



In the Spotlight

» [A User's Perspective of the HP 39gII](#)

Namir Shammis

Announced in the last issue of HP Solve, this article will present a user's view of some of the many features found on the HP 39gII.



Your articles



» [Get Rich Slow](#)

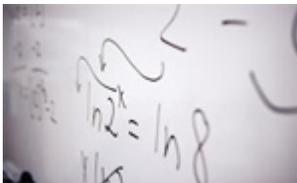
Author John Webber offers potential investors an easy-to-follow 9-step approach toward investing and building wealth in the rental real estate market, utilizing the HP 10bII+ calculator to make critical financial calculations a snap.



» [Collecting, Displaying, Demonstrating, and Storing HP Calculators](#)

Richard J. Nelson

Collecting calculators is more popular than one might think. This article explores several of the issues that face HP Calculator collectors.



» [HP Calculator Programming](#)

Richard J. Nelson

There are many useful, powerful, time saving programs that every calculator user should be aware of. Read this overview on programming and its applications across HP calculators.



» [The WP 34S Evolves](#)

Jake Schwartz

No calculator is perfect or error free. Members of the HP User Community are discovering for themselves that designing and maintaining a calculator is an incredibly difficult undertaking. The results however are amazing.

Issue 27 April 2012

Welcome to the twenty-seventh edition of the HP Solve newsletter. Learn calculation concepts, get advice to help you succeed in the office or the classroom, and be the first to find out about new HP calculating solutions and special offers.

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From the Editor



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» **Meet an HP Calculator user**

Meet Jo Vandal, an electrical engineer manager based out of Belgium. Read how Jo has been active in the Belgium HP User Community.



» **HP RPN Evolves**

Richard J. Nelson

RPN itself is usually associated with HP because HP has been making RPN calculators for 41 years. Learn how Classical RPN has evolved into Entry RPN.



» **Fundamentals of Applied Math Series #10**

Richard J. Nelson

Calculating numerical roots is a challenging problem if you do not have a modern electronic calculator. In this math review series, it will show how a modern scientific or graphing calculator will calculate numerical roots at the press of a key.

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A User's Perspective of the HP 39gII

HP Solve #27 page 3

Article – [Next →](#)

A User's Perspective of the HP 39gII

Namir Shammas

Introduction

The HP 39gII graphing calculator is the latest member of the HP graphing calculators, which HP had first launched in 1990. The new arrival is aimed at the high school students in China, and as such can be operated in either English or Chinese. As the model's name suggests, this algebraic machine replaces the algebraic HP 39GS calculator. The lack of RPL support, present in most HP graphing calculators, should not let the reader conclude that the new HP 39gII is a lightweight graphing calculator. Quite the contrary! The new arrival is a heavy hitter.

Calculator Layout

Figure 1 shows the full layout of the HP 39gII calculator in text mode. The machine has a display that supports 256 by 126 pixels. Below the LCD you find the following set of controls:

1. **Six function buttons**, labeled F1 through F6 to support various *soft* menus.
2. The **cursor keys** are located to the right and below the menu keys. These keys are molded into a single plastic component. The cursor keys allow you to navigate up and down a list, left or right in a list or a line editor, or all four directions of a table, depending on the current App.
3. The **six HP Apps keys** are located to the left of the cursor keys. The blue-shifted button labeled Home supports setting of the Modes App.
4. The **common math buttons**. These buttons occupy the three rows of buttons below the cursor keys.
5. The rest of the keys include the numeric keys, the two shift keys, the ON key, the ENTER key (used to execute an operation), and the comma key. The red shift key allows you to enter a character. The blue shift key serves to access shifted commands and menus.

In addition to these keys, the HP 39gII has a USB port located on the right side. You can use that port to connect the calculator to a PC.

Regarding the power requirements of the HP 39gII, its battery compartment has space for four AAA cells. Interestingly, these four batteries are connected in parallel. This means that the calculator really needs only one cell to operate! The

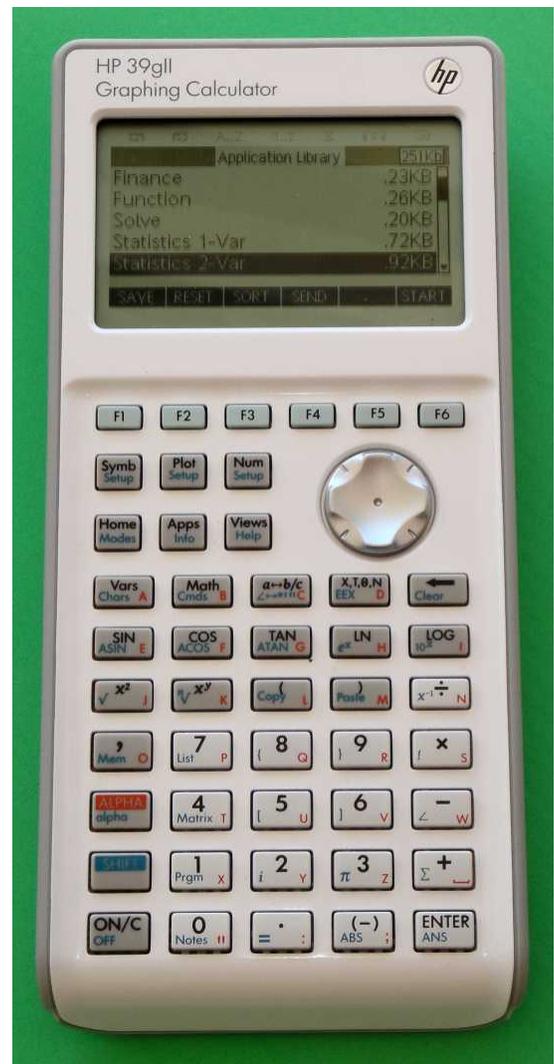


Fig.1 - The HP 39gII.

additional three cells ensure that the calculator will run for a good while. Moreover, since the machine is aimed at students, they can lend a battery to another student who needs it to keep her or his calculator going, especially during a test!

When you press the Home key, you shift to basic calculations mode. Figure 2 shows this mode. The display comprises of the following set of lines:

1. The top line is an annunciator line. It shows information like the level of battery power.
2. The Title line. This line displays information like the current angle mode, and up/down scroll indicators.
3. The History lines make up five lines. They display recent operations and their results. You can scroll these lines up and down.
4. The Edit line is the placeholder for entering and editing an expression or a command.
5. The Menu key labels appear as the bottom most line. This line displays the current *soft* menu.

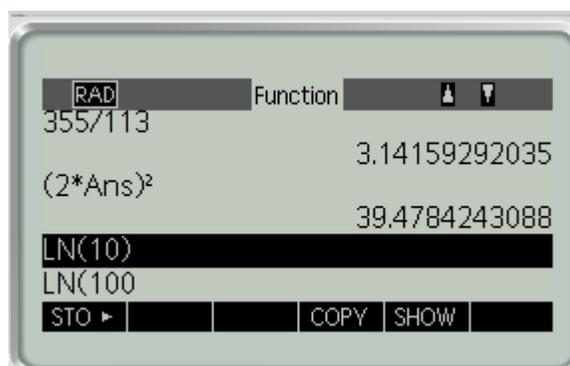


Fig. 2 - The Calculation mode.

Working with the History lines is easy. You can scroll up and press the COPY soft menu to copy that item into the Edit line. You can then edit the command or expression and execute the modification. This feature can save you a lot of typing, especially if you repeat the above operation many times.

The Vars Menu

The HP 39gII calculator supports several types of variables and offers a number of predefined variables for each data type. You can access the data types and their associated predefined variables by pressing the Vars button. The calculator presents you with menu of data types:

1. Complex. The calculator supports ten predefined complex variables named Z0 through Z9.
2. List. The calculator offers ten predefined list variables named L0 through L9.
3. Matrix. The calculator provides ten predefined matrix variables named M0 through M9.
4. Modes (variables related to the Modes settings)
5. Real. The calculator supports the predefined real variables A to Z, and θ .

You can also access the list of predefined list variables and matrix variables using shift keys. Figure 3 shows a sample screen that accesses a predefined matrix variable. The figure shows that the matrix variable M1 is selected. Notice that under the list of data types, the calculator has a line that displays the

size of the currently selected matrix. In Figure 3, the matrix variable M1 has five rows and four columns. In a similar manner, the calculator displays the size of the selected list variable.

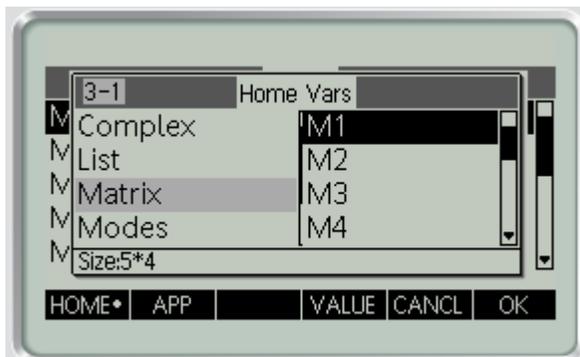


Fig. 3 - The Matrix variables.

Figure 4 shows the Real variables. The figure shows that variable A is currently selected. The line below the list of data types shows the current value of variable A, which is 2.30258509299. In a similar manner, the calculator displays the values in the selected complex and modes variables.



Fig. 4 - The Real variables

The Math Menu

The Math menu is, in my opinion, the computational powerhouse of the HP 39gII. This menu displays a list of the following sets of mathematical functions:

- | | |
|------------------------------|--|
| 1. Calculus functions | 8. Loop functions |
| 2. Complex functions | 9. Matrix functions |
| 3. Constants | 10. Polynomial functions |
| 4. Statistical distributions | 11. Probability functions |
| 5. Hyperbolic functions | 12. Real functions |
| 6. Integer functions | 13. Relational tests and Boolean operators |
| 7. List functions | 14. Trigonometric functions |

When you select a specific function, the display shows you the general syntax for calling that function. This information includes the names of the parameters. This a very useful on-the-fly tip.

The designers of the HP 39gII offer a very adequate set of functions for each of the above categories of functions. These functions make the HP 39gII a serious contender in the calculator market. I was pleased

to see that the set of matrix functions included a rich collection of function that went well beyond the minimum list of matrix functions (i.e. determinant, inverse, and transpose). The list of function includes ones for eigenvalues, eigenvectors, identity matrix, LU decomposition, QR factorization, SVD factorization, and least-square regression (my number one favorite command for this machine), to say a few.

Figure 5 displays the Math Functions menu showing the list of matrix commands. The figure shows the selection of the LSQ matrix function, which performs least-square regression.

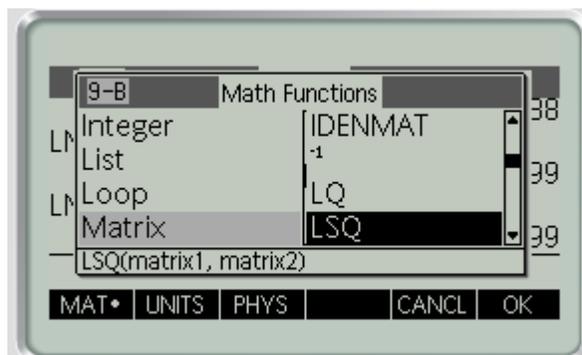


Fig. 5 - The Math Functions menu showing the list of matrix commands.

The Apps Menu

The Apps menu offers the calculator user several form-based Apps that perform a wide variety of tasks. These Apps absolve you from creating them using custom programs. Each App displays its own input form and soft menus. The HP 39gII offers the following Apps:

1. The **Function App**. This App allows you to enter up to ten functions that you can use to plot.
2. **The Solve App**. This App allows you to enter up to ten functions that you solve for their roots. The heart of this App is the HP Solve software that is present in many HP calculators.
3. The **Statistics 1 Var App**. This App allows you to enter data in a matrix and then select the column for which you obtain many descriptive statistics.
4. The **Statistics 2 Var App**. This App allows you to enter data in a matrix and then select the columns for which you obtain many statistics for the correlation between any two columns.
5. The **Inference App**. This App allows you to tests the means of two populations using normal and Student-t tests. Each set of tests can check if the two means are less, equal, or greater than each other.
6. The **Parametric App**. This App allows you to define pairs of parametric X and Y variables that depend of a third variable T. The calculator uses the information to make parametric plots.
7. The **Polar App**. This App allows you to define polar variables and uses the information to make polar plots.
8. The **Sequence App**. This App allows you to define sequence variables and uses the information to make plots.
9. The **Finance App**. This App performs basic TVM (time value of money) calculations and also displays an amortization table.

10. The **Linear Solver App**. This App allows you to solve systems of two or three variables, by easily entering the values for the matrix coefficients and the constants vector.
11. The **Triangle Solver App**. This App allows you to solve for the sides or angles of a triangle.
12. The **Linear Explorer App**. This split graph/text view App allows you to explore the slope and intercept of a straight line. You can use the navigation keys and the soft menus to change the slope and intercept. The App alters the graph of the straight line according to the current settings.
13. The **Quadratic Explorer App**. This split graph/text view App allows you to explore the plot of a quadratic equation. You can use the navigation keys and the soft menus to change the parameters for the quadratic equations and instantly change the shape of the quadratic curve.

The Graphics Features

The HP 39gII supports graphing function in a manner we are accustomed to. The Function App allows you to specify one or more functions to plot. The Function Plot Setup command (invoked by pressing the blue shift and Plot buttons) allows you to specify the range of the plot as well as other plotting parameters. Figure 6 shows a sample Function Plot Setup form.

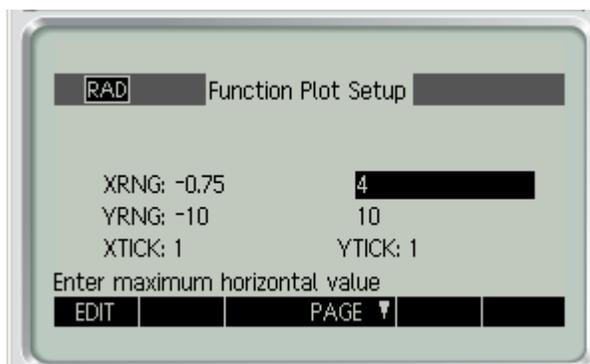


Fig. 6 - A sample Function Plot Setup form.

