Advanced Programming Features

Compute Tools 4 and 5
Program Area Level 5

The two advance programming templates for manipulating data are Compute Tools 4 and Compute Tools 5. Each of these templates provide a way to manipulate or do additional calculations on your data set(s) beyond the capabilities found in Compute Tools 1 – 3. This document describes the basics of how to program in each of the advanced programming templates.

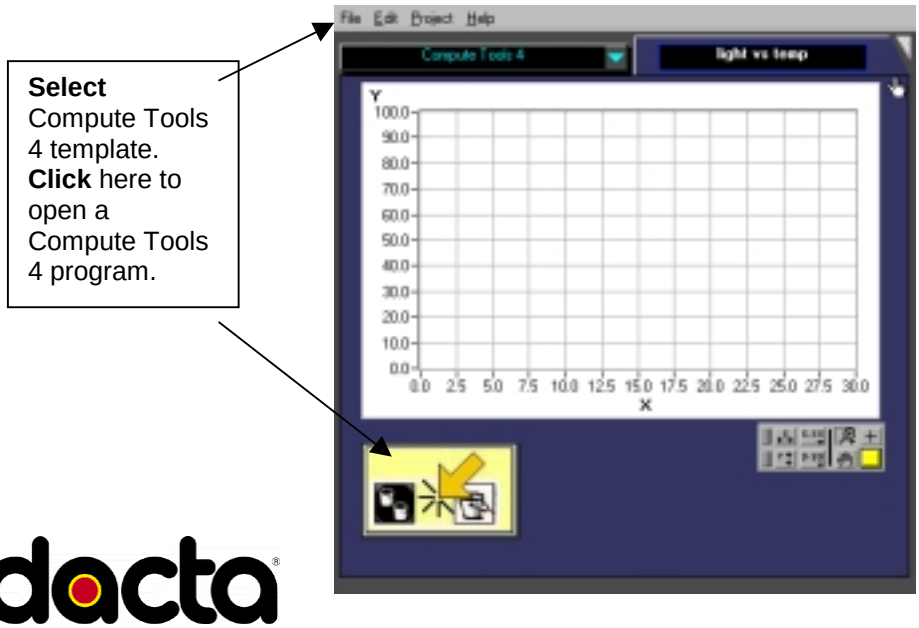
Compute Tools 4 is a modified LabVIEW programming environment. You create the program in a diagram window, similar to Inventor Level programming, and the resulting data is displayed on the graph. There are a limited number of programming options.
Compute Tools 4 is best for situations such as:

1. Doing more than two operations to a data set, and
2. Separating the x and y axis variables so that they can be operated on independently before plotting the results.

Compute Tools 5 (also known as G Code) provides a full LabVIEW programming environment. Included in the Functions Palette are the Investigator data set icons from Compute Tools 4 and a series of LabVIEW submenus. In Compute Tools 5 there is no limit to the type of data manipulation that can be done.

Compute Tools 4

Starting a Compute Tools 4 Program
Select the Compute Tools 4 template and click on the small yellow program window. This opens the program diagram window. The default Compute Tools 4 program takes the red data bin, averages the lines and then integrates twice. The resulting data is assigned to the yellow data bin and plotted on the graph.

