

Investigation Playing with light

The light sensor of the CBL2 can be used to study the properties of different light sources.

Materials

TI Graphing Calculator with DataMate program installed

CBL2 interface probe

Light probe

Light sources

Starting the DataMate Program and setting up

1. Use the following steps to start the DataMate program on your calculator:

TI—73, TI—82, and TI—83 Calculators:

Press **PRGM** then press the calculator key for the number that precedes DATAMATE. Press **ENTER**. An introductory screen will appear, followed by the main screen.

TI-83 Plus Calculators:

Press **APPS**, then press the calculator key for the number that precedes **DATAMATE**. Press **ENTER**. An introductory screen will appear, followed by the main screen.



2. Plug the Light Probe into channel **CH 1** on the CBL2 interface.
3. Start the DataMate program. Press **CLEAR** to reset the program. DataMate will detect the auto-ID sensor, set the data collection parameters, and display the current sensor reading.

Calculating a frequency of a light signal

Collecting data

1. Hold the light probe tight in your hand leaving about 1cm projecting from your closed fist. Point the light probe towards a light source during the recording run.
2. Press **2: START** to begin the measuring run using the default settings.
3. Cover the end of the probe with your thumb and expose it to the light at regular intervals during the run.
4. At the end a graph will appear of the light levels recorded by the probe over 9 seconds.



Analysing the data

1. A cursor will appear flashing on the y-axis. Use the cursor keys  or  to examine the data points along the displayed curve of light vs. time. As you move the cursor right or left, the time (X) and light intensity (Y) values of each data point are displayed below the graph. Move the cursor to the point where the light intensity is for the first time at zero (or close to it). **Record the time to the nearest hundredth of a second (=A).**

2. Continue to use the cursors to find the last point where the light intensity reaches zero (or close to it).
Record this value to the nearest hundredth of a second (=B).
3. How many complete cycles have been carried out between A and B? In other words how many times did you obstruct and expose the probe to the light source?
Record this value(=C)
4. You may now **ENTER** and then **6**: **QUIT** to leave the DataMate program.
5. **Calculate the mean (average) period of one cycle:** That is the number of seconds per cycle =
The duration of the periods divided by the number of periods = $\frac{B - A}{C}$ seconds
6. **Calculate the frequency of a cycle:** That is the number of cycles per second = $\frac{1}{\text{period}} \text{ s}^{-1}$

Investigating a fluorescent light

Setting up the recording run



1. Return to the DataMate program. Press **CLEAR** to reset the program. DataMate will detect the auto-ID sensor, set the data collection parameters, and display the current sensor reading.
2. Press **1**: **SETUP** and using the cursor buttons,  or  (be patient it's a bit sluggish!)
select **MODE** press **ENTER**.
3. Select **2**: **TIME GRAPH** and the screen **TIME GRAPH SETTINGS** will appear.
4. The default settings are 180 samples every 0.05s. The experiment will collect temperature readings for 9s. To change this select **2**: **CHANGE TIME SETTINGS**
5. Type in a time interval of 0.0003s, press **ENTER**, then type 99 samples press **ENTER**. What will be the length of this experimental run?
6. Press **1**: **OK** then and again press **1**: **OK** to return to the main screen.

Collecting data

1. Point your light probe towards a fluorescent light source (e.g. in the ceiling). Select **2**: **START** to begin data collection, a double “beep!” from the interface will confirm you are recording.
2. After the data collection is complete the interface will “beep!” again and an autoscaled graph of the data will appear.
3. If the measurements are not satisfactory press **ENTER** and then **2**: **START** to try again. Your results should appear as number of peaks and troughs. What do the peaks represent and what do

the troughs represent for this flickering light?

Analysing the data

1. A cursor will appear flashing on the y-axis. Use the cursor keys  or  to examine the data points along the displayed curve of light vs. time. As you move the cursor right or left, the time (X) and light intensity (Y) values of each data point are displayed below the graph. Move the cursor to the point where the light intensity is at a maximum for the first peak.

Record the time (=A)

2. Continue to use the cursors to find the last point where the light intensity reaches a maximum value for the last peak.

Record this time (=B)

3. How many peaks are there between A and B?

Record this value(=C)

4. You may now **ENTER** and then **6: QUIT** to leave the DataMate program.

5. **Calculate the mean (average) period of one cycle:** That is the number of seconds per cycle =
The duration of the periods divided by the number of periods = $\frac{B - A}{C}$ s

6. **Calculate the frequency of a cycle:** That is the number of cycles per second = $\frac{1}{\text{period}}$ s⁻¹

7. In France electrical installations use an alternating current with 50 cycles per second. How does this figure compare with your result?

NB the polarity of the AC current changes twice per cycle.

8. Why is the lowest value recorded never zero?

Try the same experiment with different light sources. Incandescent light bulb, a LED, the sun, light from a battery driven light bulb, a TV screen.

Research

Why can we not see the fluorescent light flickering?