

Appendix E

Working in RPN mode

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Introduction

This appendix describes the RPN operating mode, and how to work with this mode. It also describes how to use the interactive stack commands to manipulate the objects on the stack.

RPN stands for Reverse Polish Notation. The main feature of this notation is that you specify operations after the numbers or objects to operate on. When you use the HP 49G in RPN mode, you have access to the stack. RPN mode, in conjunction with the stack, makes it easy to re-use the results of previous operations, and to perform chains of calculations.

Using the stack

In order to perform operations in RPN mode, you place the object or objects on the stack, then apply the operation.

Entries on the stack are numbered (as in the example at the right). Each entry on the stack has an associated *level*. The level is the number of the line on which the entry appears. In the example at the right, 58 is on level 4, 6 is on level 3, $\sqrt{8745}$ is on level 2, and so on.

RAD	SIZE	HEX	R=	'X'
CHONES				
0:				
4:				58
3:				6
2:				$\sqrt{8745}$
1:				93.514704726
EXEC HALT Stylus				

To set RPN mode, press $\overline{\text{MODE}}$ to access the Calculator Modes input form, and set the Operating mode option to RPN.

Placing objects on the stack

You can create new objects and place them on the stack, or you can retrieve objects from memory and place them on the stack.

- To enter a number on the stack:
 - a. Use the numeric keys to enter the number. The number appears on the command line.
 - b. When you finish entering the number, press $\overline{\text{ENTER}}$. The number appears on level 1 of the stack.
- To enter an object that you create in an application, such as a matrix or an equation:
 - a. Access Matrix Writer or Equation Writer.
 - b. Create the matrix or the equation.
 - c. Press $\overline{\text{ENTER}}$ to place it on level 1 of the stack.
- To retrieve an object from memory and place it on the stack:
 - a. Press $\overline{\text{VAR}}$ to display the directories and variables in the current directory.
 - b. Navigate to the directory that holds the object you want.
 - c. Press the appropriate function key to select the object. It appears on level 1 of the stack.

When you add a new item to the stack, the existing items are pushed up a level. That is, the item at level 1 is pushed up to level 2, and the item at level 2 is pushed up to level 3 and so on.

Performing RPN calculations

You use the command line and the stack to perform RPN calculations.

- When you use a command that takes only *one* argument, you can execute the command with the argument on the command line or the stack.
- When you use a command that requires multiple arguments—that is, a command that needs more than one object to act on—you place the arguments on the stack before you apply the command. You specify one argument per level, in the correct order. You can apply a multiple-argument command when the last argument is still on the command line.

A command's arguments are removed from the stack when the command is executed, and replaced by the result of the operation.

For example, to find the cube of 52, you need to specify two arguments: the number (52) and the index (3).

To perform the calculation, you enter:

52 **ENTER** 3 **y^x**

That is, you enter 52 onto the stack, and 3 is on the command line before you apply the operation. Since the **y^x** operation requires two arguments, it uses the value on level 1 as the first argument, and the value on the command line as the second argument.

Alternatively, you can place 52 on stack level 2, and 3 on stack level 1 before you apply the **y^x** operation. The operation uses the value on level 2 as the first argument, and the value on level 1 as the second argument.

Note that when you place all arguments on the stack before you apply a command, you can undo the command (by pressing **↶ UNDO**), and return to the original stack.

For example, if you place both arguments on the stack before you apply the **y^x** operation above, **↶ UNDO** returns 52 on level 2 and 3 on level 1. If you apply the command with the last argument on the command line—that is, 52 **ENTER** 3 **y^x**—the **↶ UNDO** operation returns only 52 on level 1.

Example stack calculations

Using a one-argument command

1. If the argument is not already on level 1 of the stack, enter the argument onto the command line (and, optionally, onto the stack). If the argument is already on level 1 of the stack, go straight to step 2.
2. Execute the command.

Example: To calculate $\frac{1}{\sin 30}$

1. Enter 30 and press ENTER .
2. Press SIN .

The result of $\sin 30$ is now on level 1 of the stack. This result can be used as the argument of a further command without the result needing to be manually entered.

3. Press $\frac{1}{x}$.

Note that if you get a symbolic answer when you wanted a numeric answer, press NUM . The symbolic answer is evaluated.

Using a multi-argument command

Method 1

1. Enter the arguments, pressing ENTER after each one.
2. Execute the command.

Example: To calculate 23×97

1. Enter 23 and press ENTER .
2. Enter 97 and press ENTER .

23 is now on level 2 of the stack and 97 is on level 1.

2:	23
1:	97
SEARCH GOTO EDIT →BEG →END INFO	

3. Press \times .

In this example, the order in which you enter the arguments does not affect the answer. However, this is not always the case with two-argument commands. In the cube example on page E-3, the result of entering the 3 before the 52 is the 3 raised to the power of 52, a very different result to 52 raised to the power of 3. Other examples where the order you enter the arguments is important include subtraction, division, and the percentage commands ($\%$, $\%CH$, and $\%T$).