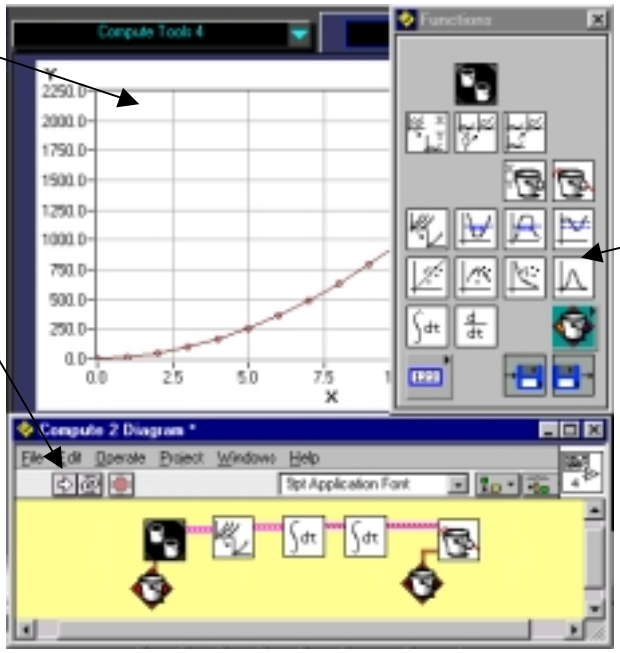


©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

You can open a new Tools 4 program or open an existing one in the same manner as Program Level 4 and 5 for Inventor. When you select your program, it opens in the Inventor Level programming environment.

Graph results from the program are shown here.

Diagram Window write the program in this space.



Functions Palette for Tools 4.

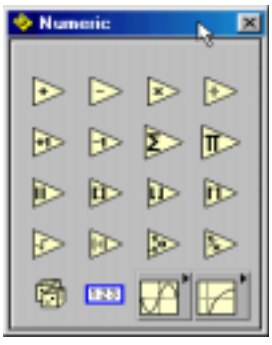
The default Tools 4 takes the red data bin, averages the lines and then integrates twice. The resulting data is assigned to the yellow data bin and plotted on the graph.

Note: after writing the program in the Diagram Window, click on the run button to show the results on the Graph.

Most of the functions are displayed on the main Functions Palette for Compute Tools 4. There are two sub-menus, Bin Modifiers and Numeric.

Selecting the Bin Modifier Icon opens the sub-menu window. These are command modifiers, used to assign which bin the data will be taken from or put into.

Selecting the Numeric Icon opens a sub-menu with mathematical functions. These functions can be used to operate on any of the data sets.



©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

A summary of the functions available on the Main Function Palette for Compute Tools 4 is given in the following table. More information is available in the Help Function when the cursor is over the icon, or by double clicking on the icon when it is in the diagram window.

	View All	This allows you to view (or operate on) the data in any bin. The default is for the red bin.
	Extract	Separate the X and Y coordinates of a data set into two arrays. The default data set is number 0.
	Combine	Combine the X and Y values into a plot. If a plot is wired to Data Set in, the new plot is appended to the old.
	Combine Bins	Combines two plots together.
	XY Plot	This adds the Data Set defined by the X and Y numbers to an existing bin. The default bin is the red bin.
	Bin Plots	Put the contents of a plot into a bin. The default bin is the red bin.
	Average Lines	This averages all Data Sets in a bin together. It assumes that all lines have the same spacing in time.
	Well Time	This finds the time that the measured value in a Data Set is below a given threshold value.
	Peak Time	This finds the time that the measured value in a Data Set exceeds a given threshold value.
	Threshold	This extracts the measured values in a Data Set when the Data Set value is between two values.
	Fit Line	This will fit a line to the desired Data Set.
	Fit Curve	This will fit a curve to the desired Data Set. The default order for the curve is second order.
	Fit Exponential	This will fit an exponential curve to the desired Data Set.
	Histogram	This returns a histogram for each Data Set.
	Integrate	This integrates every Data Set in the bin separately and returns a plot of the integrated Data Sets.
	Differentiate	This differentiates every Data Set in the bin separately and returns a plot of the differentiated Data Sets.

©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

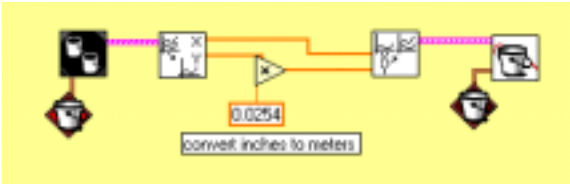
Save Data — This saves the Data Set to a spreadsheet file.

Load Data — This reads the Data Set from a spreadsheet file.

