Introducing the Quantum Northwest qCHANGER 6/Shimadzu

Figure 1. The Quantum Northwest qCHANGER 6™/Shimadzu

The Quantum Northwest qCHANGER 6 is a Peltier-controlled, 6-position linear cuvette changer for use in UV/Vis Spectrophotometers. It has a useful temperature range of at least -15 °C to +105 °C with a precision of ±0.01 °C.

The qCHANGER 6 has magnetic stirring with speeds, identical in each cuvette, that may be precisely set from 200 to 2000 rpm, thus maintaining uniform temperature within the cuvettes. It accepts cuvettes that use a standard z-height of 15 mm. A dry gas purge system directs dry gas to the surfaces of the cuvettes to minimize condensation when working below the dew point temperature.

Each qCHANGER 6 includes a matched and calibrated TC 1 Temperature Controller. The TC 1 controller has a probe input that accepts a Series 400 or Series 500 thermistor probe for independent measurement of the sample temperature.

Versions of the qCHANGER 6 are available for mounting in a variety of different spectrophotometers, and can usually be adapted to others as needed. Quantum Northwest offers a version for Shimadzu UV/Vis spectrophotometers called the qCHANGER 6/Shimadzu, shown in Figure 1.

Quantum Northwest's development of the qCHANGER 6/Shimadzu focused on use of the Shimadzu UV-1800. Testing was done using the setup shown in Figure 2. Figure 3 shoes the qCHANGER 6/Shimadzu mounted in the sample compartment of the UV-1800.

Computer control of the qCHANGER 6 is usually done with a Quantum Northwest program called T-App. For Shimadzu applications, Quantum Northwest's Dr. Louis Libertini has developed a new version of the program called T-App(S). T-App(S) expands the functionality of the qCHANGER 6 in the Shimadzu UV-1800. In addition to controlling sample temperature and cuvette position, T-App(S) acquires sample absorbance (or %T) from the Shimadzu instrument. Kinetics, melting, annealing, stability, and other experiments are now possible through T-App(S) control.

Figure 2. Testing the qCHANGER 6 with a Shimadzu UV-1800

Figure 3. qCHANGER 6 mounted in the Shimadzu UV-1800

To demonstrate the effectiveness of using T-App(S) with the qCHANGER 6/Shimadzu UV-1800 setup, calf thymus DNA at five ionic strengths was melted. The experimental details are provided in the Appendix.

Results as plotted in the **UV-1800** window are shown for five ionic strengths with green the lowest, progressing to gray the highest. A 6th sample, lacking DNA was also measured but is not shown (it was a straight line at 0 absorbance).

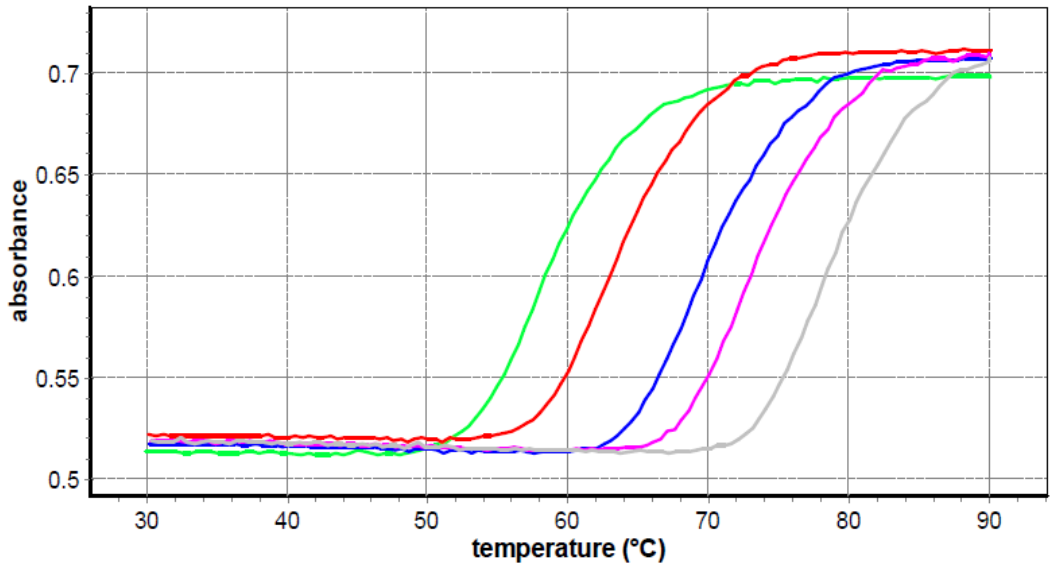

Figure 4. Melting of calf thymus DNA at 5 different ionic strengths

As seen in Figure 4, the qCHANGER 6 was successfully used to simultaneously record the temperature response of six different samples. T-App(S) works to integrate the functionality of the Shimadzu UV-1800 and the Quantum Northwest sample holder.

Appendix – Description of experiment

A DNA stock solution was prepared by allowing calf thymus DNA to dissolve overnight in 1.5 mM sodium citrate, 15 mm sodium chloride in the refrigerator.

Five samples were prepared directly in cuvettes containing 1.5 mM sodium citrate and sodium chloride at five concentrations such that, once the DNA stock was added (see below), the final sodium chloride concentrations were 0.7, 5.0, 15, 30 and 50 mM. The cuvettes were placed under vacuum for about 30 minutes to reduce dissolved air (which avoids bubble formation as the temperature is increased). The capped cuvettes were placed in a Quantum Northwest qCHANGER 6 sample holder in positions 2, 3, 4, 5, and 6 in order of increasing salt concentration. The cuvettes in position 1 and in the reference beam contained 1.5 mM sodium citrate and 15 mM sodium chloride.

T-App(S) was started and the appropriate script was run. When a small dialog box displaying the message "Add DNA" was presented, stock DNA was added (to give a final absorbance at 260 nm of near 0.5). When that dialog was closed the script continued to run without user interaction until a second dialog displaying the message "The script is complete" was presented, this time with the computer beeping once per second.

An excerpt of the script used is shown below.

*14 **[*MSG - Add DNA]** causes the appearance of a small dialog box containing the message "Add DNA". The script will not continue unless the user clicks the OK button in the dialog. The minus sign indicates that the computer should not beep at 1 second intervals while the dialog is shown.*
*15 **[*D 500]** see 8.*
*16 **[F1 CT -]** directs the temperature controller to stop automatic sending of sample holder*
*17 **[F1 RR S 1.0]** sets the ramp rate parameter to 1 ^{o}C/min.*
*18 **[F1 TT S 90]** sets the ramp target (final) temperature to 90 ^{o}C. The controller starts the ramp at this time.*
*19 **[*CTD]** see 2.*
*20 **[*SS +]** see 5 (the command is included here just in case the user unchecked the Sample Holder checkbox in the Spectrometer window).*
*21 **[*LS 125]** causes the script commands from here to a corresponding [*LE] command to be repeated (looped) 125 times [this number was determined empirically by timing one loop and dividing 60 minutes (the duration of the ramp) by the resulting time interval.*