You can use this setup repeatedly to fine-tune the plotted functions. To view the graphs of the functions, you press the Plot button. Figure 7 shows a sample function. The calculator offers additional soft menus, once you invoke the MENU option. You can then zoom in on the graph, trace the values on the curve, and jump to the curve at a value of X of your choice.

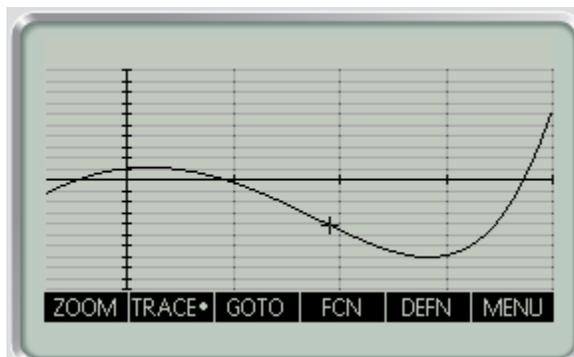


Fig. 7 - A sample function plot.

Programming the HP 39gII

Programming the HP 39gII is another impressive aspect of the calculator. The approach to programming the HP 39gII is to create functions with optional, though frequently needed, parameters. These parameters are type-less and can be complex, list, matrix, and real typed-values. A function can call other existing functions. It can also declare local and exported variables that can be complex, list, matrix, and real typed-values.

When you press the Prgm command (invoked by pressing the blue shift and 1 buttons), the calculator displays the Program Catalog form, as shown in Figure 8. This form lists the names of the programs along with their sizes.

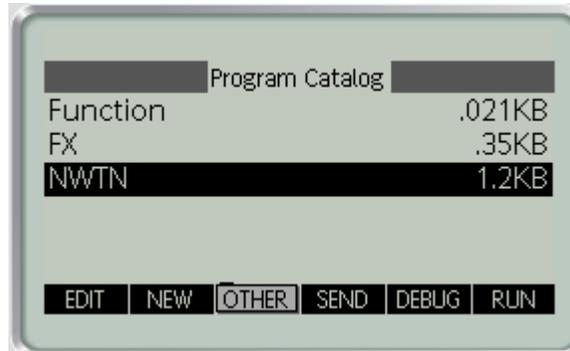


Fig. 8 - The Program Catalog form.

The Program Catalog form allows you to create a new program, edit, debug, run, delete, clear, and transmit the currently selected program. When you select to create a new program, the calculator first prompts you to enter the program's name. It then displays the program form, after inserting a minimum skeleton code. Your task is to insert any parameters used by the program, declare any local variables, declare any exported variables, and enter the program statements. You need to declare variables whose names exceed one letter. The program requires that each statement ends with a semicolon.

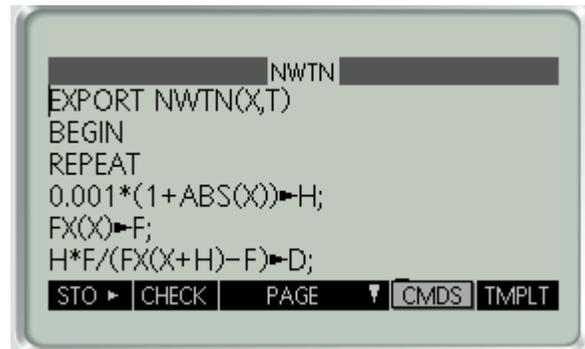


Fig. 9 - A Sample program.

The HP 39gII supports common decision-making and looping constructs. The TMPLT soft menu allows you to insert various kinds of constructs:

1. Decision-making constructs. These constructs include IF-THEN, IF-ELSE-THEN, CASE, and IFERR (to handle runtime errors).
2. Looping constructs. These constructs include FOR, FOR STEP, REPEAT-UNTIL, and WHILE.
3. Input constructs. These constructs include CHOOSE and INPUT.

Using the EXPORT command, you can export variables from programs so that you can access their values after their host programs terminate. You can use the Vars menu to view these exported variables.

You can run a program from the Program Catalog form or from the edit line after you press the Home button. If you choose the former, the calculator dynamically creates a form that lists the program's parameters and waits for you to enter a value for each parameter. The default value for each parameter is zero. Once you are done with the input, you press the OK soft menu. This action executes the program using the current arguments you entered, and default values you chose to accept, for the different parameters. The calculator then displays the result in a small popup window. To store the value returned by a program you need to invoke it from the editor of the basic calculation mode, and assign the result to a variable.

Since Figure 9 shows part of the listing of program NWTN (which uses program FX), here are the listings for both programs. First, here is program FX:

```
EXPORT FX(X)
BEGIN
e^X-3*X^2;
END;
```

Here is the listing for program NWTN, which implements Newton's method to calculate the root of the function in program FX:

```
EXPORT NWTN(X,T)      H*F/(FX(X+H)-F) →D;
BEGIN                 X-D→X;
REPEAT                UNTIL ABS(D)<T;
0.001*(1+ABS(X))→H;  X;
FX(X)→F;              END
```

The subject of programming the HP 39gII is worthy of one or more separate articles. So for now, I will limit my coverage to the above discussion.

Conclusion

The HP 39gII is a powerful machine that uses a rich set of soft menus and forms to interact with the user. The machine packs a respectable set of math and graphing functions, along with a versatile BASIC-like programming language.

About the Author

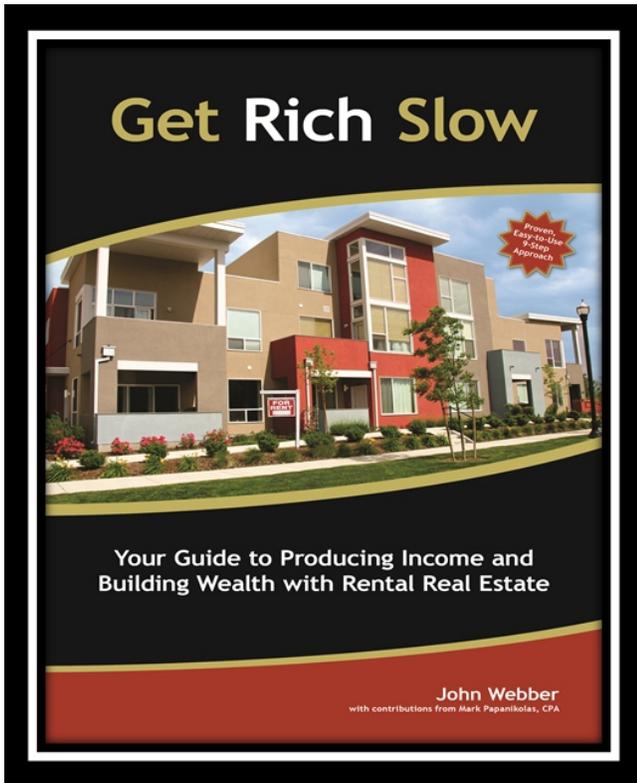


Namir Shammass is a native of Baghdad, Iraq. He resides in Richmond, Virginia, USA. Namir graduated with a degree in Chemical Engineering. He received a master degree in Chemical engineering from the University of Michigan, Ann Arbor. He worked for a few years in the field of water treatment before focusing for 17 years on writing programming books and articles. Later he worked in corporate technical documentation. He is a big fan of HP calculators and collects many vintage models. His hobbies also include traveling, music, movies (especially French movies), chemistry, cosmology, Jungian psychology, mythology, statistics, and math. As a former PPC and CHHU member, Namir enjoys attending the HHC conferences. *Email me at: nshammass@aol.com*

Get Rich Slow

HP Solve #27 page 11

[← Previous](#) **Article** – [Next →](#)



With rental market occupancy rates on the rise and the stock market experiencing another volatile year, there may be no better time than now *To Get Rich Slow*. John Webber, author of the book *Get Rich Slow*, offers potential investors an easy-to-follow 9-step approach toward investing and building wealth in the rental real estate market. This book is a roadmap to financial freedom in a market space that tends to be easier to predict, experiences less volatility, provides steadier rates of return and is a good hedge against inflation.

“With this 9-step approach, we get into the “nitty-gritty” of investing in the real estate market.”

“If a potential investment doesn’t work out on paper; it won’t work out in real life!”



John Webber is a business professional and teacher within real estate development. John has held many leadership positions such as:

- ❖ Vice President of the Salt Lake Board of Realtors
- ❖ Chairman of the Education Committee for the Utah Association of Realtors
- ❖ Regional Governor for the National Association of Independent Fee Appraisers
- ❖ Partner at Intermountain Tax Consultants

John teaches at the Salt Lake Community College and has authored several books:

- ❖ Math for Business and Life
- ❖ Contemporary Business Mathematics
- ❖ Investment Analysis

However, this book won't turn investors into instant millionaires! This investment strategy requires methodical thinking and patience. John's philosophy, "I consider investing in the real estate market to be a *slow* but *reliable* opportunity to build wealth. This investment strategy minimizes much of the risk that investors experience today when investing in the stock market."

The following is an overview of *Get Rich Slow* and John Webber's roadmap to financial success...

Step 1: Weigh the Pros and Cons

John helps his readers evaluate a variety of investment alternatives from the traditional stocks and bonds to rare precious metals and collectibles. He then outlines eight critical factors for people to consider when making investment decisions.

After providing an overview of a range of investment types, the author narrows his focus on real estate investment. He prompts readers considering investment in real estate to ask themselves, "Do I really want to be a landlord?" If the answer to this question is "YES!" then continue to read on....John clearly outlines a roadmap to building wealth in the real estate market in Steps 2-9.

Step 2: Get Your Ducks in a Row

Chapter two focuses on building a foundation for Success. The author advises hopeful investors about how to assemble a team of experts to help them make solid real estate investment decisions. This team of experts will help investors to find appropriate properties, determine appropriate timing, locate adequate funding and analyze potential partnership benefits.

Step 3: Eliminate the Duds

No investor wants to purchase a money pit. John helps investors analyze potential properties to assess whether or not the purchase is a valuable one. He helps readers calculate the price per unit, the price per square foot and the gross rent

8 Critical Investment Decision Factors

- 1. Management of the investment**
 - Determining the level of involvement needed to maintain a positive ROI
- 2. Liquidity**
 - Understanding how quickly one can turn their investment into cash
- 3. Cash Flows**
 - Knowing when and how often one will receive money inflows on their investment
- 4. Appreciation**
 - Not all investments experience an increase in value such as CD's a fixed return investment
- 5. Tax Consequences**
 - Not all investments are taxed equally nor in an equal time period
- 6. Risk**
 - Determining the investors level of risk adversity
 - perhaps the most important factor to consider when making an investment
- 7. Leverage**
 - Using borrowed funds in order to make an investment—impacting cash flows
- 8. Rate of Return**
 - Determining which investment provides the highest level of return

“Get Rich Slow brings value to the novice investor because the proven, easy-to-use 9-step approach minimizes the fear of investing in rental properties.”

multiplier. Once these calculations have been made, investors can determine whether or not the investment is worth pursuing by comparing these figures to the average comparable sale of the investment.

Step 4: Estimate Net Operating Income

How much income will the property produce each month after all expenses have been paid? Every investor will want the answer to this question and John helps them determine it. He explains what an operating statement is, the importance of analyzing the properties historical operating statements, how to project future revenue streams, and determining the investment property’s capitalization rate.

Step 5: Get to Know Your Hidden Partner— The Tax Man

It was all fun up until this point. However, taxes are just one of those things everyone can count on and investing in real estate is no exception to this rule. John outlines the different set of rules laid out by the Internal Revenue Service (IRS) and helps investors determine their after-tax rate of return after determining their tax bracket, depreciation, purchase and loan costs, passive losses, paying tax on gains and the alternative minimum tax.

Step 6: Crunch Numbers Like a Pro

John points out that in order to make good financial decisions and money, you need to know how to crunch the numbers. In this chapter, John outlines three important financial calculations every investor should know and understand: time-value-of-money, amortization of mortgage loans, and calculation of cash flows. He makes several calculator recommendations and features keystrokes for the newly released HP 10bII+ financial calculator and the TI BAII Plus.

Step 7: Figure the Bottom Line: Cash Flows & Rate of Return

As John states in this chapter, “It is time to get our money’s worth!” After making the calculations in

“Get Rich Slow also appeals to experienced investors because now they have a method for evaluating investments, instead of relying heavily on gut-instinct.”

steps 3-6 investors can now project their cash flows and determine their final rate of return. John helps investors figure their cash-on-cash return, project their cash flows after tax and operating expenses, project cash flows after tax for the sale of the property, and finally, calculate their after-tax rate of return.

Step 8: Buy It or Walk Away: Decision Time

Now that investors have calculated their after-tax rate of return, John walks them through the process of determining whether or not the property meets the investment criteria. If so, John then explains how to make an offer on the

property, discusses the importance of due diligence during the purchasing process, and encourages investors to modify their calculations of after-tax cash flows and rate of return based on any new info discovered and the final negotiated numbers.

Step 9: Help the Money Tree Thrive: Effective Landlording

At this point investors are now officially landlords!!!! It's time for them to roll-up their sleeves because the real work begins. John informs landlords of all the follow-up items that need to be accomplished after the closing, the importance of selecting good tenants, the need to keep the property in good condition, the importance of good record keeping, how to maximize rent and control expenses. IF all of that sounds a bit overwhelming, John outlines the benefits of hiring a property management company.

Need and want to understand how to use your HP 10bII+ calculator? John can help you; he provides step-by-step problems that will help make critical financial calculations a snap!