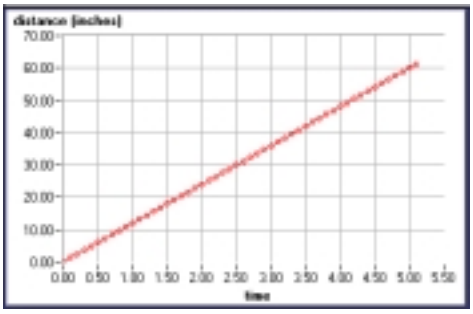
Examples

Example 1

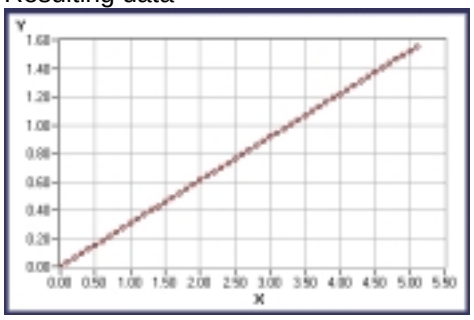
This program takes the data from the red bin, separates the x and y axis information, multiplies the y-axis value to convert from inches to meters and then puts the x and y axis information back together. The result is stored in the brown bin.



Initial data



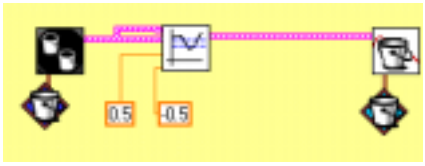
Resulting data



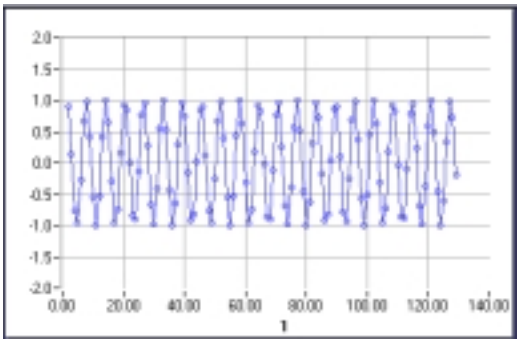
©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

Example 2

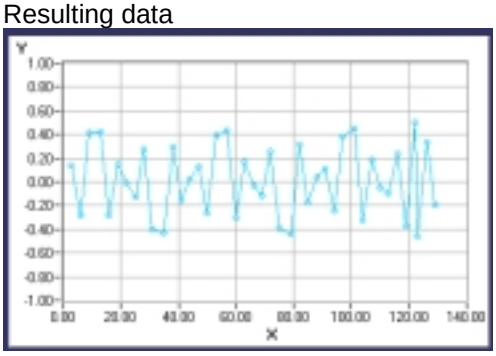
This program separates out and plots all of the points that fall between within the threshold. The initial data was a sin function that ranged between 1.0 and –1.0.



Initial data



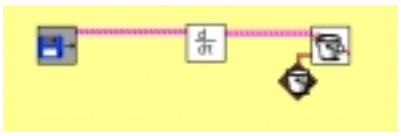
Resulting data

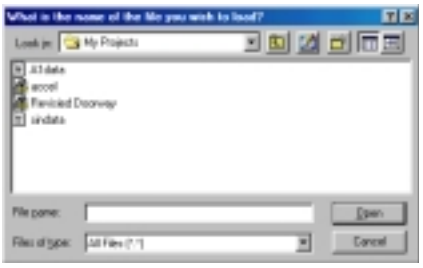


©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

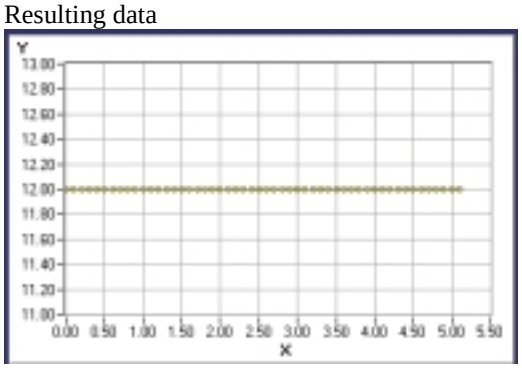
Example 3

This program loads the data from a file on the computer. The data is differentiated, resulting in a plot which shows the slope of the line. When the program is run, a window opens for you to specify the name of the data file that the program should load.