Method 2

In method 1 above, each argument is entered onto its own level of the stack before the command is executed. Another way is to enter all the elements onto the command line separating each with a space. You can then either:

- press **(ENTER)** to place the arguments onto the stack and then execute your command or
- execute your command with the arguments still on the command line.

Example: To calculate $\sqrt[3]{531441}$

1. Enter 531441 **(SPC)** 3
2. Press **(ENTER)**.
3. Press **(\rightarrow)** **($\sqrt[3]{}$)**.

1:
531441 3
SEARCH GOTO EDIT +REG +END INFO

Step 2 can be omitted if you will not want to undo the command and see the arguments. Pressing **(\rightarrow)** **(UNDO)** without having first placed the arguments on the stack deletes all record of the command: the result and the arguments. On the other hand, if you place the arguments on the stack before executing the command, pressing **(\rightarrow)** **(UNDO)** deletes the result but re-displays the arguments.

Multi-command calculations

Because the result of a calculation is retained on the stack, you can easily perform complex calculations by accumulating the results of sub-calculations on the stack and then treating these results as the arguments in a further calculation.

Example: To calculate $13^2 - (17 \times 19) + \frac{3}{7}$

1. Enter 13 **(\leftarrow)** **(x^2)**.
The result—169—appears on level 1 of the stack.
2. Enter 17 and press **(ENTER)**.
3. Enter 19 and press **(ENTER)**.
4. Press **(\times)**.

The product of 17 and 19—323—appears on level 1, and the previous result—169—is at level 2.

5. Press \ominus .

The two previous results—169—and 323—are now treated as the arguments in a further operation. This operation replaces the arguments with the result of the operation, that is, the difference between the first result and the second.

6. Press $3 \text{ (ENTER)} 7 \text{ (}\div\text{)}$ to place the result of $\frac{3}{7}$ on level 1.

If the calculator is in exact mode, the result appears as a fraction.

7. Press \oplus to add this to the previous result.

If the calculator is in exact mode, the answer is displayed as a number and a fraction. To display the approximate answer to 12 digit accuracy, press $\text{P} \text{ (}\rightarrow\text{NUM)}$

Using computer algebra commands

Example: To substitute $x = y + 3$ in $x^2 + 3x + 7$

1. Use Equation Writer to create $x^2 + 3x + 7$ and press (ENTER) to place it on stack level 1.
2. Use Equation Writer to create the substitution, $x = y + 3$, and press (ENTER) to place it on stack level 1. This pushes the previous expression to stack level 2.
3. Press $\text{P} \text{ (ALG)}$ to access the Algebra command menu and select the SUBST command. The HP 49G performs the substitution and the result appears at stack level 1.

Manipulating stack data

The HP 49G provides functions to manipulate the stack levels. To access these functions, you enter interactive stack mode.

- To enter interactive stack mode, press \blacktriangle .
The interactive stack commands appear on the function key menu.
 - a. Use the arrow keys to navigate up and down the stack to select the stack level that you want.
 - b. Use the function keys to select the command that you want to apply to the current stack level.
- To exit interactive stack mode and return to normal stack operations:
 - press $\text{\textcircled{ENTER}}$ to apply the interactive stack command that you selected, or
 - press $\text{\textcircled{CANCEL}}$ to cancel the command.

When you enter interactive stack mode, data on the stack is displayed in text mode. For example, any equations on the stack are displayed in text mode rather than textbook mode.

Interactive stack commands

Command	Function
→LIST	Creates a list that contains the stack objects from 1 to the current level. The newly created list is placed on level 1 of the stack, and the original objects are removed.
DROPN	Deletes all levels below the selected level.
DUPN	Duplicates the levels from the currently selected level to level 1, and pushes up the existing levels to accommodate the duplicated levels.
ECHO	Press ECHO, then $\text{\textcircled{ENTER}}$ to copy the contents of the current level to the command line. Edit the contents on the command line, and press $\text{\textcircled{ENTER}}$ to place them on level 1 of the stack.

Command	Function (Continued)
EDIT	Opens the contents of the current level in the most appropriate editor, ready for editing. For example, if the current level contains a matrix, the matrix opens in Matrix Writer.
GOTO	Prompts for a stack level to select, then selects the level number that you enter.
INFO	Displays information about the object at the current level, including its size in bytes.
KEEP	Deletes all levels above the selected level.
LEVEL	Copies the current level number to level 1 of the stack.
PICK	Copies the contents of the current level to stack level 1. All existing levels are pushed up one level.
ROLL	Moves the contents of the current level to level 1. The portion of the stack below the current level is rolled up to fill the space that is left.
ROLLD	Moves the contents of level 1 to the current level. The portion of the stack beneath the current level is rolled down to fill the space left by the item at level 1.
VIEW	Displays the contents of the current level in textbook mode.