeping every 0.5 degrees (to provide more information over a critical range of temperatures). The third ramp takes the temperature quickly to 80 degrees, again with beeping at 2 degree intervals. At this point beeping is stopped and an 8 minute delay of script execution allows time for equilibration at 80 degrees; the probe temperature is reported every 30 seconds. The final ramp is down to 20 degrees at 2.5 degrees/min with probe temperature reports every 5 degrees. This is followed by a 7 minute delay for equilibration with automatic probe temperature reports every 30 seconds. Figure 1 shows a typical example of the sample holder and probe temperatures as a function of time.

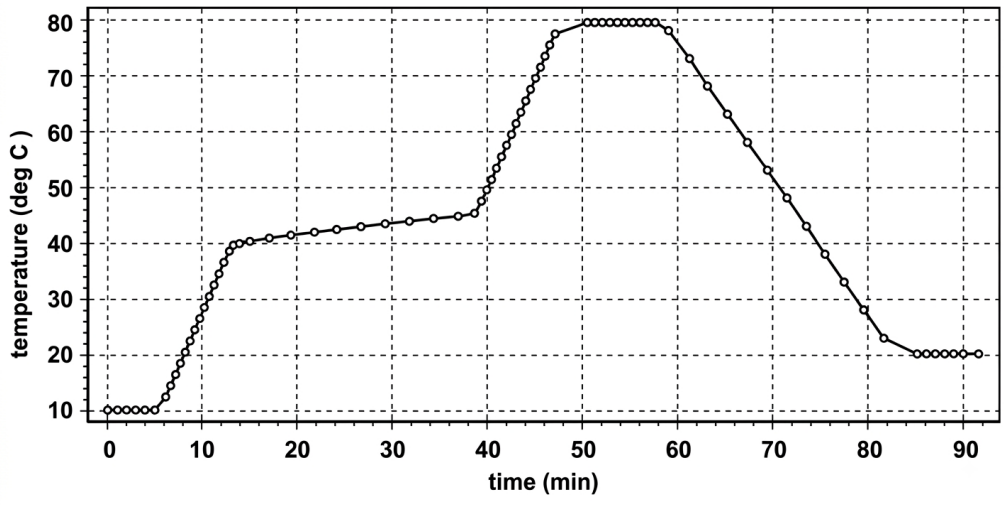


Figure 6. Actual data obtained by running the example script in the Serial Control Program (V2.3). The sample holder temperatures are plotted as a solid line without tokens; the probe temperatures are shown as filled circles connected by a line.

This multi-ramp script would be useful if a researcher were monitoring fluorescence intensity or absorbance of a sample showing a sharp melting transition near 42 °C. By recording the time and signal amplitude each time the probe temperature was reported (each time the computer beeped, between 5 min and 50 min in Figure 1) and correlating those time/amplitude pairs with the time/temperature pairs reported by the Serial Control program, a plot of signal amplitude vs time could be generated. The plot below is a simulation of such a result.

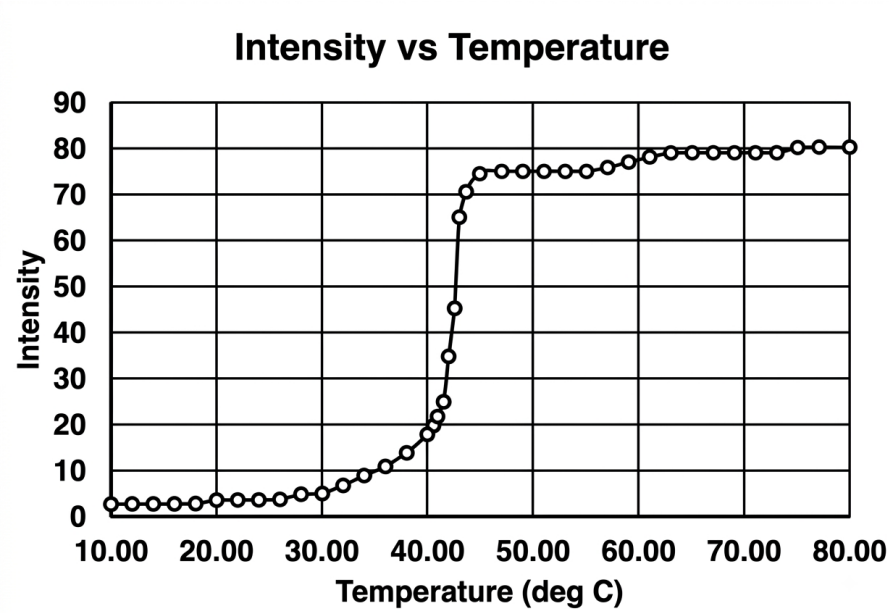


Figure 7. Simulated melting data that might be measured

Of course, it would be optimal if the sample temperature and the measured parameter could be automatically obtained simultaneously. However, that requires that temperature monitoring and parameter acquisition be done by the same program. Lacking that, then one would like to be able to acquire temperature and parameter data at the same time interval with both acquisition processes started at as close to the same time as possible.