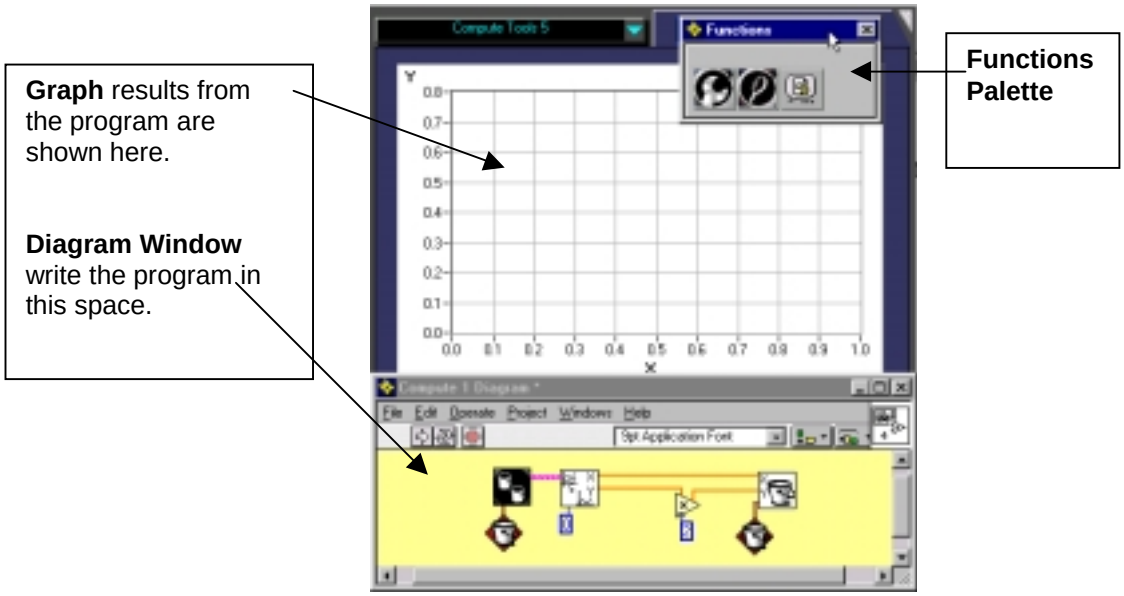
Resulting data



©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

Compute Tools 5

Starting a Compute Tools 5 Program
Select the Compute Tools 5 template and click on the small yellow program window. This opens the program diagram window. The default Compute Tools 5 program takes the red data bin, separates the array into x-axis and y-axis values, multiplies the y-axis values by 2. The resulting data is combined and assigned to the brown data bin.



The Functions Palette for Compute Tools 5 has three menu options. Each one will open a different Functions Palette or Window.

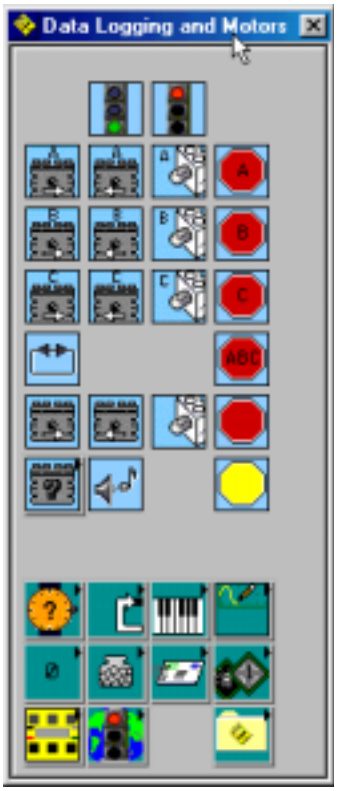
 Selecting this icon opens the Investigator Functions Palette for Compute Tools 5 (or G Code).

