LabPro Quick Start Guide

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Loading the DataMate Program Into Your Calculator

Follow the instructions given for loading the DataMate program on your calculator if you have not already done so. DataMate needs to be loaded only once at the beginning of the quarter.

Transferring the DataMate Program to a Calculator

The DataMate program is stored on the LabPro or CBL 2 interface. Use the following procedure to transfer it to your calculator.

1. Free up space in your calculator by resetting the memory. Note: This will delete all data and programs in your calculator. It is not always necessary, but is recommended. If the screen becomes faint or blank after resetting the memory, you may need to increase the contrast.

2. Slide the cradle onto the interface from the bottom. You should hear it click into place.

3. Place the top of the calculator into the top of the cradle then snap the calculator's body into the cradle. Note: The TI-92, TI-92 Plus, and Voyage 200 will not fit in the cradle.

4. Plug the short black link cable into the link port on the bottom of the TI graphing calculator and the interface.

5. Prepare the calculator to receive DataMate.

   TI-73, TI-83, TI-83 Plus, and TI-84 Plus
   Turn on your calculator and press [2nd] [LINK] (on the TI-73, press [APPS], then select 1:Link). Press [▶] to select RECEIVE, then press [ENTER].

   TI-86
   Turn on your calculator and press [2nd] [LINK]. Select <RECV>.

   TI-89, TI-92, TI-92 Plus and Voyage 200
   Turn on your calculator and go to the home screen.

6. Press the TRANSFER button on the interface. "Receiving…", followed by a list of the loaded programs (or application), is displayed on the calculator.

The "Done" message on the calculator and two beeps from LabPro indicates the transfer is complete. Press (2nd) [QUIT].

7. Verify that DataMate has been successfully loaded.

TI-73[1], TI-83, and TI-86
Press (PRGM) to see DATAMATE and its sub-programs. **Important:** Do not delete any of these subprograms. They are all necessary for DATAMATE to function.

TI-83 Plus and TI-84 Plus
Press (APPS) to see DATAMATE.

TI-89, TI-92, TI-92 Plus and Voyage 200
Press (2nd) VAR-LINK to see DATAMATE and its sub-programs. **Important:** Do not delete any of these subprograms. They are all necessary for DATAMATE to function.

Using the DataMate Program

Using the DataMate Program

The DataMate data-collection program for the TI graphing calculators is used to collect, examine, analyze, and graph data in the *Advanced Chemistry with Vernier* experiments. DataMate is a group of programs that runs collectively as a single program or application. The TI-83 Plus shows DATAMATE as a single application (or APP). The other calculators list all of the sub-programs, but you will always choose the main program, DATAMATE. DataMate will automatically access the other sub-programs as needed.

Use the link cable to connect the LabPro or CBL 2 to the TI graphing calculator. Firmly press in the cable ends. Turn on the calculator. Follow these steps to start the DataMate program on your calculator:

TI-73[1] or TI-83 Calculators

Press (PRGM), then press the calculator key for the *number* that precedes DATAMATE (usually (1)). Press (ENTER) and wait for the main screen to load.

TI-83 Plus or TI-84 Plus Calculators

Press (APPS), then press the calculator key for the *number* that precedes the DATAMATE program. Wait for the main screen to load.

TI-86 Calculators

Press (PRGM), press (F1) to select <NAMES>, and press the menu key that represents DataMate. (<DATAM> is usually (F1)). Press (ENTER), and wait for the main screen to load.

TI-89, TI-92, TI-92 Plus and Voyage 200

Press (2nd) [VAR-LINK]. Use the cursor pad to scroll down to "datamate", then press (ENTER). Press ( )) to complete the open parenthesis that follows "datamate" on the entry line and press (ENTER). Wait for the main screen to load.

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[1] Until recently, DataMate for the TI-73 has always been a program. When DataMate is released as a TI-73 application in early 2004, the instructions for the TI-83 Plus will apply.