Keystrokes for the HP 10BII+ are shown throughout the book to calculate:

- A. Time Value Money calculations
 - i. Present and future value of Single deposit investment
 - ii. Present and future value of a multi-deposit investment
 - iii. Yield on an investment
 - iv. APR for an installment plan
 - v. Amount to pay for a promissory note
 - vi. Time remaining on a term loan
- B. Amortization Calculations
 - i. ARM's and Balloon Payments
 - ii. APR for a mortgage loan
- C. NPV: Calculate the net present value of an investment
- D. Additional calculations also shown in excel

Collecting/Displaying/Demonstrating/Storing HP Calculators

HP Solve #27 page 16

[← Previous](#) **Article** – [Next →](#)

Collecting, Displaying, Demonstrating, and Storing HP Calculators

Richard J. Nelson

Introduction

What is a collectable? People collect just about anything from buttons to motor cars. The reasons will vary from having a special interest in the collected item to inheriting a collection. Collectables are interesting, and are a great conversation topic for friends to talk about.

My mother once received a small angel figurine as a gift from a casual friend. She displayed it on a shelf for all to see. Her other friends saw the angel and they also bought her angels for gifts. Before long - five years - she had become an angel “collector.” Fig. 1. shows a small corner used to display her collection. The angels range in size from 2 inches to over 20 inches. Some have fiber optic colored lighting and moving wings. Some represent various cultures and beliefs. They are made of a dozen different materials and each has a story.



Photo by Richard J. Nelson

Fig. 1 – Example of a collectable – 45 of hundreds of angels.

When the number of people who collect things increases, a market for buying and selling them develops. At this point the “collection” starts to increase in value. This often justifies the collection and its value grows over a life time.

The angel example illustrates that many collections do not start out as a formal activity. If forethought were put into the items to collect there would be several major considerations. Imagine hundreds or even thousands of the collectable. Where would they be kept? How long will they last? What about the accessories such as descriptive literature or owner’s manuals? Of course the most important part of deciding what you collect is cost and your own personal interest.

Collecting HP calculators

Calculators are attractive as a collectable to technical people because they have not been around for very long – about 43 years commercially – and the technology of calculators covers the same technology as computers. The very first calculators (4 bangers) were very expensive selling for hundreds of dollars⁽¹⁾.

The ability to make instant calculations of large numbers using a small electronic device was useful to just about every technical person in society. Their collectable size is “reasonable” because they don’t take up much space. Because millions and millions of calculators have been made by hundreds of manufacturers⁽²⁾ the calculator has become a low cost and very common tool.

Because so many different calculators have been made, most calculator collectors restrict the kinds or types of machines they collect. A few examples are:

1. LED display machines.
2. 1970s machines.
3. A specific manufacturer’s machines.
4. Mechanical calculators.

5. Programmable calculators.
6. Calculators from a specific country, esp. Russia.
7. Unusual machines, technology advances.
8. Machines with “collector’s” value
9. Machines of a style, function set, or type that appeal to the collector.

If you know a serious calculator collector – you have met some of them in the pages of *HP Solve* in the Customer Corner column – you will discover that no matter what kind of collection they have, they always have a few HP’s. If you are an HP user you can understand why.

What most collectors fail to immediately recognize is the magnitude of materials that soon become a part of collecting calculators. Fig. 2 shows a few examples of associated items. User Guides, books, sales literature, Ads, accessories, Limited Editions, Anniversary Editions, and Foreign Editions are just a few categories of associated HP calculator collectables.

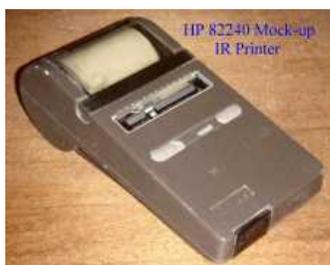


Photo by Richard J. Nelson

Fig. 2a – Prototypes.

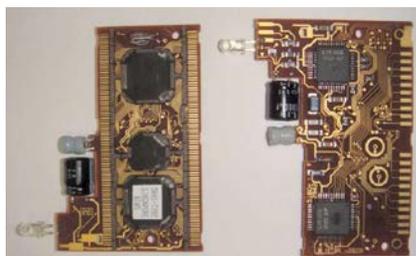


Photo by Richard J. Nelson

Fig. 2b – Assemblies.



Photo by Richard J. Nelson

Fig. 2c – AC Adapters.



Photo by Richard J. Nelson

Fig. 2d – 3rd Party.

Basically there are three types of HP calculator collectors.

1. The **casual collector**. This is usually a long time user of HP machines who has bought many of the new models as they are introduced.
2. The **user collector**. This is often the casual collector who has become more of a real collector because he buys and sells calculators in order to build his collection. His wife and family are the limiting factors in “how he operates.”
3. The **formal collector**. This is the person who is collecting just to collect and the challenge is growth and completion. Often these collectors have extra money to spend and these are the people who drive the prices up on eBay.

Displaying HP Calculators

One of the biggest issues every HP calculator collector has is being able to display their machines. If you have a dozen or less, they may be placed on any convenient book shelf or small display case. If you want to display your machines - most collectors don’t because of the obvious reasons of space - you will consider shelves, display cases, and stands. If you just have a couple hundred machines the problem is manageable, but what if you have over a thousand calculators? In terms of HP’s machines the number of the basic models is about 120, but if you also include the many variations on these models, and the models that were never produced, etc. the number is multiplied by five or more.

A calculator stand is useful for displaying your HP calculators because it puts the machine at a nice angle for viewing. Most stands are designed and made for using the calculator (rather than displaying) and

several examples will be shown. Let's first list a few objectives for a calculator stand.

Calculator Stand Objectives

- a. To put the display at a more normal angle for easier reading.
- b. To reduce display glare from various lighting sources – sunlight from a window or strong glare from overhead lights.
- c. To provide stability.
- d. To provide a wireless interface or external power supply (larger batteries).

What makes a good calculator stand?

1. Portable, easily carried with the calculator.
2. Sturdy, pressing any key should not cause tilting.
3. Easily adjustable angle.
4. Won't slide or move.
5. Is attractive.
6. Is reasonable in cost.

The various attributes of calculator stands are best illustrated with photos. Fig. 3 shows four basic mid 70's designs of calculator stands.

- A. Low cost plastic folding stand, 3-1/4" wide, 6-1/8" high, and sold under the brand names CalConverter and Countdown. The Countdown brand by Bibi was made in Hong Kong, and sold for 99¢ at *Thrifty*. The stand has 16 adjustable positions, folds flat, and fits most calculators. It has a desk top gripping rubber base and is of sturdy construction. It weighs 2.91 oz. and the 16 calculator angles range from 21 degrees to 57 degrees.
- B. Rubber coated steel rod is used for this simple low cost nonadjustable stand. The HWD dimensions are: 2-7/16" x 2-1/2", x 5-9/16." At 1.29 oz. the calculator angle is 26 degrees.

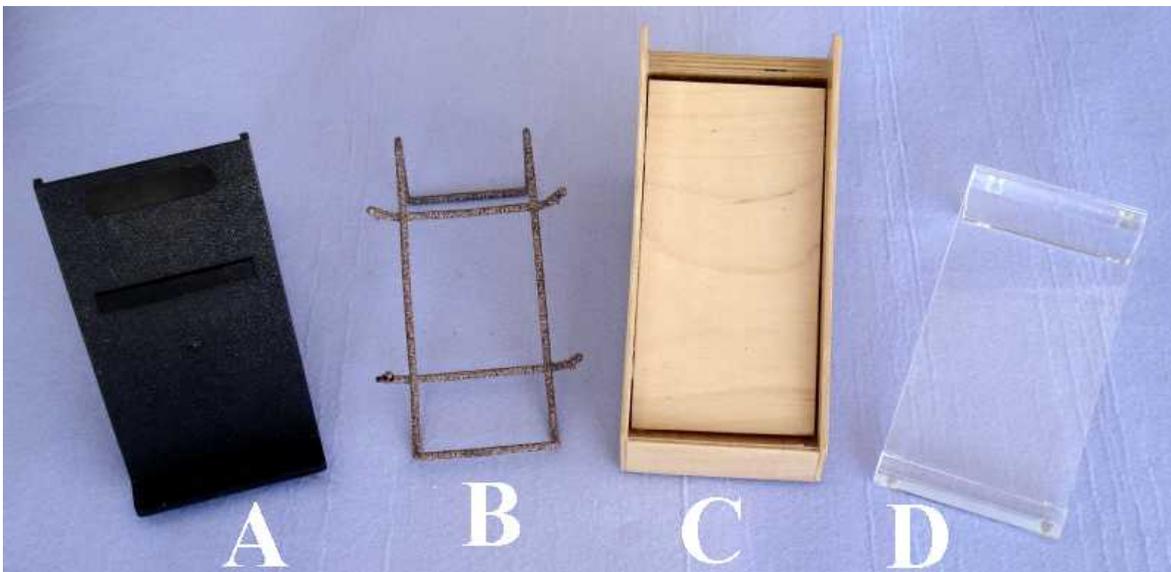


Fig. 3a – Four basic designs of vertical format calculator stands front view. See text for details.

- C. This is a homemade wood stand that looks like it should open to store accessories inside. Instead the space is about half filled with plaster(?) which make it quite heavy – 4 pounds. It is 4-1/2” high, 3-3/8” wide, and 6-3/4” deep with an angle of 30 degrees.
- D. One of the most popular calculator stand styles is the acrylic stand. It always looks modern, and it is still popular today. This stand is 1-3/4” high, 3-3/16” wide, and 6-9/16” deep, it weighs 4.75 oz. and the calculator angle is 15 degrees.

Stands for larger (office and BASIC) machines would be wider and, if necessary higher. Fig. 5 shows a smoky acrylic stand made specifically for the HP-71B calculator.

Individual stands would add to the space required for a calculator display and perhaps a wider stand would be better. Fig. 6 shows a smoky acrylic stand that is suitable to display multiple machines.

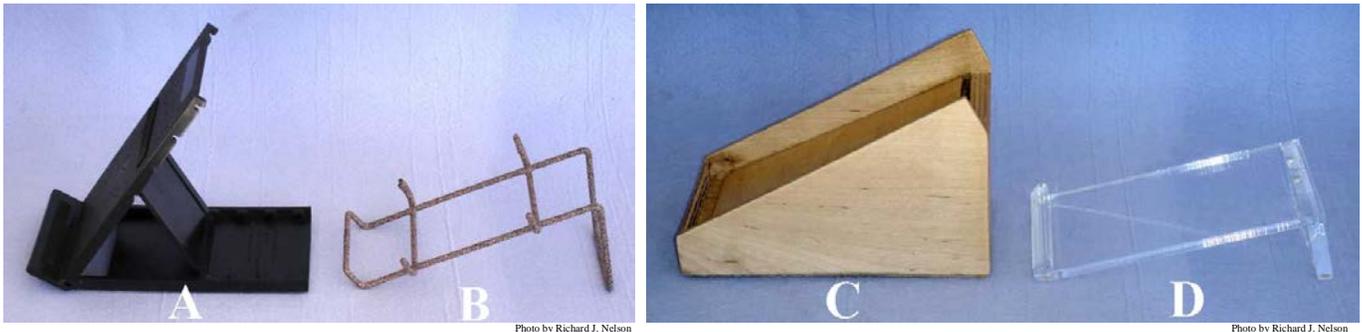


Fig. 3b – Two designs of calculator stands side view. Fig. 3c – Side views of calculator stands. See text for details.

If a sloping (45° - 60°) shelf book shelf were built to display calculators a strip of 1 inch quarter round should be added to the bottom to support the machines.



Fig. 4 – Four basic designs of Fig. 3 with calculators in place.



Photo by Richard J. Nelson

Fig. 5a – Two prototype examples of a dark smoky acrylic stand showing two densities.



Photo by Richard J. Nelson

Fig. 5b – HP-71B calculator on a dark smoky acrylic stand.

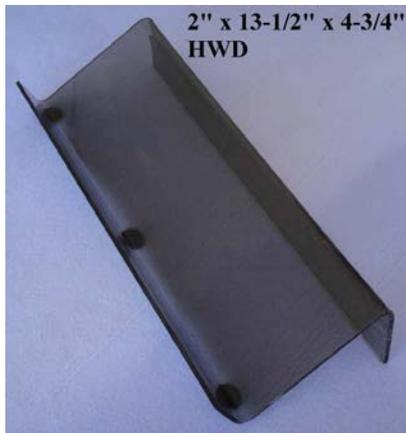


Photo by Richard J. Nelson



Photo by Richard J. Nelson

Fig. 6 – 8 oz. wide stand example. Fig. 7 – Four Pioneer series machines on one 29 degree calculator stand.

Many old time HP calculator users, especially collectors and authors, have many of the machines that HP has made during the last 41 years. Figs. 8 and 9 show a large HP calculator stand that puts 30 machines at a convenient location to be easily found. This stand is easily moved and it allows items to “pile” up

around it on the desk top. This space is nice for User's Guides. It is a much more convenient solution to having the machines piled up in a drawer.

The calculator stand shown in Figs. 8 & 9 has proven to be very useful to keep a large number of calculators within easy reach. The front of the stand is 8-3/4" above the desk top. It is 20" wide, 4-9/16" deep, and the shelf is 7-1/8" high. It is made of gray painted 7/16" plywood.

The calculator compartment is tilted back 60 degrees. HP calculators are wedged shaped with the display end thicker than the keyboard end. As shown, there are 7 machines stacked one "on top" of each other. The wedge effect is to have the front (top) machine nearly vertical. It is desirable for them to lay back for better stability. For the 4-1/8" shelf depth the angle probably should be closer to 75 degrees. The best angle will depend on how many machines are stacked. The "wedge angle" ranges from $\approx 7^\circ$ for an HP-35A to $\approx 2^\circ$ for a HP 30b.

One of the nice features of the 30 calculator stand is that you may see the tops of the machines. When the higher models are at the rear the machines are more easily recognized and the desired machine may be easily selected, pulled out, and then replaced.