 Selecting this icon opens the Programmer Functions Palette for Inventor Level 5.

 Selecting this icon opens a dialog window that allows you to browse for the vi you want to open from anywhere on your computer.

©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

The Investigator Functions Palette for Compute Tools 5



Investigator Functions are used to manipulate data that has either been acquired by the RCX or imported from spreadsheets.

The first 9 rows of the Functions Palette contain the icons from Compute Tools 3 and Compute Tools 4.

The last 3 rows of the Functions Palette contain LabVIEW submenus with programming structures, variables, boolean values, text strings, array operations, and an assortment of other functions. If you want to learn how to use any of these LabVIEW functions, we recommend the following references:

- LabVIEW Student Edition
- LabVIEW for Everyone

On the following page is a brief summary of each LabVIEW submenu icon.

©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

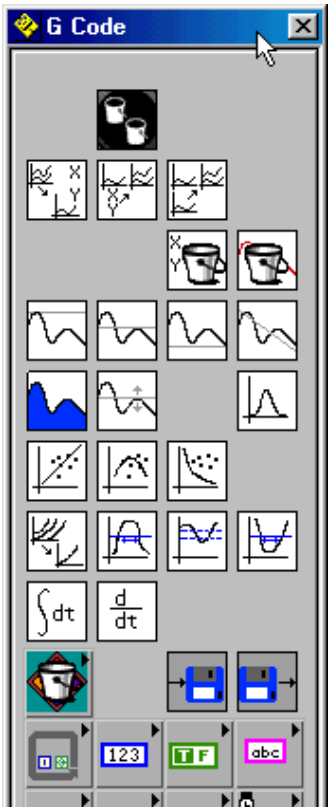
This table provides a summary of the sub-menu options in Compute Tools 5.

	Structures	Structures include while and for loops, sequences, case statements, and formula nodes.
	Numeric	Numeric includes all numeric functions such as addition, multiplication, square root, and constants.
	Boolean	Boolean includes all Boolean logic such as and, or, not.
	String	String includes ways to use text strings, break them up, combine them, and reset them.
	Array	Array includes all the functions for operating on arrays (Data Sets)
	Cluster	Cluster includes ways to bundle and unbundle clusters of information from arrays.
	Comparison	Comparison includes ways to compare numeric values or text strings.
	Time & Dialog	Time & Dialog includes ways to use the timer and set up dialog boxes that will appear while the program runs.
	File I/O	File I/O includes an assortment of ways to do input and output with files.
	Analysis	Analysis includes a basic set of signal generation functions.
	G Code	Location for your own subroutines.

©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

Program Level 5

The Functions Palette for Program Level 5



Program Level 5 offers additional programming options for the RCX, providing a limitless environment for controlling your invention while running your investigation.

The Structures submenu has additional structures for looping, conditional (if-then), and while conditions. The addition of these structures provides unlimited programming options.

Advanced Programming Options

- The RCX can communicate with other RCX units.
- The RCX can be directly interrogated to find values.
- The RCX can be run in direct mode to obtain values.

Examples of these advanced functions are shown on the following pages.