An example of this latter procedure is given in Figure 3 which shows experimental data obtained for the melting transition of the synthetic alternating copolymer of deoxyadenosine and deoxythymidine, poly(dA-dT) using a simple temperature ramp script. The absorbance data were obtained using a fiber-optic spectrometer, light source and software in combination with a **qpod 3®** fiber-optic sample holder and the Serial Control program. The temperature ramp and absorbance data collections were started “simultaneously” using a timing interval of 0.1 minute.

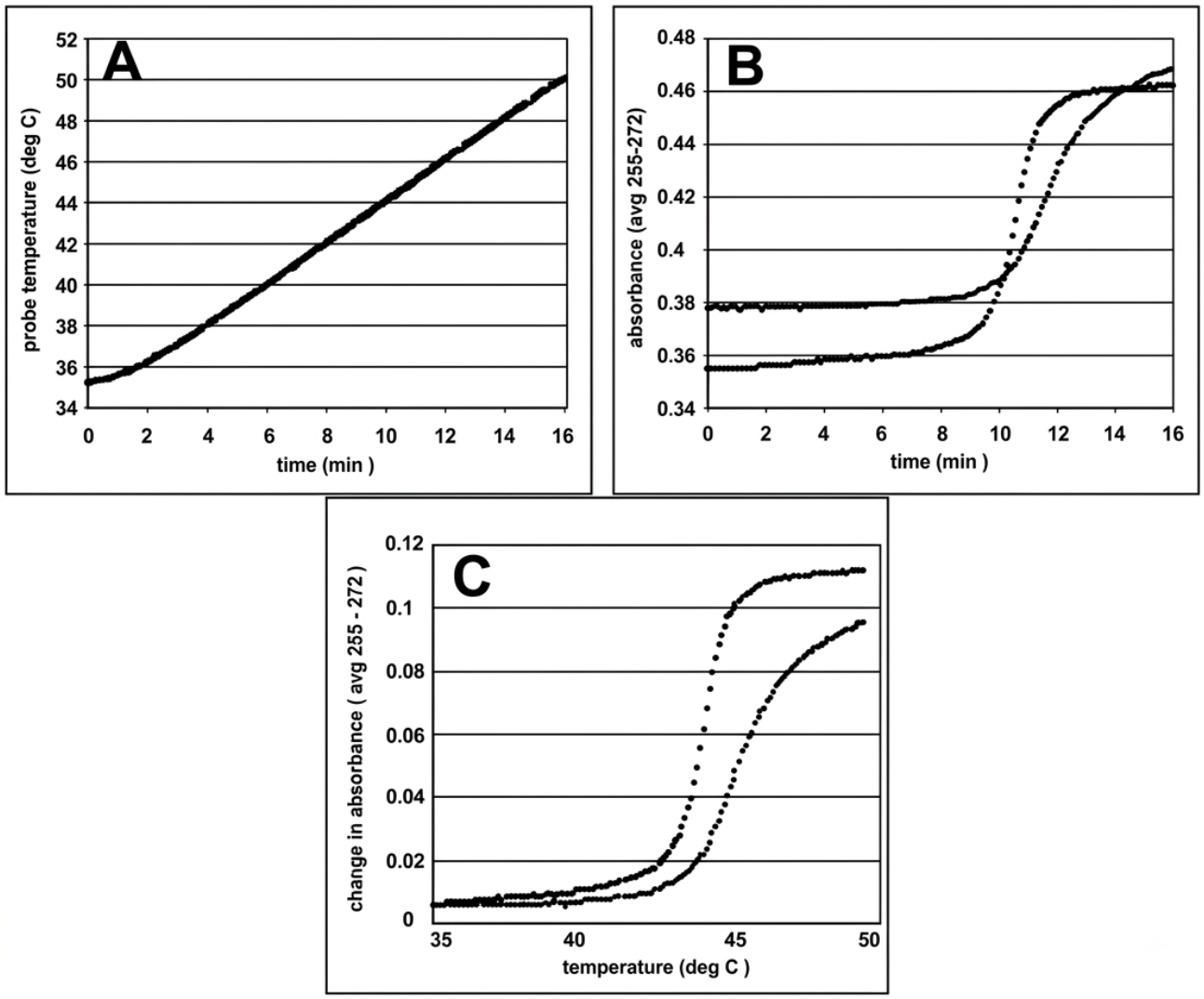


Figure 8. Experimental data obtained for the melting transition of the synthetic alternating copolymer of deoxyadenosine and deoxythymidine, poly(dA-dT) using a linear temperature ramp. Data are shown for the copolymer alone (black) and for the copolymer in the presence of ethidium (gray). Panel A shows the temperature as a function of time. Panel B shows the average absorbance as a function of time. Panel C combines the data in A and B to show the change in the average absorbance as a function of temperature.

Questions?

Chat with us at www.oceanoptics.com.
info@oceanoptics.com

US +1 727-733-2447
EUROPE +31 26-319-0500
ASIA +86 400-623-2690

We Measure What Matters.

We empower scientists, engineers, and innovators with precise, reliable optical sensing solutions that drive discovery and improve lives.