Photo by Richard J. Nelson

Fig. 8 – Calculator stand that will hold (store) up to 30 HP calculators depending on the models used.



Photo by Richard J. Nelson

Fig. 9 – Oblique view of the 30 calculator stand showing the steep angle to keep the machines handy.

This stand is easily moved around. If you move to another location to work you may just pick it up and move it. The weight as shown is 13.4 pounds.

There is one interesting calculator stand specification that never seems to be mentioned in any of the promotional literature or box information. The missing and most important specification is the angle⁽⁴⁾ of the stand. In all the literature I have seen the angle is described as “most desirable angle”, “upward angle”, “higher angle”, “natural angle” “ideal angle”, “a better angle”, or “a suitable angle.” I have never seen the actual angle in degrees specified. It is clear from the various angles given for the few examples in Figs. 3 - 7 that there is not a “best angle.”

If you Google “calculator stand” you will get: “About 56,600,000 results.” Bing returns “48,900,000 results.”

Fig. 10 shows a formal display case of a few of Wlodek’s calculators in the UK. The Display case was provided by Imperial College for a conference and it is not optimum for calculator displaying.



Photo by Jake Schwartz.

Fig. 10 – Formal Display case.

Demonstrating HP Calculators

One of the issues that collectors have is the number of and variety of batteries that are used for them. Let's estimate the cost of batteries for the few calculators shown in the 30 calculator stand. At a conservative \$3 per calculator that is \$90 just for batteries. A casual HP collector will have at least 200 machines. Keeping all of these machines in batteries is a major cost issue.

To demonstrate a calculator means that it has to power up and work. If it is an HP classic machine the display will use battery hungry LED displays and an AC adapter would probably be used to demonstrate these seven machines. There are other LED display models and the space (and weight⁽³⁾) of the adapters adds to the issues of a well displayed working HP calculator collection. See Fig. 2d on page 2. AC adapters require AC outlets and wires. Some HP calculators cannot be AC adapter powered without their batteries and to do so will damage the machine. The Woodstock machines fall into this category. All of these are considerations for the calculator collector's display area(s). Yes, a full room is required for a moderate HP calculator collection. Don't forget all the related materials listed above that are associated with each machine.

One solution to the calculator power (battery) problem is to have a universal AC adapter that has an adjustable DC supply voltage that is set to the requirements of the machine. A proper set of leads with E-Z Hook⁽⁵⁾ type connectors on the end to allow clipping on to the battery terminals in the battery compartment is reasonable in terms of cost and convenience. A single AC adapter could power any calculator made.

Let's not forget about adequate table top space – with handy AC outlets.- to spread out the many machines being explored and demonstrated.

Storing HP Calculators

A small hand held calculator with all of its accessories and other associated materials such as user Guides etc. takes a considerable amount of storage space. The manuals will store on a book shelf. Other paper materials such as instruction sheets, photos and ads will store nicely in a filing cabinet. Storing the calculators, however, is an important challenge to be carefully considered.

An HP Calculator collection will often develop in stages as it grows. The collector I am writing about here is the User Collector as described above (page 2). The primary interest is the calculators and not the collection. The result of this approach is that nicely organized displaying and storing of the machines is a nice idea, but not the most important task to be worked on. The important task is acquiring and learning



Fig. 11 – Dresser is used to store calculators.



Fig. 12 – Another Dresser drawer.

about the next machine. I asked several collectors to take a photograph of the storage of their machines. I received one. For obvious reasons he didn't want to be identified.

I have had a lot of technical materials in storage which I unpacked after I retired. Unpacking a life time of materials is a long process, but at least I am organizing what I have. My calculator "collection" is slowly getting organized. Collection is in quotes because I do not fall into any of the three categories as defined above. I am a user type collector with the exception that I haven't sold my calculators.

In my case I dedicated a dining room sideboard into a cabinet for calculators. I built a shelf to put on top of the sideboard and the "calculator department" is shown in Fig. 13. This provides accessible storage for my few hundred machines.



Photo by Richard J. Nelson

Fig. 13 – RJN Calc. Department.



Photo by Richard J. Nelson

Fig. 14 – This is the top drawer of Fig. 13. The four sideboard drawers are lined with green felt and the machines are "stacked" only if they are of the same type or model number. This is an old photo. Many boxes of machines have been unpacked since this drawer was started.

The white boxes on top are used to store various "other" calculators, hard cases, and soft cases. The two shelves, now completely packed are used to store boxed machines. The left section of the sideboard is used for various items such as power supplies, and other related equipment. The filing cabinets and book shelves are in another room.

While tidying up after the last HHC Conference I noticed two card board boxes that were left from HP bringing calculators. They were designed for shipping calculators from China and they are made of double corrugated cardboard. Since I was driving from CA to back AZ I had the space, but I regret only taking one. See Fig. 15. One of the issues related to storing calculators is that they tend to get stacked and finding a particular model may require a bit of moving machines and looking.

The box eliminates the searching if each compartment is identified and an inventory is made. Having an inventory is very important for many reasons, and it becomes ever more important as your collection grows. Here are the specifications of the box. 10-3/8" x 21-3/8" x 10-5/5/8" HWD. It has 35 compartments approximately 3-1/2" wide and 1-1/8" high. I am not sure if the box was designed for a specific machine or to be a generic box. I put several larger machines into various compartments to illustrate. B2 is an HP-12C. There is lots of space. B4 is an HP 49g+, C7 is an HP-71B, D5 is an HP 40gs, and D2 is

an HP 30b in a bubble pack bag. The back (bottom) of the box is white foam to also protect the machines. I presume that there was a similar piece of foam for the top as well because there is space above the compartment dividers. Just about every handheld machine that HP has made will fit. Even the very wide OfficeCalc series will fit if put into a top or bottom compartment with a divider cut away. The Woodstock machines are 2-1/2" thick and are too heavy. The HP-75C/D machines are too wide to fit properly as well. This box, however, would make a great means to store HP calculators if they must be stacked up in a closet. Even the small compartments at the sides may be used for interface cables. The lettering columns however, should be "A" through "G" if they are used.



Photo by Richard J. Nelson

Fig. 15 – Corrugated calculator shipping box. The 35 compartments are suitable for most of HP's models.

I know one collector who has every HP Machine ever made in its original box. This is actually his second collection (the first complete set didn't have the "original box" requirement) that he intends to pass the collection on to his children. Obviously this collection is stored in the same manner as a large gold coin collection because of its very high value.

The value issue is one that begins to take importance as the collection and investment grows. One collector I talked to mentioned that he has his collection stored in three different locations. If someone were to break in and steal some machines the loss would be less.

The first task at storing a calculator is removing the cells (batteries.) ALL cells leak and the damage the electrolytic causes greatly diminishes the value of the machine – either for use or for future sale.

Observations and Conclusions

Each of the four topics of the title deserve its own a book or separate article so this single article cannot

delve into very much detail. HP calculator collectors expand their collections because of the tremendous depth and technology changes of the various models of the last 41 years of HP calculator production.

The three basic HP Calculator Collectors are: the Casual, the User, and the Formal collector. There are quite a few collectors who have every model HP has ever produced. Some even have multiple versions of the same model starting with the very first model, the HP-35A, which has at least five significant variations. If you include all of these variations the basic number of about 120 models easily extends to many hundreds of machines.

Displaying HP calculators is a natural for collectors, but space and cost are major considerations and very few collectors have a formal display of their machines. The use of calculator stands and appropriate display cases is briefly discussed. Demonstrating the machines requires batteries and the cost of keeping them all in batteries is not practical and an AC Adapter is proposed with a suitable connector for all machines.

Storage is space intensive and examples show that every imaginable space from under the bed, in a closet, to a dedicated room is used.

Collecting, Displaying, Demonstrating and Storing HP Calculators – Notes

- (1) One of the very first four banger machines was the Sharp QT-8 introduced in March of 1970 for \$495. See Fig. N1, Ball & Flamm. This machine would cost \$2,961.83 in today's dollars based on the CPI at: <http://www.minneapolisfed.org/>. \$3,000 in 1970 would buy you a new car!
- (2) There are many books and Internet pages dedicated to calculator collecting. The two "must have" references are shown below.

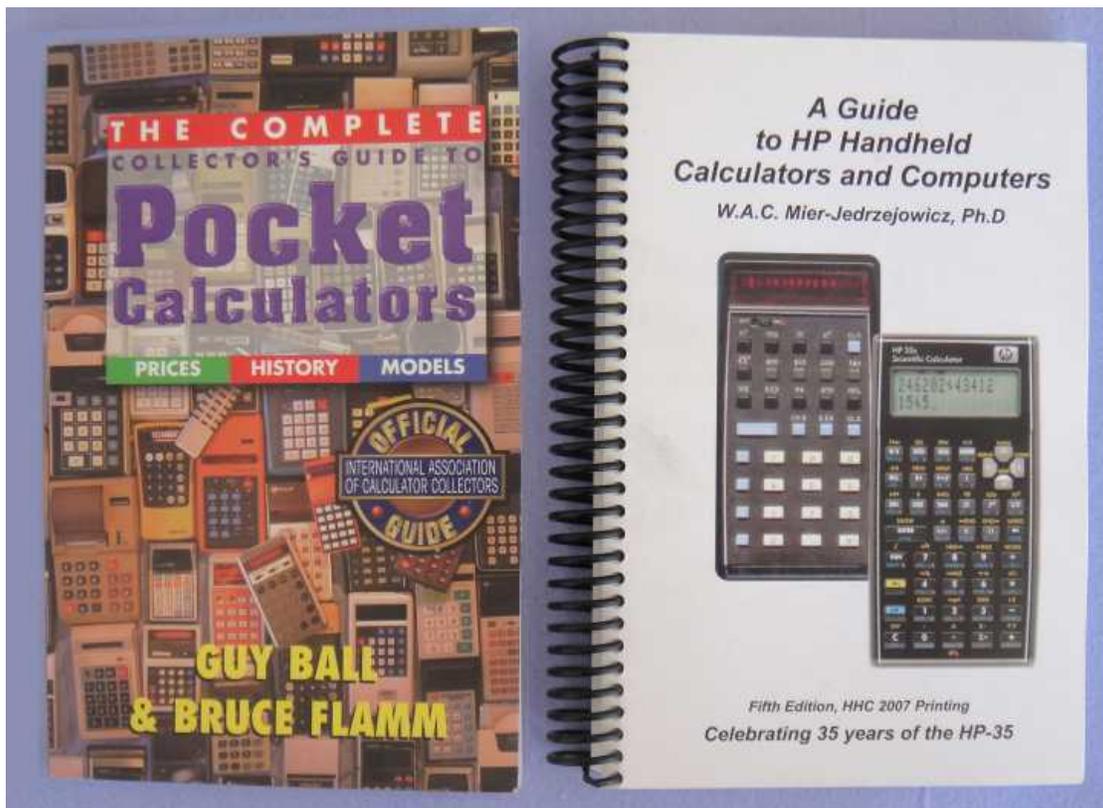


Fig. N1 – Two excellent reference books for calculator collectors to find information related to calculators.

- (3) Older calculators (especially 1970's models) that used AC adapters had heavy linear type adapters. Most modern cell phone or laptop AC adapters are switchers. These are much lighter than the old linear technology of the first dozen years of calculators.
- (4) The angle of the calculator stand is the angle between the support surface and the table top. A popular angle is 15 degrees for stands intended for formal desk top use. A very important consideration is lighting glare and there are many situations where the user doesn't have control of the lighting and an adjustable angle is more desirable. If you want to determine the approximate angle of the stand divide the display end height by the length of the stand that the calculator sits on and take the arcsine. For example, "Multipurpose Acrylic Riser/Stand, Nonskid Pads, 9 x 11 x 2 1/4". Arcsine of $2.25/11 = 11.8$ degrees.
- (5) An E-Z Hook connector is a popular engineer's clip-on connector for making electrical connections to circuit components. An example is shown greatly enlarged below. Red would be used for positive and black for negative. The user presses the end like a syringe to open a small hook (at the left end as shown below) to clip onto a small part of the battery terminal. Various sizes are available including a micro hook model. See: <http://catalog.e-z-hook.com/category/test-hooks?>

Perhaps a calculator stand with holes to allow the leads to protrude below the stand would be desirable. An additional set of connectors consisting of alligator clips would work better for the older and larger sized battery compartments.



Fig. N2 – E-Z Hook example to consider using to connect an AC adapter to calculator battery terminals.

HP Calculator Programming

HP Solve #27 page 29

[← Previous](#) **Article** – [Next →](#)

HP Calculator Programming

Richard J. Nelson

Introduction

Do you use an HP calculator that has a programming capability, and do you actually use it?

Of the 24 models, see Table 1 below, 23 are on the HP website 13, or 54.2%, are programmable. If the Home and Office machines are omitted, the numbers are: 17 models, and 13 or 76.5%, are programmable. What does this mean?

A program is a sequence of instructions (functions and/or data) that are keyed (or loaded) into the calculator's memory that will solve a particular problem or provide specific information. A program capability also includes special instructions that provide prompting for inputs and labeling for outputs. Another aspect of a program capability is the ability to perform decision logic so the particular parts of a program may be changed depending on the results of previous instructions. This capability provides "intelligence" to the program.

The program capability of the 10 current models ranges from very simple such as the HP-12C to very complex (and very powerful) such as the HP 50g. Older HP calculators such as the HP-71B or HP-75C used a computer like programming language called BASIC. The HP-12C and HP-15C programming language is an RPN FOCAL⁽¹⁾ like language, and the HP 50g uses an RPL programming language. The algebraic calculators use what may be called an Aplet programming language.