Main Screen

The main screen of DataMate is shown at the right. The top half of the screen shows the current sensor setup and data collection mode. The bottom half displays the menu options.

```
CH 1:TEMP(C)      21.82


MODE:TIME GRAPH-100
1:SETUP      4:ANALYZE
2:START      5:TOOLS
3:GRAPH      6:QUIT
```

LabPro and CBL 2 will automatically identify auto-ID sensors, display the channel each is connected to, and display the current reading. Only active channels will be displayed. The screen will update as auto-ID sensors are added and removed from the interface. Some sensors will not have auto-ID and need to be manually set up.

The main screen supports a "meter mode" displaying readings for active probes every few seconds. The meter option can be toggled on and off by pressing ⟨ + ⟩ on the calculator. The advantage of turning off the meter is to conserve battery power.

SETUP

If you want to change the current setup, choose SETUP from the main screen. From here you can change sensors, change the data-collection mode, load or save an experiment,[2] and calibrate or zero a sensor.

```
► CH 1:STAINLESS TEMP(C)
  CH 2:
  CH 3:
  CH 4:
  DIG1:
  DIG2:
  MODE:TIME GRAPH-100
1:OK          3:ZERO
2:CALIBRATE 4:SAVE/LOAD
```

Sensors

To change a sensor or add a sensor that is not auto-ID, use the ⟨ ▼ ⟩ key to position the cursor opposite the desired channel. Press ⟨ENTER⟩ and a list of sensors will be displayed.

Select the appropriate sensor or choose MORE to see the next list of sensors.

```
     SELECT SENSOR
1:TEMPERATURE
2:PH
3:CONDUCTIVITY
4:PRESSURE
5:FORCE
6:HEART RATE
7:MORE
8:RETURN TO SETUP SCREEN
```

Data-Collection Modes

To change modes, move the cursor to MODE and press ⟨ENTER⟩. This brings up the SELECT MODE screen at the right.

```
      SELECT MODE
1:LOG DATA
2:TIME GRAPH
3:EVENTS WITH ENTRY
4:SINGLE POINT
5:SELECTED EVENTS
6:RETURN TO SETUP SCREEN
```

TIME GRAPH is the default data-collection mode. The sensor you are using will set its own sample interval and length of run. For example, if you select a Temperature Probe, DataMate will automatically set the interface to collect one sample per second for 180 seconds.[3] These settings can be changed by choosing CHANGE TIME SETTINGS from the TIME GRAPH SETTINGS screen.

```
   TIME GRAPH SETTINGS
TIME INTERVAL:    1

NUMBER OF SAMPLES: 100

EXPERIMENT LENGTH: 100
1:OK          3:ADVANCED
2:CHANGE TIME SETTINGS
```

A TIME GRAPH will be displayed live unless you are sampling at a rate faster than 10 samples per second or slower than one sample every 270 seconds. If you are using multiple sensors and they are identical, all of the data will be displayed live on one graph. If they are not identical, only one channel can be displayed live.

LOG DATA - Data can be collected using the interface without being attached to the calculator using the LOG DATA mode. DataMate can then retrieve the data from the interface.

EVENTS WITH ENTRY - Data are collected one point at a time and only when the ⟨ENTER⟩ button on the calculator is pressed. The calculator will then prompt you to enter the corresponding value, such as volume, concentration, or trial. This mode is used for titrations, Boyle's law, etc.

[2] This feature is not available on the TI-73, and TI-83 due to memory constraints.
[3] These settings may be different on the TI-73.

SINGLE POINT - One averaged data point is displayed. The interface will collect data for 10 seconds and report a single, averaged value on the calculator screen.

SELECTED EVENTS - Data are collected one point at a time and only when the [ENTER] button on the calculator is pressed.

