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# HP Key Notes

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## HP-IL Introduction

On December 21, 1981, the *Hewlett-Packard Interface Loop* concept became a reality. This date marked the beginning of a new era in low-cost systems for electronic data transfer and electronic control.

Now, your HP-41 hand-held computer can easily communicate with, and control, any Hewlett-Packard Interface Loop (HP-IL) peripheral. Present HP-IL peripherals include a printer, a digital cassette drive, a converter, and a digital multimeter.\* But that's not all. A video interface has been announced but will not be available until later this year. Also, with the new HP 82938A Series 80 HP-IL Interface Card, your HP Series 80 Personal Computer can interact with your HP-41 through HP-IL, and it can act as a controller of the HP-IL loop. And, with the addition of the new HP 82182A Time Module, your HP-41 becomes a care-free, *time-based controller*. Ah, but this is jumping ahead; let's discuss the fundamentals.

The HP-IL concept revolves around a two-wire cable that can connect as many as 30 HP-IL devices in a closed series loop. HP-IL is a "master-slave" interface, meaning that one active controller regulates the information flow between all of the devices in the loop. Data and commands move around the loop in one direction.

The reason we use such terms as "the controller" and "a device" is because HP-IL is a *general-purpose interface*. The elements of the system that you choose to use will be tailored specifically to your application. This is the flexibility of the HP-IL concept.

At the core of this new concept is the new HP 82160A HP-IL Module. This module fits into any of the four HP-41 ports, and it expands the HP-41 with a powerful set of functions for interaction with the devices in the loop. Now, printers, mass-storage devices, and a variety of instruments can be controlled by the HP-41 through one port!

\* This digital multimeter is not available through HP Calculator Dealers. Contact your local HP Sales Office for more information and prices.

All prices in this newsletter are suggested retail prices excluding applicable state and local taxes—Continental U.S.A., Alaska, and Hawaii.

## THE CASSETTE DRIVE

The new HP 82161A Digital Cassette Drive is an HP-IL mass-storage device. Each of the digital mini-cassettes driven by this device can store up to 131,072 bytes of data, programs, status information, and directory in files that *you* name. Just think: *131,000 bytes is over 50 times the full RAM capacity of the HP-41CV!* In fact, we have stored on just 3/4 of one mini-cassette, **all of the programs in every HP-41 "Solutions" book!** This is why we call it *mass storage*. Also, the HP 82161A Digital Cassette Drive is fast, with an average file access time of 13 seconds, and a 30-second maximum rewind time. Yet, accessing a program file is easy. With the Digital Cassette Drive in the loop, simply place the name of the file in the ALPHA register, key in **[XEQ]** "READP", and the program is available in the RAM of your HP-41 within seconds. Other files are accessed (and recorded) just as easily by executing different HP-IL commands.

## THE PRINTER

The new HP 82162A Thermal Printer/Plotter is an HP-IL compatible device that is similar in appearance and function to the HP 82143A Thermal Printer/Plotter. In addition to *all* of the convenient features of the HP 82143A Thermal Printer/Plotter such as double- and single-wide printing, right and left justifying, 128 standard characters, and special character building, the new HP-IL printer has a **FORMAT** statement that allows you to automatically center words on the page and to easily right- and left-justify two columns. Plus, the new HP 82162A Thermal Printer/Plotter has a 101-element buffer, and a **STANDBY** position of the on-off switch helps conserve battery power.

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## THE MULTIMETER AND THE CONVERTER

With HP-IL, your HP-41 can control, and take data readings from, the new HP 3468A Digital Multimeter. Or, if you have a considerable knowledge of electronics and interfacing techniques, you can use the new HP 82166A HP-IL Converter to connect your own 8 or 16 bit-parallel device into the HP-IL system.

A general application of such an HP-IL system would use the new HP 82182 Time Module, which is discussed in the following article, to "wake-up" the HP-41 in the middle of the night, while you are at home sleeping. Automatically, then, the HP-41 would begin to execute a control program.

HP-IL allows you to program the HP-41 to power-up devices in the loop, take readings from instruments, make data listings, read subprograms from mass storage devices, and interact with other devices in the loop as prescribed by the programs. The extensive programming capabilities of the HP-41 allow it to make critical decisions based on the data received from the instruments in the loop and interact with other devices in the loop, accordingly. Then, with its job complete, the HP-41 can power-down the devices in the loop, including itself. When you arrive at work in the morning, after a good night's rest, a printer listing awaits you, documenting the events of the night as monitored by the HP-41!