Table 1 – Current HP Calculator Products (24)

#	Financial Calculators	Scientific & Graphing	Home & Office
1	HP 10bII	HP 10s	HP Calcpad 100
2	HP 10bII+	HP-15C Limited Edition	HP CalcPad 200
3	HP 20b	HP 33s	OfficeCalc 100
4	HP 30b	HP 35s	OfficeCalc 200
5	HP-12C	HP 39gs	OfficeCalc 300
6	HP-12C 30th Anniversary	HP 39gII	PrintCalc 100
7	HP-17bII+	HP 40gs	QuickCalc
8		HP 48gII	
9		HP 50g	
10		SmartCalc HP 300s	
	5 of 7 = 71% programmable	8 of 10 = 80% programmable	None programmable

Note: Programmable calculators are in blue.

Programmable Calculators

Very simple programmable calculators are often described as keystroke programmable. The idea is that if you wanted to make a calculation such as calculating the volume of a sphere using RPN;

$$V = \frac{4\pi r^3}{3}$$

you would key the radius, r, press ENTER twice, x twice (cubes the radius), π , x, 4, x, 3, \div . If the diameter is 2 inches the radius is 1 inch, and the volume is 4.188 cubic inches.

Now let's increase the diameter by 1/2 inch so the radius is 1.25 inches. The volume now is very nearly double or 8.181 cubic inches.

If you are an orange grower making a statistical size analysis of your oranges, and if you had dozens of problems to solve, you would soon get tired of pressing so many keys for each orange measured. The process of keying the same keystrokes and storing them in program memory is called "writing" a program. Even a simple program can be a big time saver if many problems of the same type are being solved. If it took you twice the time to put the keystrokes into memory as it did to make a single calculation you would save time starting with the third calculation. The calculations from then on would be solved nearly instantaneously.

There are two ways a program may be entered into a calculator. (1) By keying it into the calculator as just described, or (2) By downloading the program from an external source as the HP 50g does by using its USB or IrDA port. If the user is experienced with the model he or she uses the keying of short programs is very fast. Longer, more complex programs, however, are best downloaded. The *HP Solve* ongoing HP 48 One Minute Marvels column, started in issue 14, is an example of very useful and especially efficient programs that may be keyed into the RPL programmed HP 48/49/50 in one minute or less.

Running a program requires starting the program by pressing a key. Depending on the model a single keystroke or perhaps one with a shifted key is required. Running programs on HP calculators is easy and straight forward. When you have multiple programs in memory the convenience of running a particular program will depend on the programming feature set of the machine. Running multiple programs on the HP-12C, for example, is much more difficult than running hundreds of programs on an HP 50g. The latter has many more programming features.

Using vs. Writing Programs

You don't have to write programs in order to take advantage of using programs. One characteristic of calculator programmers is that they tend to collect programs because they want to take advantage of other programmer's expertise. Every programmable calculator user should learn to be able to key in a short program. This skill is very powerful, and it will allow you to greatly extend the capability of your calculator. Calculators are not only work-horse tools; they may also be a source of boredom relief and actual fun. See the examples of four games for the HP-12C in the article "The HP-12C, 30 Years and Counting" in *HP Solve* issue 25, page 9, I25,P9, Appendix C. The ability to write a game program is beyond the average HP-12C user, especially because the programming environment is so simple, but the ability of any HP-12C user to play the games should not be limited because a small effort to learn how to load a program isn't made.

In the early days of calculators, especially the first two decades, the high end programmable scientific calculator was the most powerful tool a technical user could buy. There was a tremendous effort by HP and the HP user community to write and share programs. What most current users may not appreciate is the fact that these tens of thousands of programs will frequently run on today's models with little changes for the new/changed functions.

An example is the financial HP 20b or 30b that is repurposed into a high end RPN scientific calculator⁽²⁾. One of the sources for program ideas, as well as new functions to be added to the machine, is the PPC ROM⁽³⁾.

There are many sources aside from a specific internet search for HP Calculator programs, RPN, RPL, or Aplet. Here are a few.

1. Google “HP Calculator Aplets” for 230,000 results. Downloading Aplets to an HP 39/40gs is described in a pdf file by G. T. Springer at:
http://glencoe.mcgraw-hill.com/sites/dl/free/0078887046/628217/Aplets_to_the_HP_3940gs.pdf
2. RPL programs may be found at: <http://www.hpcalc.org/>
3. RPL and RPN programs may be found at: <http://www.hpmuseum.org/>
4. RPN and RPL programs may be found on a DVD available at: <http://www.pahhc.org/ppccdrom.htm> . This DVD has all the User Community Newsletters (where many programs were published), the PPC ROM User’s Manual, 29 years of HPCC Datafile, the Australian Newsletters, and HHC Conference Proceedings.
5. HP’s Calculator website: <http://h30248.www3.hp.com/calclub/>

Observations and Conclusions

More than three quarters of HP’s Financial, Scientific, and Graphic calculators are programmable. This means that HP is providing the greatest value to their users with a programmable “language” of a type that may be described as RPN FOCAL like, RPL, or Aplet. The best programming features will include easy editing, input prompting, labeling of results, and conditional branching that provides the “intelligence” needed for advanced programming. Most HP calculators have a single keystroke capability for running programs and considerable time may be saved if multiple calculations of the same type are required. It is very useful for any programmable calculator user to learn how to enter programs into their machine because you don’t have to be a programmer to save time.

Programs may be user keyed or loaded through an I/O port. Many programs written years or decades ago will run on current models. A table of current models is provided with the programmable machines indicated. Internet resources are provided as a resource for the reader to find a program to suit their current needs.

HP Calculator Programming - Notes

- (1) *FOCAL is a folklore name given to the programming language RPN HP-41C/CV/CX machines. See **HP Solve** Issue 23 page 34, I23,P34. Most of the RPN programmable calculators from the HP-65 to the HP-41 used a similar programming “language” that may be described as FOCAL like.*
- (2) *See **HP Solve** issue 24, page 22, I24,P22, for the article by Jake Schwartz on Repurposing the HP 20b/30b Calculator platform. An update on this HP user Community project is included in this issue.*
- (3) *The PPC ROM was an early 80’s HP User Community project that developed highly efficient programs that provide the core calculations to be applied to many very high level programming tasks. The programs were specific to the FOCAL language of the HP-41C/CV/CX machines, They were so well documented with so many applications examples, that the 500 page, telephone sized book, the PPC ROM User’s Manual, apply to today’s RPN machines. Hundreds of the smartest international minds contributed to these programs. See issue **HP Solve** 16 for an overview of the HP-41C.CV/CX in the article titled, “The HP-41System – 30 Years old.” The PPC ROM project was essentially the first “Community Software Development for Embedded Devices”. See:
<http://www.embeddedcomponents.com/blogs/2007/04/community-software-development-for-embedded-devices/>*

An HHC 2011 Conference presentation at HP San Diego, The PPC ROM 30 Years Later, provided a PPC ROM review with historical information previously unpublished. A video of the presentation, prepared by Eric Rechlin, may be found at: <http://www.youtube.com/watch?v=L-3SI5jRHv8>

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HP Solve #27 page 33

[← Previous](#) **Article** – [Next →](#)

The WP 34S Evolves

Jake Schwartz

Introduction

Back in Issue #24, we introduced the WP 34S, a suite of firmware which repurposes either an HP20b or HP 30b financial calculator into a sophisticated RPN scientific keystroke-programmable calculator. The team of Walter Bonin (in Germany), Paul Dale (in Australia) and Marcus von Cube (also in Germany) worked hard to bring this masterwork to life. Then last September at our HHC2011 conference in San Diego, Marcus presented a detailed history of the project and spent additional time discussing the 34S' inner workings while Neil Hamilton introduced his 34S programming tools and Eric Rechlin showed the process by which his keyboard overlays and custom key covers were made and applied to a "clean" calculator.

Subsequently, the development team had proposed some significant upgrades to the then-existing version-2 firmware, but after discussing them with the user community via the HP Museum Forum⁽¹⁾, it was decided to incorporate them into a new version 3, while allowing version 2 to coexist in its earlier, more-familiar configuration. Fig. 1 shows an image of both version-2 and version-3 machines.



Fig. 1 - WP 34s Version 2 (left) and Version 3 (right). The Version-3 machine is in Double-Precision mode, displaying decimal places 16 through 33 of a popular irrational number.

Keyboard Rearrangements and More

The first thing one will notice when comparing the two versions is the modest keyboard rearrangement.

The $CL\alpha$, $X \rightarrow \alpha$, $\alpha \rightarrow x$ and L.R. functions were removed (and relocated into catalogs). Also pi, STATUS the X.FCN catalog and the left-shift-display-window and right-shift-display-window functions were relocated. The SF (set flag) and CF (clear flag) was brought out to the keyboard and SUMS and MATRIX catalogs were added. The SUMS catalog represents the summation-functions separated from the STAT catalog and the MATRIX catalog is new, providing basic matrix functionality for the first time. At HHC2011, Gene Wright had presented his initial version of user-code programs based on matrix routines “M1” through “M5” from the PPC ROM (for the HP41 calculator series); and this evolved afterward to a suite of 19 matrix routines (including determinant, inverse and transpose) incorporated into the 34S itself, with the capability to handle two-dimensional matrices up to 100 elements in size.

Other Highlights of Version Three

There are several additional changes added to the version-three software which are significant. A user may now choose to allocate fewer than the default number of numeric registers (R00 to R99) in order to allow additional space for other items such as (among others) more program steps, subroutine levels or the newly-created local data registers. Local data, numbered R.00, R.01 and so forth, may be allocated for any or all programs in memory, so similarly-numbered registers may contain their own private values if need be. (Local flags F.00, F.01, etc. may likewise be created and used.) Flash memory has been reorganized so a large library of user-created programs may be easily managed in flash and accessed by programs in RAM. The statistical summation registers have been pushed out of the numeric-register range and into their own area so they do not interfere with other directly-addressable storage and in fact are not allocated from RAM if no statistical sums are accumulated. Many mathematical functions have been modified to produce more accurate results through the use of higher-precision intermediate values. And now, a double-precision mode has been made available to the user which, when enabled, maintains virtually every value in the calculator with 34-digit decimal accuracy (plus up to 4-digit exponents).

From the chatter on line, the WP 34S developers have several other ideas under consideration, but we may have already reached the point of diminishing returns with a full complement of firmware, no more RAM and just about every clever trick employed to take advantage of the keyboard and limited display of the 20b/30b family. (As Bill Wickes once said in the days of the HP48SX, “Life is short and ROM is full”.) If only the Pioneer-Series-like platform of the HP 17BII+ with its larger RAM and full, two-line dot-matrix LCD were available for repurposing, Walter, Pauli and Marcus would likely be fulfilling their original goals of endeavoring to create the home-grown successor to the HP42S (introduced in 1988), which arguably boasted the “pinnacle” of keystroke programming power.

If you haven't touched a WP 34S yet but are anxious to get in on the excitement, you need the following items:

- An HP 20b or HP 30b financial calculator
- The 34S firmware and extensive user manual, available at <http://sourceforge.net/projects/wp34s/>
- A serial programming cable, which may be obtained for nominal cost from Gene Wright, who may be reached at genewright143@hotmail.com
- An overlay and set of key covers to re-label the calculator keyboard, which may be obtained from Eric Rechlin at <http://commerce.hpcalc.org/overlay.php>

Alternately, there are computer emulators available for experimentation from Pascal Meheut who may be reached at pascal.meheut@density-tech.com. In addition, a set of programming tools were developed by Neil Hamilton which may be obtained by contacting him at nfhwp34s.tbw9z@ncf.ca. An introductory

wiki also has been maintained for the machine at <http://www.wiki4hp.com/doku.php?id=34s:start> for those searching for additional information. If you are a long-time HP enthusiast and remember the excitement of cracking open the box of a new HP calculator for the first time, you will begin to feel that same kind of excitement with the 34S. Many HHC2011 attendees who had not even heard of the machine, became “converts” almost instantly, and now use the 34S as their everyday RPN “workhorse”. You will be impressed.

Observations and Conclusions

The new version-3 WP 34S is somewhat cosmetically similar to the older version-2 firmware, but adds a significant enough amount of new functionality to justify both the new and veteran user to sample its capabilities. The development team is to be commended for their continued achievements in the areas of keystroke efficiency, memory usage and user programmability.

The WP 34S Evolves - Notes

(1) Check out the discussion on the WP 34S plus many other new and legacy HP calculators at the HP Museum forum by going to <http://www.hpmuseum.org> and then clicking on “HP Forum” on the right column.

About the Author



Jake Schwartz has been an HP calculator fan since 1971 after first trying the HP9810A desktop RPN machine at a co-op job at RCA in New Jersey. He has owned most of the scientific top-of-the-line handhelds since the HP35A in the early 1973, joined the PPC Calculator Club in 1977 and contributed to many of the clubs since, including serving as Peripheral Routines coordinator for the PPC ROM project for the HP41 in 1980. Currently working at Lockheed-Martin as a software engineer, Jake has been presenting at and videotaping the annual U.S. HP calculator conferences for more than two decades.

A YYhUb' < D'7 U`W`Uhc f'i gYf

HP Solve #27 page 37

[← Previous](#) **Article** – [Next →](#)

Meet Jo Vandale

Editor's note. Customer Corner has appeared in past issues of **HP Solve** where we interviewed the worldwide users of HP's calculators. Past interviews have been of users who live and work in the US, UK, Canada and Germany. We now go to Belgium for our next interview. Jo Vandale attended CES 2012 where we had a calculator users dinner and an opportunity to "catch up." See photo in the From the Editor column.



HP Solve: *What is your background?*

I was born in Belgium, Adinkerke on 16 February 1959. Adinkerke is a small city 2 Km from the coast and the French border. Our house was just next to the attraction park "Meli" which in the mean time changed name to "Plosa Land". Until 12 did go to school in Adinkerke, Veurne and Ostend. I start working at Philips in 1981 and I'm still working at Philips. In 1982 I moved together with my girlfriend Annie to an apartment in Bruges close to the Philips premises. 10 years later I invested in a house and moved to Oostkamp which is only 10Km from Bruges. I have a son, Ruben, born in 1998 so currently 13 years. My hobby's were initially electronics, software & airplanes, as of today in more F1 and software (web development). Together with my brothers Hans and Geert I also run a company providing IT support and web design to small companies (less than 15 seats) and individuals (www.petss.be).