START

The START option begins data collection using the current mode. In this example, it is a TIME GRAPH using a Temperature Probe (°C), collecting data at one sample per second for 180 seconds. If at any time you wish to stop the data collection prematurely in a TIME GRAPH, press the [STO▶] key.
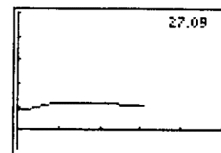
GRAPH

The GRAPH option allows you to manipulate your graph. When chosen, the graph will be redrawn. Press [ENTER] to see the screen at the right. In this example, a Temperature Probe was in Channel 1 and a pH Sensor was in Channel 2.

SELECT REGION - Allows the selection of a region of the graph for further analysis. Be aware that this will delete the portion of data that was not selected.
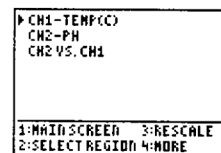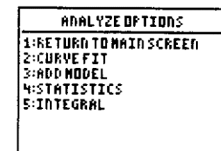
RESCALE - Allows you to change the x- or y-axis scale or autoscale your graph.

ANALYZE

The ANALYZE option produces this list of analysis features.

CURVE FIT - Displays a list of curve fit options including linear, power, quadratic, and exponential fits.

ADD MODEL - Allows manipulation of the coefficients of a function entered in Y_1 = (outside the DataMate program).[4]

STATISTICS - Displays the mean, min, max, standard deviation, and number of data points of a selected region.

INTEGRAL - Integrates a selected region of the graph.

TOOLS

The TOOLS option produces the screen at the right with these options.

STORE LATEST RUN - Temporarily stores the latest run. Only one sensor can be used and only two runs can be stored.
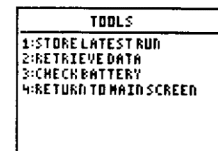
RETRIEVE DATA - Retrieves data stored on the interface from remote data collection.

CHECK BATTERY - Displays the battery power of the interface.

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[4] This feature is not available on the TI-73 due to memory constraints.

Setting-up the LabPro with Various Sensors

There are two types of sensors used in the laboratory. The older sensors have a round 5-pin DIN connector and need a DIN-BTA adapter to connect to the LabPro. Using these sensors is not a problem and requires only a couple extra steps for set-up. The newer sensors have a white BTA connector. When the DataMate program is cleared, the program automatically detects these sensors. Additional set-up may require a calibration before data collection.

Setting up a Stainless Steel Temperature Probe for Data Collection.

Temperature probe precision ± 0.1 °C

1) Plug a Temperature Probe into Channel 1 of the LabPro interface. Use the link cable to connect the interface to the TI graphing calculator.
2) **Turn on the calculator and start the DATAMATE program. Press CLEAR to reset the program.**
    a) Select SETUP from the Main screen. **If CH 1 displays TEMP(C) then set-up is complete**. If it does not, continue to set up the sensor manually.
        i) Press ENTER to select CH 1.
            (1) Select TEMPERATURE and then select the type of temperature probe that you are using. This would be option 1: DIR CONNECT TEMP(C).
        ii) Select 1:OK
    b) **The current probe temperature should appear in channel 1.**

Setting up a Colorimeter for Data Collection.

Calorimeter absorbance precision: ± 0.01 units.

1) Connect a colorimeter to Channel 1 of a LabPro interface. Use the link cable to connect your TI graphing calculator to the interface.
2) Prepare a *blank* by filling an empty cuvette ¾ full with distilled water. Seal the cuvette with a lid. To correctly use a colorimeter cuvette, remember:

    a) All cuvettes should be wiped clean and dry on the outside with a tissue.

    b) Handle cuvettes only by the top edge of the ribbed sides.

    c) All solutions should be free of bubbles.

    d) Always position the cuvette with the ribbed edges facing left-right when inserted into the colorimeter.

3) **Turn on the calculator and start the DATAMATE program. Press CLEAR to reset the program.**
    a) **CH 1: ABSORBANCE .001 should be displayed on the calculator screen.**
4) Calibrating the colorimeter.
    a) Set the wavelength on the colorimeter to the proper wavelength as indicated by the experiment by using the **arrow**

keys on the colorimeter. Calibrate by pressing the CAL button on the colorimeter and releasing when the red LED on the bottom of the calorimeter begins flashing.

    b) CH 1: ABSORBANCE .001 should be displayed on the calculator screen.

