

# DataRad Calculator Program

## THE DATARAD PROGRAM

The DataRad data collection program for the TI Graphing Calculators is a special purpose program for experiments using the Radiation Monitor and Student Radiation Monitor. DataRad works only with a Radiation Monitor connected to the DIG/SONIC1 port of the Vernier LabPro interface or the DIG/SONIC port of the Texas Instruments CBL 2 interface. DataRad is a single program, not a group. DataRad is not compatible with the original Texas Instruments CBL System.<sup>1</sup> Calculators compatible with DataRad include the TI-73, TI-82, TI-83, TI-83 Plus, TI-86, TI-89, TI-92 and the TI-92 Plus.

The DataMate program included with the CBL 2 and LabPro interfaces does not support the Radiation Monitor or Student Radiation Monitor.

## TRANSFER THE DATARAD PROGRAM TO A CALCULATOR

Before you perform any radiation experiments with the LabPro or CBL 2 interface, you must transfer the program to your calculator. Follow instructions that come with the TI-GRAPH LINK software. You will need a computer, TI-GRAPH LINK software and a TI-GRAPH LINK cable.

## DATARAD PROGRAM DETAILS

### Start DataRad

Use the black link cable to connect 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 DataRad program on your calculator:

TI-82, TI-73, TI-83 or TI-83 Plus Calculators

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

TI-86 Calculators

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

TI-89, TI-92, or TI-92 Plus Calculators

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

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<sup>1</sup> Users of the original TI CBL System can perform some of the same functions as offered by DataRad by using another program from Vernier Software & Technology called RADIATIN. RADIATIN is available on the Vernier web site at [www.vernier.com](http://www.vernier.com).

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## Main Screen

The main screen of DataRad is shown at the right. The top half of the screen shows the Radiation Monitor reading, the current data collection mode, and the status of background correction. The portion below the double bar displays the menu options.

```
DIGI: RADIATION(CPM)
MODE: TIME GRAPH- 60
BACKGROUND CORRECT: NONE
PRESS (+) TO TURN ON
-----
1: SETUP      4: ANALYZE
2: START     5: QUIT
3: GRAPH
```

Press  to toggle the background correction mode on and off.

Below the double bar you will find a varying number of menu items, depending on the mode.

### SETUP

Select SETUP to select the data collection mode, counting interval length, and background correction status. Additional information on the various setup options follows in the Setup Menu section.

### START

Select START to begin data collection.

### GRAPH

Select GRAPH to see the current graph. If no data have been collected, selecting GRAPH will end the program.

### ANALYZE

Select ANALYZE to see a list of curve fitting, modeling, and range selection functions.

```
ANALYZE OPTIONS
-----
1: LINEAR CURVE FIT
2: EXPONENT CURVE FIT
3: POWER CURVE FIT
4: ADD MODEL
5: SELECT REGION
6: RETURN TO MAIN SCREEN
```

### QUIT

Select QUIT to leave the DataRad program.

## Setup Menu

### SET INTERVAL

Select SET INTERVAL to see the current interval length in seconds. The DataRad program counts for this interval before reporting a result. From the Interval Settings screen, select SET INTERVAL to change the current setting, or select OK to return to the Setup Menu.

```
SETUP MENU
-----
1: SET INTERVAL
2: BACKGROUND CORRECTION
3: TIME GRAPH
4: RATE/HISTOGRAM
5: EVENTS WITH ENTRY
6: SINGLE INTERVAL
7: RETURN TO MAIN SCREEN
```

### BACKGROUND CORRECTION

Background correction allows you to display count rates corrected for the presence of any background radiation. Background correction must be set before an experiment is performed, and the interval to be used in the experiment must be set before setting up background correction.

```
BACKGROUND CORRECTION
-----
1: PERFORM NOW
2: RESET TO NONE
3: RETURN TO SETUP SCREEN
```

#### Perform Now

Select PERFORM NOW to measure the background count rate and set up DataRad to correct for this count rate. You will be prompted for the number of intervals over which you want DataRad

to count background events. Enter an integer (usually five or so), remove all radiation sources from the vicinity of the Radiation Monitor, and press **[ENTER]** to begin counting. After the entered number of intervals has passed, DataRad will display the average count rate in cpm (counts per minute) by which all following measurements will be reduced. In order to prevent later curve fits from failing in time and event-based data collection modes, all zero or negative corrected count rates will be changed to a count rate of 0.1 cpm. A zero or negative count rate can occur if the measured count rate is very low, and statistically happens to be less than or equal to the previously determined background correction.

**Reset to None**

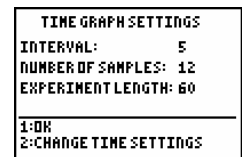
Select **RESET TO NONE** to clear a previously determined background correction. You can also temporarily disable background correction from the main screen by pressing **[+]**.

**Return to Setup Screen**

Select **RETURN TO SETUP SCREEN** to return to the Setup screen.