HP Solve: *What did you study at school?*

Industrial Engineer Electronics which is now redefined as Master in Electronics.

HP Solve: *What is your occupation?*

I work already more than 30 years for Philips. I started in de factor, moved to hardware development, later to software development and from there to advanced development also known as Know How. The latter was all locally to Philips Bruges who did grow in 25 years from a support factory lab to a real development lab. The last 5 years I have in fact 2 jobs; I'm responsible for the programming and tracking of the Advanced Development within TV but now on a global level, next to advanced development I'm also managing competition research, benchmarking and Value Engineering also within TV. Both jobs are challenging and sometimes really connected to each other.

HP Solve: *Do you do much traveling?*

Not for the moment due to travel bans within Philips. I traveled more in the past when I was involved in some standardization activities. I normally go to the IFA fair in Berlin and the CES in Las Vegas. Next to that a go once or twice to Bangalore (Philips Software Lab) and Singapore (Philips Development Lab). Next to that I travel within Europe with my family during the holidays. I'm planning to visit the US a few times in the future when my son is a few years older.

HP Solve: *When were you first exposed to HP calculators?*

My first calculator was a Texas TI-SR50 (1975) followed by a TI-SR56 (1976) only a year later. The TI-SR56 was also my first programmable calculator with only 10 registers and 100 steps. The program "Moonlander" was one of my favorite programs on the 56. In 1977 I bought a TI-58 and upgraded it only 6 months and 4 repairs later for a TI-59. As the TI-59 wasn't more reliable than the TI-59 and for that reason more in repair than in use I start looking to Hewlett Packard as a possible alternative. I played with some units in the shop to learn something strange named RPN and came in love with a information flyer of the HP-41C to be released e few months later. I got one of the first if not the first HP-41C sold in Belgium. It got it on a Friday evening around 8pm from the shop owner who specially drove up and

down to the Belgian HP headquarters in Brussels to get a unit from the first batch delivered in Belgium. I worked through the manuals in 2 days and started a dream ... which in fact never stopped. After the HP41C, CX and all the accessories I had several other HP calculators as I started collecting them, however none of them ever reached the same level of experience and joy. From normal programming it moved to synthetic and assembly, made a speedup solution and even a keyboard controlled version. Later I designed my first ROM and RAM box and together with Chris Blancke I created a DMA interface to the Commodore 64 which allowed us to write and change code on the Commodore 64 while the HP41 was running !!! A beauty in my collection is a huge fully functional HP-33E which was used in the earlier days to learn RPN to students. With a core of 5 people (André Dehondt (chairman), Philippe Roussel, Rudy Mariman, Gino Matthys and myself) we started back in 1981 the HP-41 calculator club PCC Belgium. 3 years later I took over the chairman function as Andre left the country for a new life on the other side of the globe. In the process of combining PPC Belgium with the Belgium TI User group the name of the group changed to PCX (Pocket Calculator eXchange).

HP Solve: *What have you used your calculators for?*

Nowadays only for simple calculations and small programs ;-) In the earlier days for about everything; mathematics, problem solving, gaming, interfacing, controlling ...

HP Solve: *Have you noticed anything interesting about calculator usage during your travels?*

Not in special, to me my 41 was killing my travel time ;-)

HP Solve: *Does your calculator usage involve more than your profession?*

Yes, it was a hobby as you can read above.

HP Solve: *What was the largest problem you have solved with an HP calculator?*

To be honest, I don't remember. The most challenging was definitely a synthetic HP41 program writing its own subroutines before executing them.

HP Solve: *What are you currently using HP calculators for?*

Nowadays only for simple calculations and small programs ;-)

HP Solve: *What appeals to you about HP calculators?*

The simplicity of RPN once you step over the learning hurdle.

HP Solve: *Do you have a website?*

Yes as user group PCX we have a website, <http://www.petss.be/pcx/> which we are currently upgrading to based on a Joomla CMS to give it a new and better look. In the earlier days we had the domain name www.pcx.be which we lost 5 years ago when our group had a dip ☹. As of today only the pages "Infodays" and "Last Minute" are up to date.

HP Solve: *What are the important aspects of your website?*

Not many for the moment with the exception of some nice articles in the "Last Minute" section.

HP Solve: *Do you write or post calculator articles on your website?*

Yes, see "Last Minute" and "PCX Articles" sections.

HP Solve: *Have you had contact with HHC?*

Contact yes at conferences and on other places, but I was never at location in the US.



Fig. 1 – Big HP-33E on website.

HP Solve: *How many HHCs have you attended?*

None ☹

HP Solve: *Do you have a calculator collection? How extensive is your collection?*

Yes, a rather big one. I never calculated the total cost.

HP Solve: *Do you have any “special” HP calculators?*

I have two HP-35 calculators and the big HP-33E. Ed. As shown in Fig. 1.

HP Solve: *What does your family think of your interest in calculators?*

They are not really interested in calculators or calculator meetings. However, they never hampered me in running PCX or any other calculator activity.

HP Solve: *Do you have any additional comments that may be of interest to HP Solve readers?*

I don't know if the calculator still has a long future. It will still be used in schools as an educational tool and many others will still use them for basic calculations. However I don't see it any longer as a real programming unit to solve problems as better and faster alternatives are available already today.

That is one of the many reasons why PCX, already a few years ago, expanded its boundaries to portable devices to keep the club running ... in which we did succeed until now ;-)

However, as long there is enough enthusiasm (Richard N.) you should never stop doing the thing you enjoy every day! **We're never gonna survive, unless ... We get a little crazy** (Seal).

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HP Solve #27 page 41

[← Previous](#) **Article** – [Next →](#)

HP RPN Evolves

Richard J. Nelson

Introduction

When HP introduced RPL as a user interface it utilized a new method of dealing with the automatic stack. RPL⁽¹⁾ operates very much like classical RPN in that it executed an operation such as + on the first two levels of the stack – X & Y registers in Classical RPN stack terms. In general terms this is called postfix logic.

If you press the digit 5 on an RPL calculator the “5” is entered into level 1 of the stack. The same thing happens with a classical RPN calculator. If, however, you then press ENTER the two user interfaces operate differently.

RPL will terminate the digit 5, and leave it on level 1 of the stack.

Classical RPN will terminate the digit 5, AND it will copy it to level 2 (the Classical RPN Y stack register) - implements a stack lift - AND it will leave the level 1 (the Classical RPN X register) ready to receive digits. If a second digit is pressed, say a 2, there will be a 5 on level 2 (Y register) and an unterminated 2 on level 1 (X register).

The Automatic Stack

There are two basic versions of RPN⁽²⁾. One is the classical RPN and the other is what I will call Entry RPN. The difference between the two “RPN” versions is making the extra copy when the ENTER key is pressed⁽³⁾.

In classical RPN terms the automatic stack is lifted when the ENTER key is pressed. Table 1 provides a specific perspective on how HP RPN machines have subtly changed in terms of how Classical RPN works. A primary requirement for defining Classical RPN is the automatic stack, and the rules that govern it. See [HP Solve](#) issue 4 page 3 for a detailed description. Here is a problem. Add -5 to 2.

Table 1 - RPN Stack Lift Test: 5, ENTER, CHS, 2, +

Case	Models (a few examples)	Result	Period	Comments
1	HP-35A	3	1/4/72	The first RPN calculator. One machine only.
2	HP-45A, 80, 65, 70, 55, 21, 22, 25, 25C, 27,	7	1973 - 1977	All 7 Classic, most, 5, Woodstock Series.
3	HP-29C, 91, 97, 19C, 41C, 34C, 15C, 35s, 20b, 30b	-3	Mid 1977 - 2012	Last “C” Woodstock, Top Cat Series, etc. to present.

Case 1 Stack diagram. ~ is don't care. ↑ is ENTER. The CHS is retained with a stack lift and a new digit entry.
Case 1 (2 stack levels) = +3.

Step	1	2	3	4	5
T	~	~	~	~	~
Z	~	~	~	~	~
Y	~	5	5	5	~
X	5	5	-5	-2	3
Press	5	↑	CHS	2	+

Fig. 1 – Case 1 HP-35A automatic stack operation.

This doesn't work because the user clearly did not enter a -2.

Case 2 Stack diagram. ~ is don't care. ↑ is ENTER. The CHS is not retained with a stack lift and new digit entry. **Case 2 (2 stack levels) = +7.**

Step	1	2	3	4	5
T	~	~	~	~	~
Z	~	~	~	~	~
Y	~	5	5	5	~
X	5	5	-5	2	7
Press	5	↑	CHS	2	+

Fig. 2 – Case 2 Classic & Woodstock automatic stack operation.

This doesn't work because the User wanted a -5.

Case 3 Stack diagram. ~ is don't care. ↑ is ENTER. The CHS terminates digit entry, and a new digit entry causes a stack lift. **Case 3 (3 stack levels) = -3.**

Step	1	2	3	4	5
T	~	~	~	~	~
Z	~	~	~	5	~
Y	~	5	5	-5	5
X	5	5	-5	2	-3
Press	5	↑	CHS	2	+

Fig. 3 –Automatic stack operation Mid-1977 to present.

The automatic stack logic illustrated by case 3 is by far the most commonly used in terms of the large number of HP calculators that use it. Note, however, that for this automatic stack operation sequence (that includes CHS) that three stack registers are used to add two numbers. If the sequence of operations were ordered differently only two stack levels are required. This, of course, is the proper way to solve the problem. In all of these variations the number of keystrokes is the same.

Step	1	2	3	4	5
T	~	~	~	~	~
Z	~	~	~	~	~
Y	~	~	-5	-5	~
X	5	-5	-5	2	-3
Press	5	CHS	↑	2	+

Fig. 4 –Alternate Fig. 3 keystrokes to only use two stack levels.

When RPL appeared with the introduction of the HP-28C in January of 1987, the “automatic stack” radically changed. One of the distinctive differences is the action of the ENTER key. In Classic RPN the ENTER key copies the X register into the Y register. In an RPL machine ENTER terminates the digit entry and does not make a copy (or provide stack lift). It appears that the RPL operating system logic has

impacted the design of recently developed calculators, which have a 4-level high stack, but which use Entry RPN.

An example of a current model Entry RPN machine is the HP 30b. If you place the machine in RPN mode, and have a clear stack, you may compare the stack operation with a Classical RPN machine such as the HP 15C. Press 5, ENTER. Next press x. On the 30b you will see 0 because the Y register is zero and $0 \times 5 = 0$. On the 15C you will see 25 because the ENTER, \uparrow , raised the stack as shown in the three cases above.

This basic difference between Entry RPN, and Classical RPN was described by Gene Wright in *HP Solve* RPN Tip 20 in Issue 20 page 10, (**I20,P10**). See the article list number 4 which is reproduced below. "I" is the Input key. Note the extra ENTER (I) required as mentioned above.

"4. The I command (=works just as well) does not copy X to Y if pressed while entering a value, but simply terminates digit entry, similar to the behavior of the HP graphing calculators. On the HP 12c, pressing 4 ENTER x shows a result of 16. To achieve this on the HP 30b, 4II*is required."

RPN Terms

Digit Entry is the process of keying digits into the calculator. The machine has to have some means to know when the number is complete. If you key 12 into an HP 35s, for example, and turn the machine off and back on again, the display will show 12 with an underscore to indicate that digit entry is not complete.

Digit Termination is the process of telling the calculator that digit entry is complete. The example given in digit entry (12_) may accomplish digit termination entry by pressing $x \blacktriangleleft \blacktriangleright y$ twice. The stack is not disturbed. Pressing a function key will terminate digit entry. Specific details of all the situations (functions and operations) that terminate digit entry are usually provided in the User's Guide.

Stack Lift Disable is activated under a very few conditions of the operation of the automatic stack. See your user's guide for details (list). Stack lift is either enabled, disabled, or neutral.

Observations and Conclusions

There are two basic forms of HP RPN. Classical RPN and Entry RPN. While they are very similar overall in that they are both a postscript user interface there are subtle differences, a few of which are described. A test to determine which one is operational on your HP calculator is provided. With a clear stack press 5, ENTER, x. On an Entry RPN machine the result is zero. On a Classical RPN calculator the number is squared.

The current machine examples of an Entry RPN calculator are the HP 20b and HP 30b.

RPN calculators have subtle differences, and the Table 1 CHS digit entry example shows that HP RPN machines have changed twice since the first Classical handheld RPN calculator, the HP-35A. These subtle differences will often impact RPN programs that may run on one RPN machine and not on another. It is highly doubtful that HP will return to Classical RPN except, perhaps, for a legacy machine such as the HP-15C. In all cases of an RPN (and RPL) calculator the best way to describe the user interface is that it is a post script logic user interface rather than one with a rigid set of automatic stack rules.

HP RPN Evolves - Notes

- (1) *RPL is an acronym for Reverse Polish Lisp. LISP is an artificial intelligence, AI, high level computer programming language. A popular programmer meaning given to LISP is "Lots of Insidious and Silly Parentheses." The programming power of RPL is astounding. See Wikipedia description of LISP at: <http://en.wikipedia.org/wiki/Lisp>. RPL is not mentioned, however. The Wikipedia entry for RPL also gives RPL as meaning ROM-based procedural Language*

A quote from one of the 1984 RPL Developers at HP Corvallis Oregon, Dr. William Wickes, says RPL could stand for Reverse Polish Lisp. "In the early days of RPL development, we got tired of calling the unnamed system 'the new system,' and one of the development team came up with "RPL," both as a play on "RPN" which has been the loved/hated hallmark of HP calcs forever, and as an accurate indication of the derivation of the language from Forth and Lisp. RPL was never particularly intended to be a public term; at the time of the HP Journal article (August 1987) on the HP 28C there was an attempt to create a less whimsical name--hence 'ROM-based procedural language,' which preserved the initials but had a more dignified sound.