5) The colorimeter can be recalibrated with a blank at any time by simply pressing the CAL button again.

Setting up a pH Sensor for Data Collection.

pH sensor precision ± 0.01 pH units.

1) Connect a pH Sensor to Channel 1 of a LabPro interface. Use the link cable to connect the interface to the TI graphing calculator.

2) **Turn on the calculator and start the DATAMATE program. Press CLEAR to reset the program.**

    a) CH 1:PH should appear on the calculator screen.

3) The pH sensors need to be calibrated each time they are used.

    a) Obtain approximately 5 mL each of pH 4 and pH 10 buffers in two large test tubes.

    b) Remove the O-ring and storage solution cap from the pH probe. This allows the probe to fit into a large diameter test tube.

    c) Select 1:SETUP from the MAIN menu.

    d) With CH 1 selected, choose 2:CALIBRATE.

        i) From the CALIBRATION menu choose 2:CALIBRATE NOW.

        ii) **Rinse the pH electrode thoroughly with distilled water**, pat dry and immerse in the **pH 4** buffer. Slowly rotate the pH electrode back and forth while in the solution. When the voltage is stable press [Enter].

        iii) Enter **4** as the pH value.

        iv) **Rinse the pH electrode thoroughly with distilled water**, pat dry and immerse in the **pH 10** buffer. Slowly rotate the pH electrode back and forth while in the solution. When the voltage is stable press [Enter].

Note, the voltage should be lower than for point 1.

    v) Enter **10** as the pH value.

    vi) The CALIBRATION is complete and displayed on the calculator screen as a slope and y-intercept. Record these values. They should be ≈ –4 for the slope and ≈ 14 for the y-int.

    vii) Select 1:OK

    e) Select 1:OK again to return to the MAIN menu.

4) The current pH should be displayed on the calculator screen.

Setting up a Pressure Sensor and Temperature Probe for Data Collection.
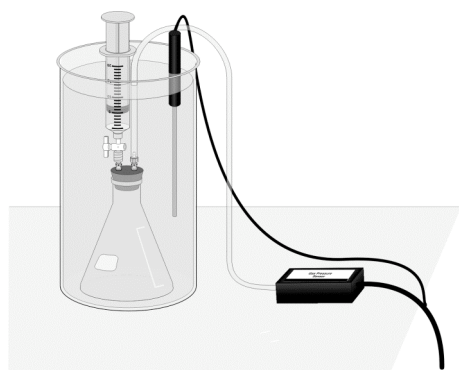
Pressure sensor precision ±10 mm Hg

1) Connect the Gas Pressure Sensor to Channel 1 and the Temperature Probe to Channel 2 of the interface.

2) **Turn on the calculator and start the DATAMATE program. Press CLEAR to reset the program.**

3) The pressure sensors are of two types, the older type with round DIN-5 connector, and the newer type auto-ID type with the BTA connector. Your set-up depends upon the sensor you have.

4) **If you are using the newer auto-ID sensor skip to step 5.**

    a) Select 1:SETUP from the MAIN menu.

        i) Select CH 1: and then press [Enter] from the SETUP menu.

        ii) Select 4:PRESSURE from the SELECT SENSOR menu.

        (1) Select 1:GAS PRESSURE SENSOR from the PRESSURE menu.

        (2) Select 2:GAS PRESSURE (MMHG) from the GAS PRESSURE SENSOR menu.

    iii) Select 2:CALIBRATE from the SETUP menu.

           (1) Select 3:MANUAL ENTRY from the CALIBRATION menu.
                (a) One the sensor should be a label with slope value. Enter it now.
                (b) Repeat with the y-int value.
           (2) Select 1:OK from the CALIBRATION menu.
        iv) Select 1:OK from the SETUP menu.
    b) The current pressure should be displayed on the calculator screen.