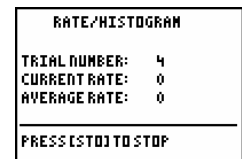
**TIME GRAPH**

Select **TIME GRAPH** to configure DataRad to collect count rate data as a function of time. For example, a lifetime measurement experiment would use this mode. A screen showing the current interval in seconds, the current number of samples to be collected, and the product of the two (the experiment length) will be shown. Select **OK** to accept the settings, and select **CHANGE TIME SETTINGS** to adjust either the interval or the number of samples. Return to the main screen and select **START** to begin data collection. During data collection, you can press **[STO]** to end data collection early.

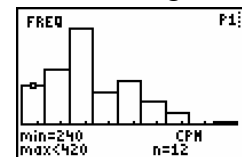


**RATE/HISTOGRAM**

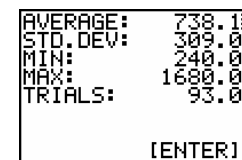
Select **RATE/HISTOGRAM** to set the data collection mode to Rate/Histogram. You will then return to the main screen. Begin data collection by selecting **START**. Data collection will begin, and the screen will display the number of intervals collected, the most recent count rate, and the average count rate over all intervals. Press **[STO]** to end data collection. A histogram will be displayed. You may scan across the histogram using the cursor keys.



Once you are done with the histogram, press **[ENTER]**. You will be prompted to adjust the number of bins for the histogram if desired. Select **YES** or **NO**. If you select **YES**, at the prompt enter a number between one and 45. The rescaled histogram will be displayed.



After selecting **NO**, the average, standard deviation, minimum, maximum and number of intervals (trials) will be shown.



**EVENTS WITH ENTRY**

Select **EVENTS WITH ENTRY** when the experiment requires count rates as a function of some parameter other than time. This parameter could be distance, number of layers of shielding, or another parameter under your control. In this mode DataRad will count for one interval and then prompt you for a numeric entry. After making that entry, data collection is

paused so that you can reconfigure the apparatus for the next data collection condition. You then press **ENTER** to recommence counting, after which DataRad again prompts for a numeric entry. Data collection can be ended after any numeric entry by pressing [STO]. After data collection has ended, DataRad displays a graph of count rate vs. the entered values.

### SINGLE INTERVAL

DataRad can be set to count for a single interval. After setting the desired data collection interval, select the single interval mode. From the main screen select START. The screen shows count rates in counts per interval and counts per minute, both raw and corrected by any previously configured background correction.

```

COUNTS/INTERVAL: 3
CORRECTED CPI: 2.6
COUNTS/MINUTE: 360
CORRECTED CFM: 312

[ENTER]

```

## Analyze Options

ANALYZE OPTIONS allows the user to perform basic data analysis within the DataRad program.

```

ANALYZE OPTIONS
1:LINEAR CURVE FIT
2:EXPONENT CURVE FIT
3:POWER CURVE FIT
4:ADD MODEL
5:SELECT REGION
6:RETURN TO MAIN SCREEN

```

### LINEAR CURVE FIT

A straight-line least squares fit of the form  $Y=A*X+B$  is performed on previously collected data. You may want to first select a portion of your data using the SELECT REGION option described below. After the fit parameters are displayed, a graph of the data with the fitted curve is shown. Press **ENTER** to continue.

### EXPONENT CURVE FIT

An exponential fit of the form  $Y=A*EXP(-B*X)$  is performed on previously collected data. You may want to first select a portion of your data using the SELECT REGION option described below. After the fit parameters are displayed, a graph of the data with the fitted curve is shown. Press **ENTER** to continue.

### POWER CURVE FIT

A power law fit of the form  $Y=A*X^B$  is performed on previously collected data. You may want to first select a portion of your data using the SELECT REGION option described below. After the fit parameters are displayed, a graph of the data with the fitted curve is shown. Press **ENTER** to continue.

### ADD MODEL

To use this feature you must enter an equation in the Y1 equation variable prior to running the program. The equation can contain up to five adjustable parameters A, B, C, D and E. You may collect data, leave the program to enter the equation, and then restart DataRad without losing the data.

The ADD MODEL feature allows the user to superimpose a manually controlled function on the data. A user-entered equation with up to five parameters is graphed. For example, if the data are to be compared to an inverse-square function, the Y1 equation variable could be set to  $A*X^2$ . The

parameter A is then adjusted after selecting ADD MODEL. After selecting the parameter A and entering a value, the data and the equation using that parameter are graphed. With certain values of the parameters the equation will not be visible on the data graph. Press **ENTER** to return to the MODEL MENU. Usually you will want to adjust the parameter several times to optimize the fit of the equation. Allowed parameters are A, B, C, D and E.

**SELECT REGION**

The SELECT REGION option allows you to delete data to the left and right of the desired region. You may want to use this function before performing a curve fit. To use, select SELECT REGION. You will see your data graphed with a left-bound cursor. Move the cursor to the desired left bound, and press **ENTER**. Then move the right cursor to the desired right bound, and press **ENTER**. Data outside the indicated region will be permanently deleted.

**RETURN TO MAIN SCREEN**

Select this to return to the main screen of DataRad.