## SEE YOUR HP DEALER...

At this point, you have read the introduction to an entirely new concept in electronic communication and control that represents a major technological breakthrough. This is a good point to sit back, relax, and think about the implications of the HP-IL concept. Just think: now, with the HP products that were announced on December 1, 1981, thousands of electronic control applications can be tackled by portable, affordable, devices.

And, this is only the beginning. Hewlett-Packard is committed to continuing its quality support of HP-IL. The devices that are compatible with the HP-41 as a mainframe controller will be compatible with future hand-held computers and personal computers with input/output capabilities. Many HP divisions—in the instrument and computer areas—will be introducing HP-IL devices.

We have enough space to give you only a small taste of the broad capabilities of HP-IL. See your local HP Dealer for a look at the new HP-IL system, and see if it will meet *your* challenge; we'll bet it can—and does!



## Three New Modules Introduced

Along with HP-IL, Hewlett-Packard introduced three new modules for the HP-41 System. These modules serve to expand the conveniences of the HP-41, both on its own and as a mainframe controller of HP-IL.

### TIME MODULE

The new HP 82182A Time Module gives you the ability to incorporate precise time and date into your calculations. With this module, your HP-41 can be a clock, a calendar, a stopwatch, an alarm, and there's much more.

You can set up to 253 separate alarms in the HP-41 (depending on the amount of memory available), and any alarm can be set to repeat itself again and again after a desired time-interval. An alarm will activate whether or not the calculator is on. And, when you set an alarm, you can choose to make it either a tone alarm, a message alarm, or a control alarm. When a control alarm activates, the HP-41 "wakes up" and immediately begins execution of a specified program. This feature makes the Time Module a valuable component of *any* HP-41 controlled HP-IL system.

The Time Module uses a quartz crystal for dependable accuracy. And, with the module's "built-in" programmable accuracy factor, your HP-41 can "fine tune" your Time Module, thus giving it a time-keeping ability that will amaze even the most scrutinizing of accuracy buffs.

There is no other hand-held computer like the HP-41. And now the HP 82182A Time Module takes the HP-41 one more step forward.



## EXTENDED FUNCTIONS/ MEMORY MODULE

The new HP 82180A Extended Functions/Memory Module expands your HP-41 with 47 new functions and 889 bytes of "extended" memory.

Such new functions as "programmable size" and "programmable assign" allow you to change the memory configurations and keyboard-function assignments under program control. Plus, there is a "SIZE?" function that returns the present number of allocated data registers to the X-register. We know, from the number of "SIZE?" routines that you have contributed to KEY NOTES, that this is a popular function. Other popular functions include the "register-swap" and "register-move" functions that help you to easily manipulate blocks of data registers.

Other new "memory-management" functions give you access to, and control over, extended memory. This extended memory brings file-structure and file-management capability to the HP-41. Three types of files can be created in extended memory: program files, data-storage files, and ASCII files. Now, the HP-41 can store and manipulate ASCII files, thus giving it a communication link with larger computers.

There are 889 bytes of extended memory in the HP 82180A module, and the memory-management functions contained in this module also give you access to even more memory housed in the new HP 82181A Extended Memory Module.

## EXTENDED MEMORY MODULE

Each new HP 82181A Extended Memory Module adds 1,666 bytes of extended memory to the HP-41. Used together with a new HP 82180A Extended Functions/Memory Module, up to two HP 82181A Extended Memory Modules may be added to the HP-41, equipping the computer with 4,221 bytes of extended *Continuous Memory*. With the 2,233 bytes of Random Access Memory in an HP-41CV (or HP-41C with a Quad RAM), you can have a total of *6.4K bytes of pocketable, Continuous Memory!!* (An HP 82180A Extended Functions/Memory Module must be in your HP-41 before it can interact with an HP 82181A Extended Memory Module.)

## SEE YOUR HP DEALER...

But, we can't possibly describe the full advantages of every one of these new modules. We suggest that you spend some time talking with your local HP Dealer to get a better idea of what can be done with these new and exciting products. You'll soon realize that the range of applications is nearly endless. Only *your* imagination will impose restrictions on what can be accomplished with the new modules... and HP-IL.

Don't forget to keep your address up to date. Send changes to the address on the back cover.