5) **The newer sensors display in kPa units. You need to change this to mmHg in the SETUP menu. These newer sensors do not need to be calibrated.**
    a) Select 1:SETUP from the MAIN menu.
        i) Select CH 1: and then press [Enter] from the SETUP menu.
           (1) Select 2:GAS PRESSURE (MMHG) from the GAS PRESSURE SENSOR menu.
    b) Select 1:OK from the SETUP menu.
    c) The current pressure should be displayed on the calculator screen.

6) See the section on setting up a stainless steel temperature probe to make ready the temperature probe in channel 2.

Data Collection Modes

The DataMate program allows for various modes of data collection. The most common mode is simply to monitor the sensor inputs on the calculator screen. Data can be recorded directly from the calculator screen as needed. This is often used in lab when simple pH or absorbance measurements are made.

TIME-GRAPH MODE

Another collection mode is called TIME-GRAPH and allows data to be collected and stored over at specific time interval. To set the parameters for TIME-GRAPH data collection do the following:

1) From the MAIN menu select 1:SETUP.
    a) Use the down arrow key to select MODE. Press [Enter].
        i) From the SELECT MODE menu select 2:TIME GRAPH.
           (1) Select 2:CHANGE TIME SETTINGS from the TIME GRAPH SETTINGS menu.
                (a) Enter the time between samples as instructed by the experiment.
                (b) Repeat for the number of samples.
           (2) Select 1: OK.
    b) Select 1:OK from the SETUP menu.
2) When you are ready to collect data select 2:START from the MAIN menu.
3) When the data collection is complete a graph will appear on the calculator screen.
4) You can use your arrow keys to move through the X-Y data pairs and observe their values.
5) When done press [Enter] to return to the MAIN menu.
6) After a TIME-GRAPH data collection is complete the data is stored in your calculator as lists in the following manner:
        L1: time
        L2: CH 1
        L3: CH 2 (if a sensor is connected)
        L4: CH 3 (if a sensor is connected)
        L5: CH 4 (if a sensor is connected)

If no additional data is to be taken, you can download this data to a computer through a GRAPH-LINK cable directly into GRAPHICAL ANALYSIS or LOGGER PRO software.

Doing a second data run in TIME-GRAPH. (ONE SENSOR INPUT ONLY)

A second data run can be done without downloading the previous data run to a computer **if you only need single channel (one sensor) data as a function of time**. Prior to starting a second data run do the following.

1) From the MAIN menu select 5:TOOLS.
    a) From the TOOLS menu select 1:STORE LATEST RUN. Data in L2 is copied to L3 (L3 is overwritten). L2 is now available to store data. When START is selected again from the MAIN menu CH 1 data is now stored in L2.
    b) After a second data run L1 contains time, L2 has the second run, and L3 has the first run.
    c) Remember, only the last two data runs are stored in L2, L3 and L4.

EVENTS WITH ENTRY MODE

Another collection mode is called EVENTS WITH ENTRY and allows data to be collected in a non time-based manner. Data are collected one point at a time and only when the [Enter] button on the calculator is pressed. You are then prompted to enter a corresponding value such as a titration volume. To set the parameters for EVENTS WITH ENTRY data collection do the following:

1) From the MAIN menu select 1:SETUP.
   a) Use the down arrow key to select MODE. Press [Enter].
      i) From the SELECT MODE menu select 3: EVENTS WITH ENTRY.
      ii) Select 1: OK.
2) When you are ready to collect data select 2:START from the MAIN menu.
3) Follow the onscreen instructions to store the first reading.
   a) After the first reading is stored you must enter a corresponding value.
   b) The calculator will show the current count of events.
4) When done press [STO] to stop data entry and display see a graph of the collected data. CH 1 will be displayed on the y-axis with the manually entered values on the x-axis.
5) Press [Enter] to return to the main menu.