The development team never calls it anything but (the initials) RPL. You can choose either of the two full-word versions that you prefer. Or how about 'Rich People's Language?'" See: <http://www.faqs.org/faqs/hp/hp48-faq/part2/>

Dr. Wickes recently retired from HP and he has the distinction of having been a development manager for HP's smallest consumer product (calculators) and HP's largest commercial product (Halo).

- (2) *Classical RPN reigned during the 70's and 80's. In the 90's, however, HP (internally) decided that the advantages of RPN should be supported, but that it needed to be modernized. The PC and other handhelds used by students used an ENTER key that behaved differently, and it was no longer an HP exclusive. This ENTER key, and how it worked became so widespread that HP felt that RPN was better "defined" as being a post script user interface rather than a rigid set of rules of how the stack must operate. This change is what I am calling Entry RPN.*
- (3) *Converting RPL based programs to run on RPN machines and vice versa will have to take this into account. If an RPN program is to run on an RPL machine an extra ENTER may be required. RPL programs are not good candidates for RPN machines because there are too many program structural differences. Converting an RPN program to run on an RPL calculator is a bit easier. RPN programs may have a GOTO instruction that is meaningless in an RPL program.*

From the Editor

HP Solve #27 page 46

[← Previous](#) **Article** – [Next →](#)

From The Editor – Issue 27

All across the US we have been experiencing a spike of warm weather and the tree shown in Fig. 1 of last issues column lost every leaf and has been completely full of green leaves for some time.

HP News

If you have checked the *HP Solve* “landing page” recently you may have noticed a nice change. Everything is more easily found and hopefully more clearly explained. Check it out at:

<http://h20331.www2.hp.com/Hpsub/cache/580500-0-0-225-121.html>

Reader Feedback

Prof. Roger Hill provides some interesting electrical (my favorite) examples of applications of the golden ratio, ϕ , described in issue 26, page 53 (**I26,P53**). He says:

Here is an extremely practical example involving light bulbs which I gave as an extra-credit problem to my physics classes: You know those 3-way bulbs like 100/200/300 watts that have two filaments (in this case filaments that produce 100 and 200 watts separately when connected to the standard 120 volts). When you turn the switch, you get filament #1 alone, then filament #2 alone, then both filaments in parallel which give the sum of the wattages (300). As long as I can remember I used to notice that there was a big difference between the 100- and 200-watt settings, but going to 300 watts was disappointing because there didn't seem to be as much of a difference. As I learned much later, this was because the eye is more sensitive to RATIOS of brightness (or wattages), and to get equally appearing steps you would need 100, 200, and 400 watts (the same sort of thing happens in sound, from which decibels arise, and also in musical-scale frequencies -- this is called the "Weber-Fechner Law." But the trouble is, you can't get 100, 200, and 400 from just two filaments.

So the problem is to design the "ideal" 3-way light bulb whose first setting is say 100 watts; what wattage does the second filament have to have so that all three settings will appear equally spaced in brightness? No knowledge of electricity is needed to solve this problem. But guess what the answer is: $100 \cdot \phi$ watts, or approximately 161.8 watts, for the second filament! The three settings then give 100, 161.8, and 261.8 watts and will appear equally spaced in brightness since $(161.8/100 = 261.8/161.8)$.

An even more remarkable continuation of this problem is, once you've got 100- and 161.8-watt filaments, consider that there is a FOURTH wattage setting that is never used in practice, that obtained by connecting the filaments in series. This will give a lower wattage than the other three -- what is it? This one DOES require an elementary knowledge of Ohm's law, etc. If you assume that the resistance of the filaments doesn't change with voltage (not really true, but may be approximately good enough), the amazing thing is that the fourth wattage will be 61.8 watts, so that ALL FOUR of the wattages will be successively related by the Golden Ratio! This will make the light bulb truly "Golden"!

I also tell my class that if anyone decides to go into business marketing these "Golden" light bulbs and makes millions off of them, please remember who gave you the idea!

Roger also pointed out that a resistor ladder network could also represent the Golden Ratio – 1.61803 . . . One ohm resistors are connected as shown in Fig. 1. Each stage is shown with a break in the circuit. If all the gaps in Fig. 1 are closed (resulting in an infinite "ladder" of resistors), and each resistor is 1 ohm, then the resistance between points A and B will be ϕ ohms or approximately 1.61803 ohms. Fig. 1 may be redrawn to better illustrate the series parallel connections. If you start with stage 7 and work towards A & B you may easily calculate the effective resistance of the seven stages.

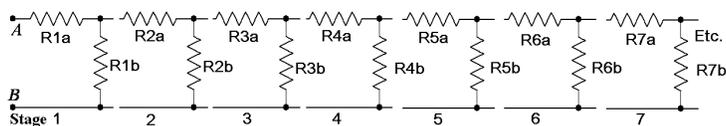


Fig. 1 – Resistor network approximates ϕ .

I connected seven stages as shown in Fig. 3. The recorded data is shown in Table 1. I used 10,000 ohm resistors so that I could apply a high enough voltage to also measure the voltages of each stage. EE students may make the calculations to verify my measurements.

I used 10K ohm resistors for three reasons.

- (1) My best meter ($\pm 0.8\%$) has 3-1/2 digits.
- (2) I wanted to apply a voltage that was high enough to have a measureable voltage after at least seven stages and not exceed the wattage rating of the resistors. I could have gone to at least 63.6 VDC with another power supply, but that would require getting it out of the cabinet, etc.
- (3) I wanted to avoid “connection” resistances (without soldering) that are a problem with 1 ohm resistors.

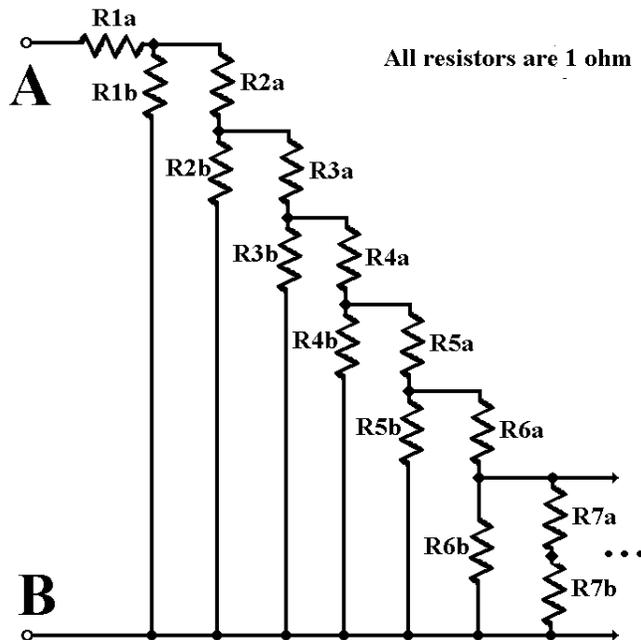


Fig. 2 – Same ladder as shown in Fig. 1.

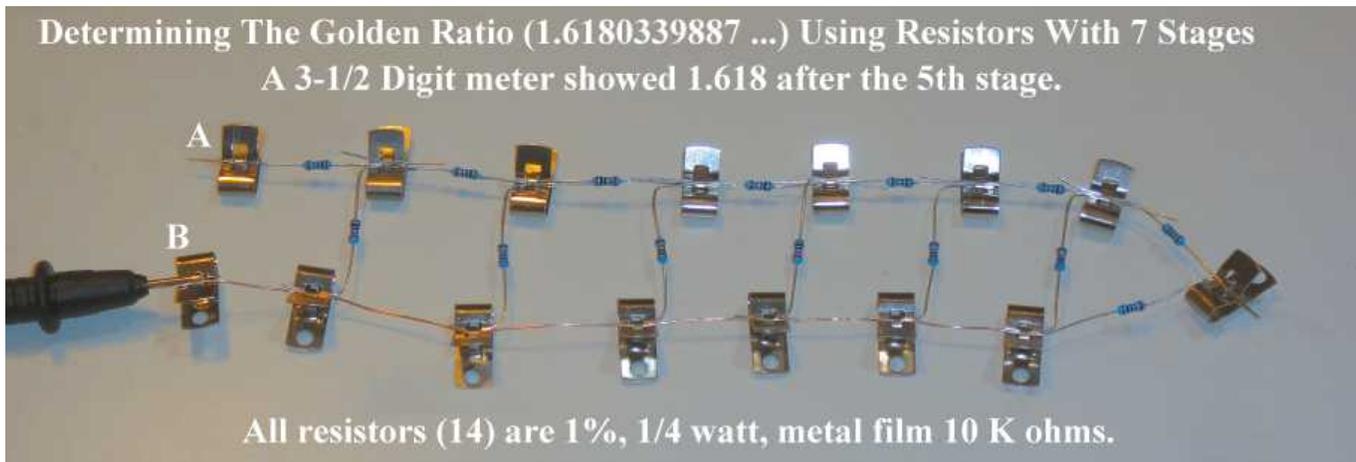


Fig. 3 – Resistors connected to determine the first four digits (limit of my meter) of the golden ratio.

I would be interested in other example of the golden ratio. Email me at: hpsolve@hp.com

Table 1 – Electrical Measurement of Fig. 3 Vs. Theoretical

Stage	Resistance	DC Voltage (29.00 Input)	Comments	Calculated Digits*
1	20.00 K	11.06 VDC	Highest power required by R1.	2
2	16.66 K	4.22 VDC		2
3	16.25 K	1.62 VDC		3
4	16.19 K	0.617 VDC		4
5	16.18 K	0.238 VDC	Five stages provide four digits.	5
6	16.18 K	0.0948 VDC	Higher resolution meter required.	6
7	16.18 K	0.0475 VDC	Higher resolution meter required.	6

* Correct truncated digits. 9 stages will provide 8 correct digits. (1.61803 39985 2)

Here is the content of this issue.

S01 – A User’s Perspective of the HP 39gII By Namir Shammam. This machine was announced in our last issue and now we present a user’s view of some of its many features.

S02 – Get Rich Slow is a very new book by John Webber. John has been active in the rental real estate business for decades and he has written book providing the step by step procedures on how this industry is able to provide a slow but sure income.

S03 – Collecting, displaying, Demonstrating, and Storing HP Calculators. Collecting calculators is more popular than you might think. Books have been written on the subject and no matter what kind or type of calculators you might collect nearly every collector will have a few HPs. Once you have a dozen or more machines you are on your way to becoming a more serious collector. Because technology is advancing at a rapid pace the older machines are soon “obsolete” and therefore increasing in value. The article explores several of the issues that face HP Calculator collectors.

S04 – HP Calculator Programming. Programming a calculator just doesn’t appeal to most calculator users. It seems to be overly complicated and in some cases e.g. the HP 50g it could be. Of the 24 current models offered by HP more than 50% are programmable. If you omit the seven Home and Office machines the number is over 75%. The article provides an overview of programming and its applications. There is a gigantic reservoir of useful, powerful, time saving programs that every user should be aware of.

S05 – The HP 34S Evolves. By Jake Schwartz. No calculator is perfect or error free. Members of the HP User Community are discovering for themselves that designing and maintaining a calculator is an incredibly difficult undertaking. The results however are amazing.

Here is the recent (4/4/2012) experience of one Southern California CFO HP User – John Fedel.

Hi Richard,

I finally used the cable you gave me and flashed one of my 30b's into a 34s. I ordered two overlays figuring I would mess one up, but the first one worked fine.

I had no idea what this calculator was. I have to say the 34 number gave me the impression it was a scientific calculator only. I think the 42sII number would have been a better choice. (saw that on one of the YouTube videos)

It's amazing! I can't believe I can buy a calculator for \$20 on Amazon and turn it into this. Of course, I'm just starting to figure out how to use it. It's a little confusing that it uses a number of manuals made for different devices, but I'm starting to go through it. In no way is that a complaint. They've created a very complete device with lots of functions.

The only thing that seems to be missing are the original financial functions. For me, basic TVM functions would be helpful. Anyway, I just ordered 3 more 30b's and 3 more overlays. My plan is these will be the "house standard" calculator and have them where needed. Something like the Harbor Freight multi-meters. :-)

The only hard part now is getting Leonie *ed. his wife*, used to using RPN.

S06 – Meet Jo Vandal from Belgium. Jo is an electrical engineer manager working for Philips. Read how Jo has been active in the Belgium HP User Community. He often attends CES and that is where we caught up with him last January when we gathered for dinner. His “big” HP-33E is the largest HP calculator. See photo in the article.



Jake Schwartz Jo Vandale Eric Smith Richard Schwartz Richard Nelson Brian Walsh Sam Kim
New Jersey Belgium California California Arizona Illinois Nevada

S07 – HP RPN Evolves. RPN itself is usually associated with HP because HP has been making RPN calculators for 41 years. When other machines became popular e.g. PC's, PDA's smartphones, etc. the use of the famous HP RPN ENTER key took on a different meaning and HP needed to adjust "RPN" accordingly. Today RPN as a user interface is generalized to be postfix logic. How Classical RPN has evolved into Entry RPN is explained in the article.

S08 – Regular Columns

- ◆ From the editor.
- ◆ One Minute Marvels.

S09 – #10 in the Math Review Series: Calculating Numerical Roots. A modern scientific or graphing calculator will calculate numerical roots at the press of a key. Problems like:

$$\pi\sqrt{e} = 3.14159265359\sqrt{2.71828182846} = \text{are easily solved. Even problems like } \sqrt{-4}$$

are easily solved by the more advanced (algebraic) models.

That is it for this issue. I hope you enjoy it. If not, tell me!

Also tell me what you liked, and what you would like to read about.

X <> Y,

Richard

Email me at: hpsolve@hp.com

HP 48 One Minute Marvels No. 14 – Numeric ID Registers

One Minute Marvels, OMMs, are short, efficient, unusual, and fun HP 48 programs that may be entered into your machine in a minute or less. These programs were developed on the HP 48, but they will usually run on the HP 49 and HP 50 as well. Note the HP48 byte count is for the program only.