## Corvallis Library Corner

The Users' Library is a service to HP-67/97/41 programmable calculator owners. As a member of the Users' Library, one of your major benefits is that you are in communication with HP calculator users all around the world. Programs that are the result of many hours of brain-work by fellow HP calculator users are yours at an almost insignificant price. And, although anyone may order programs from the Users' Library, there are countless advantages to becoming a member. Read on ...

## LIBRARY SUBSCRIPTIONS (CORVALLIS)

There aren't many investments you can make that give you an immediate return of over twice the invested value, but a subscription to the Users' Library is an investment that does just that, and better. In the United States and Canada, the fee for a one-year subscription to the Users' Library is \$20.\* This \$20 fee places you on the mailing list to receive the *Catalog of Contributed Programs* (\$10) and one update, and the *Programmers Reference Guide* (available March 1: a \$10 value). Plus, you will presently receive a coupon good for four free programs, each program valued at \$6. And, for the year of 1982, HP KEY NOTES will be sent to you free (\$5 value) if you are a member of the Users' Library. Now, if you get out your HP calculator and total these figures, you will find that for an initial investment of \$20, you get a package with a monetary value of \$49. And the monetary value is only a small part of the true value of being a Users' Library member.

If you live outside the U.S. or Canada, the fee for a one-year subscription to the Corvallis Users' Library is \$30\* because of considerably higher postage and handling charges. Though you don't double your investment here, you still have everything to gain by becoming a Users' Library member.

And, you have a choice of how you renew your subscription. You can pay either the full subscription price (\$20 in the U.S. and Canada, \$30 elsewhere) and receive a coupon for four free \$6 programs (\$24 value), or if you don't need the four free programs, you pay only half of the original subscription price (\$10 in the U.S. and Canada, \$15 elsewhere).

You can subscribe to the Users' Library by using the form on page 15 or you can charge it to your major credit card over the

\* U.S. dollars. Orders from anywhere outside the U.S. must include a negotiable check (or money order), in U.S. dollars, drawn on a U.S. bank. All orders from anywhere outside the U.S. must include an additional 10 percent fee for special handling and air mail postage. (For example, an order for two programs =  $\$6 \times 2 = \$12 + \$1.20 = \$13.20$  total.) If you live in Europe, you should order KEY NOTES programs directly from the Geneva UPLE, but make certain you make payment as required by Users' Program Library Europe; the above \$6 fee is good only for orders to the Corvallis Library.

phone. (Call 800-547-3400, except from Alaska and Hawaii; in Oregon call 503-758-1010.)

The greatest advantage of Library membership is being able to choose from a large collection of software that is immediately ready to serve you in your application. The savings in time and effort are worth much more than the small membership fee.

You also should look into the possibility of the Library fee being income tax deductible. You might even be able to deduct the cost of some purchased Library programs.

## ORDERING PROGRAMS

HP-67/97 and HP-41 programs featured in KEY NOTES are now available from both the Library in Corvallis and the Library in Geneva. **Readers in Europe should order from Geneva (address on back cover) to get quicker service.** Readers elsewhere should order from Corvallis, where programs cost \$6\* each and each program includes documentation and prerecorded magnetic cards; for HP-41 programs, this \$6 price includes bar code.

Whenever possible, use the Users' Library Order Form in your *Catalog of Contributed Programs* to place orders for programs you see in KEY NOTES. If you do not have an order form, a plain piece of paper with your name and address and the program numbers you desire is certainly adequate. Make certain that your address is legible and complete.

Mail your order and a check or money order to the Corvallis or Geneva address shown on the back cover of KEY NOTES. Don't forget to include your State or local taxes. Or, in the U.S., you can place your order by calling toll-free: 800-547-3400, except from Alaska and Hawaii (in Oregon call 503-758-1010).

When ordering from outside the U.S., **attach your payment to your order.** Much time is wasted and orders are held up, trying to match orders and checks that are sent in separately. Your payment can be in the form of an International Money Order, a Foreign Draft, or the equivalent. *Any payment must be in U.S. dollars, drawn on a U.S. bank, otherwise it will be returned to you.* Another option for payment is to use such major credit cards as American Express, VISA, or MasterCard.

Orders are usually shipped within 2 working days after they are received in Corvallis. However, if you need a program yesterday, call us today at 503-757-2000, extension 3371. Although we can't get it to you yesterday, we'll do our best to get it in the mail today.