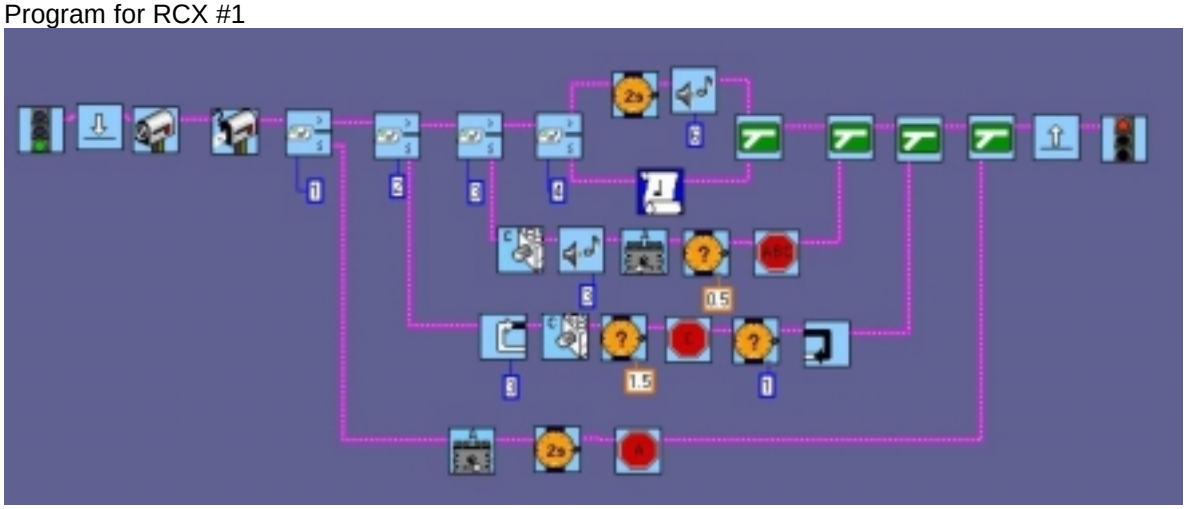
©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

Examples

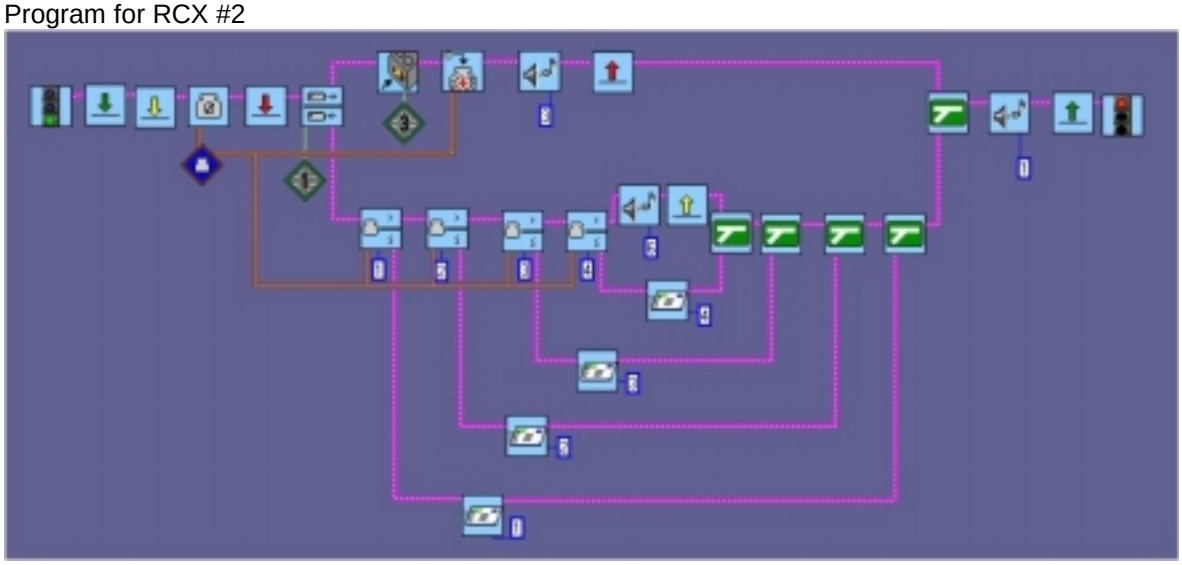
RCX to RCX Communication

The RCX's can communicate with each other via infrared transmissions. This example shows two programs. The first one is downloaded to one RCX and the other to another RCX. Both RCX's must be running their programs for this to work. When the touch sensor on 1 is pushed, the number of clicks accumulated from touch sensor 3 is sent out over the infrared. If the number of clicks is greater than 4, nothing is sent and a tone is played. RCX #2 sits and waits to receive an infrared 'mail' value. Depending upon the value received RCX #2 will do a variety of things.