Simple Numeric ID, "register", data base

These three programs were written to emulate sequentially numbered registers á la the HP-41, and most

other early calculators. The HP-41 had a SIZE “command” which allocated memory to the number of data registers desired. Memory limited SIZE to 319. The STO key was pressed when you wanted to store something in a register and you responded to a prompt for a register number. This was not pure RPN, but we really didn’t mind. Does this also demonstrate the importance of prompting?

The HP48/49/50 are Entry RPN⁽¹⁾ and so the syntax for storing changes. HP49 users will take their machine out of the box in algebraic mode and will have set up a Start variable to insure their machine will always turn on in RPN mode if they desire (especially after a warm start). The “registers” are stored in a list called ‘reg’ when SIZE is run. They are numbered from 0 to n.

‘size’ << 1 →LIST 0 CON OBJ→ DROP →LIST ‘reg’ STO >>
9 commands, 44.0 Bytes, # E0Fah. 1000 registers created in 2.22 seconds.

Zero is used as a place holder for each register. Register counting is from zero so if you want register 100 use 101 as the input for ‘size’.

‘sto’ << 1 ± reg SWAP ROT PUT ‘reg’ STO >>
8 commands, 43.0 Bytes, # 4E76h.

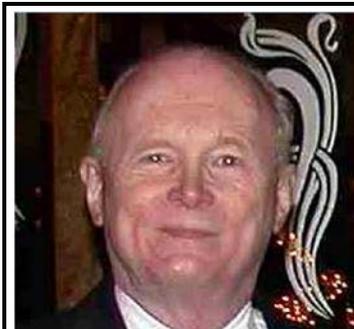
Place the object to be stored on level two and the register number on level one and run ‘sto’.

‘rcl’ << 1 ± reg SWAP GET >>
5 commands, 26.5 Bytes, # 9F49h.

Key the register number (you have to remember what is in which register) and run ‘rcl’.

Lower case names are used to avoid machine name conflicts. The one plus starting ‘sto’ and ‘rcl’ may be omitted if register “zero” is not needed. This system may be used to store programs, names and addresses, etc. as well. You may have a bunch of routines that you want to “hide” and then call in one or more programs. Simply store the program in a “register” and use the sequence n rcl EVAL in the calling program. A series of alarms used by different programs is one example.

About the Editor



Richard J. Nelson, a long time HP Calculator enthusiast, was editor and publisher of *HP-65 Notes*, *The PPC Journal*, *The PPC Calculator Journal*, and the *CHHU Chronicle*. He has also had articles published in *HP65 Key Note* and *HP Key Notes*. As an Electronics Engineer turned technical writer Richard has published hundreds of articles discussing all aspects of HP Calculators. His work may be found on the Internet and the HCC websites at: hhuc.us He proposed and published the PPC ROM and actively contributed to the UK HPCC book, *RCL 20*. His primary calculator interest is the User Interface. Richard may be reached at: rjnelsoncf@cox.net

: i bXUa YbhU`g'cZ5dd`]YX`A UH`GYf]Yg'`%\$

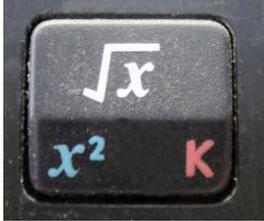
HP Solve #27 page 52

[← Previous](#) **Article**

Calculating Numerical Roots

Richard J. Nelson

Introduction – What is a root?



Do you recognize this number⁽¹⁾? 1.41421 35623 73095 04880 16887 24209 69807 85696 71875 37694 80731 76679 73799 07324 78462 10703 88503 87534 32764 15727 35013 84623 09122 97024 92483 60558 50737 21264 41214 97099 93583 14132 22665 92750 55927 55799 95050 11527 82060 57147 01095 59971 60597 02745 34596 86201 47285 17418 64088 91986 09552 32923 04843 08714 32145 08397 62603 62799 52514 07989 68725 33965 46331 80882 96406 20615 25835 23950 54745 75028 77599 61729 83557 52203 37531 85701 13543 74603 40849 ...

Fig. 1 - HP35s √ key.

If you have had any math classes you have probably run into this number and you should recognize it as the square root of two, $\sqrt{2}$. The square root of a number, n, is that value when multiplied by itself equals n. $2 \times 2 = 4$ and $\sqrt{4} = 2$. Calculating the square root of the number is the inverse operation of squaring that number $\sqrt{n^2} = n$. The "√" symbol is called the "radical" symbol or "check mark."

MS Word has the radical symbol, $\sqrt{\quad}$, but we often use it with a line across the top. This is called the "vinculum" circa 12th century. The expression " $\sqrt[n]{\quad}$ " is read as "root n", "radical n", or "the square root of n". The vinculum extends over the number to make it inclusive e.g. $\sqrt{98,696,044,010.9} = 314,159.265359$. Most HP calculators have the square root key as a primary key as shown in Fig. 1 because it is used so much.

Roots and Powers

Numbers may be raised to any power (y, multiplied by itself x times) and the inverse operation, taking the root, may be expressed as shown below.

$$^4\sqrt{81} = 3 \quad 81 = 3 \times 3 \times 3 \times 3$$

The problem is taking the fourth root of 81. This problem may also be expressed as:

$$81^{1/4} = 3$$
 Raising a number to a power uses the key shown in Fig. 2.

The key sequence is 81, ENTER, 4, 1/x, y^x . The "extra" key is the reciprocal key, 1/x.

Without your HP calculator you would have a very difficult time making this calculation. This problem is easy because it uses integers. How about the problem of:

$$\pi\sqrt{e} = 3.14159265359\sqrt{2.71828182846} = 1.37480222744.$$

As a quick check, with the answer displayed, press ENTER twice and x twice to get 2.59848779509 which is the answer cubed. This is very close to the number under the radical. The root is a little over 3.

Using the y^x key for square roots is good practice for all power and root problems. Solving the example problem given above, $\sqrt{98,696,044,010.9} = 314,159.265359$, you would key 98696044010.9, ENTER, 2,



Fig. 2 – HP 35s Power Key.

$1/x$, y^x . This is an extra key press for square roots, but it will give you a generalized procedure which provides confidence when the more complex problems like ${}^{\pi}\sqrt{e}$ present themselves.

The HP 35s is our “standard” calculator for the Fundamentals of Applied Math Series unless specified otherwise. The suggested general process recommend above is actually for most other models. The key shown in Fig. 1 also has a left shifted function ${}^x\sqrt{y}$ as shown in Fig. 3. This should be used for calculating numerical roots. The number of keystrokes is the same because the root key is a shifted key.



Fig. 3 – HP 35s General Root Key.

Negative Roots

If the square root of a number, m , is that number, n , that when multiplied by itself equals the number, what happens when the number, m , is negative? Two negative numbers, when multiplied, results in a positive number. Is the square (even) root of a negative number meaningless? The cube (odd) root of -27 has a solution, -3 , because $-3 \times -3 \times -3 = -27$.

Taking a square root of a negative number on the HP 35s results in a “SQRT(NEG)” message. Taking the even root, of a negative number on most HP calculators using y^x will usually result in an ERROR message (INVALID on the HP-35).

For a very long time the idea of taking the square root of a negative number couldn’t be represented in terms of “normal” mathematical operations – until the concept of the imaginary unit, often called a unit imaginary number was applied. The imaginary unit is usually designated as i ⁽³⁾. No real number has a negative square so the (confusing) term imaginary is used.

Remembering that a negative multiplied by a negative results in a positive, the square root of any real number, excluding zero, has two values \pm . The term often applied to these roots is the principle, $+$, root.

Let’s use the definitional property of i .

$$i^2 = -1$$

In practical terms $i = \sqrt{-1}$.

The square root of -1 has two values, $+i$ and $-i$. While these two values are the negatives of each other, they are algebraically the same.

The square root of -2 is expressed as $1.41421356237i$ which is an imaginary number and a particular case of complex numbers. The subject of complex numbers will be covered in a future installment of Fundamentals of Applied Math Series.

Imaginary numbers may be operated on in a similar manner as real numbers. Squaring an imaginary number is a negative number (zero excluded). The HP 35s has operations to perform complex arithmetic ($+$, $-$, \times , \div), complex trigonometry (\sin , \cos , \tan) and the mathematical functions $-z$, $1/z$, Z^{z^2} , $\ln z$, and e^z - where z and z^2 are complex numbers.

The square root of -2 is also expressed on more advanced calculators as a complex number which is an ordered pair of numbers shown as $(0,1.41421356237)$. The i is assumed to be attached to the second number. Most complex number functions are found on algebraic and graphing calculators.

Table 1 shows the current HP calculator lineup. All of the financial, scientific, and graphing calculators have a $\sqrt{\quad}$, and a $y^{x(4)}$ key. The OfficeCalc⁽⁵⁾ 100, OfficeCalc 200, and OfficeCalc 300 has a $\sqrt{\quad}$ key, but no y^x key. Some of the Scientific and Graphing machines also have a symbolic capability which is indicated by an *.

Table 1 – Current HP Calculator Products (24)

#	Financial Calculators	Scientific & Graphing	Home & Office
1	HP 10bII	HP 10s	HP Calcpad 100
2	HP 10bII+	HP-15C Limited Edition	HP CalcPad 200
3	HP 20b	HP 33s	OfficeCalc 100
4	HP 30b	HP 35s	OfficeCalc 200
5	HP-12C	HP 39gs*	OfficeCalc 300
6	HP-12C 30 th Anniversary	HP 39gII* (new)	PrintCalc 100
7	HP-17bII+	HP 40gs*	QuickCalc
8		HP 48gII*	
9		HP 50g*	
10		SmartCalc HP 300s	

* indicates a symbolic math capability.

The symbolic features (complex operations) of these machines allow them to deal with negative roots.

Imaginary Numbers

i is a number and not a variable. i is not found on the real number line because i is not a real number.

When dealing with powers of i you must remember four cases that repeat themselves in a cycle.

Table 2 – Cyclic 4 Values of Powers of i

$i^{-4} = 1$	$i^0 = 1$	$i^4 = 1$
$i^{-3} = i$	$i^1 = i$	$i^5 = i$
$i^{-2} = -1$	$i^2 = -1$	$i^6 = -1$
$i^{-1} = -i$	$i^3 = -i$	$i^7 = -i$

Imaginary numbers require care in their use. Use the same rules you normally do. Here are some examples.

$$i^2 = \sqrt{-1} \cdot \sqrt{-1} = -1$$

$$i^3 = i^2 \cdot i = -1 \cdot i = -i$$

$$\sqrt{-7} = \sqrt{1 \cdot 7} = \sqrt{1} \cdot \sqrt{7} = i\sqrt{7}$$

$$\sqrt{-a} = \sqrt{1 \cdot a} = \sqrt{1} \cdot \sqrt{a} = i\sqrt{a}$$

Here is an example of multiplying square roots that is incorrect because $\sqrt{x}\sqrt{y} = \sqrt{xy}$ is only true if at least one of the two numbers (x & y) is positive. $i^2 = \sqrt{-1}\sqrt{-1} = \sqrt{(-1)(-1)} = \sqrt{1} = 1$

Observations and Conclusions

Calculating numerical roots is a challenging problem if you did not have a modern electronic calculator. We learn many roots in school, especially the squares of the numbers 1 to 12 so that the square root of 144 is (or should be) from memory to be 12. We normally think of square roots, but any-number root, is mathematically possible. A problem like $\pi\sqrt{e} = 3.14159265359\sqrt{2.71828182846} = 1.37480222744$ would not be thinkable without a calculator. Some root problems such as an even root of a negative number is not possible, e.g. $\sqrt[6]{-13}$ unless expressed as an imaginary number, i . In practical terms $i = \sqrt{-1}$. Most calculators will give an ERROR message but more advanced (algebraic) calculators will calculate (even roots of negative numbers) using complex numbers. Complex numbers will be discussed in a future Fundamentals of Applied Math installment.

Calculating Roots - Notes

- (1) *Three hundred ninety five digits are shown here for the irrational square root of two See the link below for one million digits and a referenced link for 10 million digits. <http://apod.nasa.gov/htmltest/gifcity/sqrt2.1mil> If the digits are downloaded it requires 261 pages, is 1,000,158 digits, and 12,502 lines. The file size is 993 KB, and 688 KB as a pdf file. Most five digit sequences will be found if the $\sqrt{2}$ digits are searched e.g. the first five digits of π (7x), e (5x), ϕ (13x). The square root of 2 has some unique and interesting properties. See how it may be calculated geometry and used to approximate π as well as other properties at: http://en.wikipedia.org/wiki/Square_root_of_2*
- (2) *Adding mathematics expressions to text is always difficult. While there are many options for doing this one common solution is to create an image and insert it into the document. One technique is to type it slightly larger as closely as possible in MS Word and screen capturing the expression into an image program. The image is then touched up, and converted to a tightly cropped B&W image. The image may then be sized as desired when inserted into MS Word. This process produces a more bold looking set of characters.*
- (3) *Electrical engineers will use j as the imaginary unit because i is used for electrical current.*
- (4) *Finical calculators use the math operations behind the y^x key making it easy to include this very powerful function on the keyboard.*
- (5) *The officeCalc series of calculators are 14 digit calculators. These machines will provide the greatest number of digits for calculating square roots. Programs running on the programmable models will provide square roots of numbers to hundreds of digits – usually limited by memory.*

About the Author



Richard J. Nelson has written hundreds of articles on the subject of HP's calculators. His first article was in the first issue of *HP 65 Notes* in June 1974. He became an RPN enthusiast with his first HP Calculator, the HP-35A he received in the mail from HP on July 31, 1972. He remembered the HP-35A in a recent article that included previously unpublished information on this calculator. See <http://hhuc.us/2007/Remembering%20The%20HP35A.pdf> He has also had an article published on HP's website; HP Calculator Firsts. See <http://h20331.www2.hp.com/Hpsub/cache/392617-0-0-225-121.html>.