Program for RCX #1



Program for RCX #2



©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

Examples

Interrogate RCX

Selecting Interrogate RCX from the Project Menu Opens a window that allows you to directly check values and reset the RCX. Note: Interrogate RCX is only available if you have installed extras.

Options available in Interrogate RCX:

- View battery level
- Click on input ports to view value of attached sensor.
- Click on output ports to view power level supplied to port.
- Reset angle sensor or timer
- Clear data
- Remove all tasks

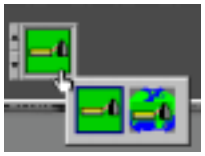
Viewing other information

Clicking on the button to the right of the displayed RCX image opens a window from which you can select items for which you would like to know the values.

For example, the displayed example shows the value of the red container is 2. Other options include the programming timers, the input ports, the RCX internal clock, and the value of mail.

RCX location

The interrogation can occur with the RCX near your computer, or to one that is connected to the internet. In order to interrogate an RCX over the internet, you will need to know the IP Address of the computer the RCX is communicating with.

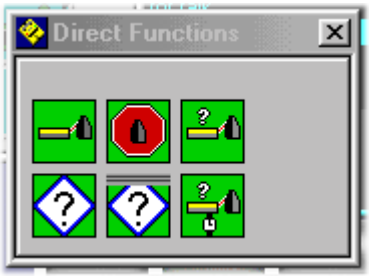


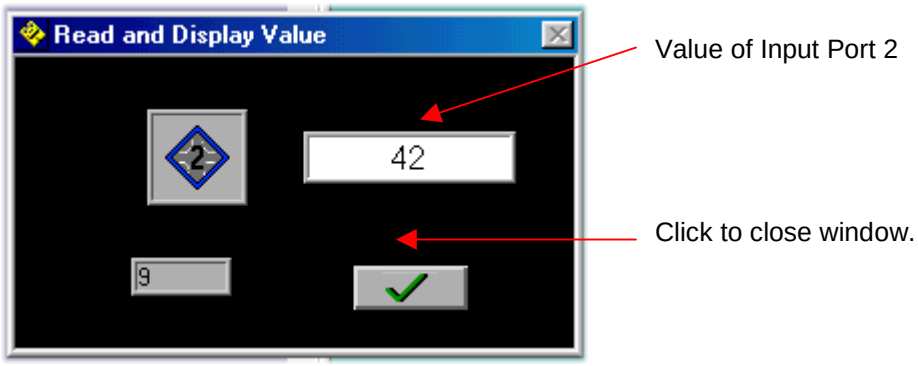
©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

Examples

Direct Mode

Program level 5 allows you to get values from the RCX in direct mode. The following program starts a direct mode to obtain the value of input port 2. When the program is run, a new window opens and displays the value requested. The value is updated every time it changes. The RCX needs to be near the IR Transmitter and on for the program to run.





©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.

Direct Mode Icons

Icon	Icon Name	Icon Function
	Begin Direct Mode	This is the first icon in the direct mode program. String a command after this one to run it immediately (no download).
	End Direct Mode	This completes the direct mode commands.
	Is RCX In View?	This command checks to see if the RCX is in view of the IR Transmitter.
	Wait for RCX to be in View	This command waits for the RCX to be in view of the IR Transmitter.
	Read and Display Value	This command polls the RCX for any value (sensor port, container, timer, etc.) and displays it to the user.
	Read Value	This command polls the RCX for any value (sensor port, container, timer, etc.) and outputs the value as a number.

©2000 The LEGO Group. LEGO, DACTA, ROBOLAB and RCX are trademarks of the LEGO Group. LabVIEW and National Instruments are registered trademarks of National Instruments Corporation. This page may be photocopied for non-commercial educational use. All other rights reserved.