## SUBMITTING PROGRAMS

Programs submitted to the Users' Library should be on Hewlett-Packard standard Library submittal forms, or they should include, at least, the documentation required by those forms. To maintain the high quality of the programs submitted to the Users' Library, we encourage you to

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**HP Computer Museum**  
**[www.hpmuseum.net](http://www.hpmuseum.net)**

**For research and education purposes only.**

closely follow the *Users' Library Contributor's Guide for the HP-41, HP-67, and HP-97*. Complete and orderly documentation is essential to ensure the acceptance of a program into the Library.

We also encourage you to read the ongoing KEY NOTES column, "In the Key of HP." This column addresses some of the things we look for when we are reviewing programs that are submitted to the Users' Library.

Programs that are submitted to the Library for the HP-67 or HP-97 must include magnetic cards, and HP-41 programs must include either magnetic cards, reproducible bar code, or a data mini-cassette for use with the new HP 82161A Digital Cassette Drive. (The cassette will be returned to you.) It would take far too long to review and check all the many program submittals if we had to key them in line by line. Also, there is always an increased chance of error when someone keys in handwritten keystrokes.

*The management of the Users' Library reserves the right to reject programs which, in its opinion, do not represent a significant contribution, are not clearly or sufficiently documented, or are not otherwise appropriate for the Library.*

## CURRENT LIBRARY NEWS (CORVALLIS)

January 1982 marks the tenth anniversary of Hewlett-Packard personal computing products. Although the Users' Library is a little younger, we are going to celebrate in a big way! Our most exciting news is for our authors. Now, they can make "points" with the Library! For every submitted program accepted by the Library, we will award the author *one point*. These points are redeemable for Hewlett-Packard accessories AND calculators. One point may be redeemed for a Solutions Book, one mini data cassette, or a custom keyboard—just to name a few of the items available. One point is also redeemable for the traditional "four free \$6 programs coupon," or save the points and redeem them for such large items as an HP-41CV or even an HP-85 Personal Computer!! The complete list of products available for the "point" system will be sent out with each accepted submittal. (This list is available from the Library upon request.)

## NEW LIBRARY CONTEST

To further celebrate our tenth anniversary, the Library is sponsoring another contest. Beginning March 31st, and through August 31, 1982, the Library will award eight new HP 82182A Time Modules and either two new HP 82161A Digital Cassette Drives or two new HP 82162A Thermal Printer/Plotters (including HP-IL Modules) to the authors of the ten programs judged most outstanding each month by our review committee. The programs will be judged on merit with the same guidelines as with the last contest. For documentation forms, or further information, contact the Users' Library.

## NEW TAXES SOLUTIONS BOOK

As unpleasant as tax time can be, your HP-41 is again equipped to help you through the paper-work. The *HP-41 1981 Taxes Solutions Book* (00041-90403) will be available February 1 and will cost \$12.50.\* Contact your local HP Dealer, or send your order directly to the Users' Library. If you order through the Library, please include a \$3.50 Handling Charge and any applicable State and/or local taxes.

## ORDER STATUS ETC. (CORVALLIS)

The Library is remaining current on orders and coupons, thanks to a great staff (that always seems to include ambitious temporary help). Remember, call the Library directly—503-757-2000, extension 3371 NOT TOLL-FREE—and your order will ship that same day (credit card or purchase orders only).

Our quantity discount offer was so popular that we are extending it through our tenth anniversary year. Order six or more Library programs, and deduct 25% (Library programs only).

Programs are now available from the Library recorded on a data mini-cassette for use with the HP 82161A Digital Cassette Drive. The mini-cassettes are \$9.50\* each, with a program order from the Library, plus the price of each program requested. (For example: One cassette plus one program = 9.50 + 6.00 = \$15.50.) Take advantage of the *quantity discount* and fill a cassette today. Each cassette will hold up to 250 programs, depending on program length.

The Library is here to support Hewlett-Packard programmable calculator owners. If you have suggestions for future Library services, let us know.

## HP-11C AND HP-12C LIBRARY (CORVALLIS)

A Users' Library for the HP-11C and HP-12C slim-line calculators is just around the corner. You will be reading more details about the establishment of this new library in upcoming issues of HP KEY NOTES. Please do not write or call until we publish details, as those details are still not firm.

## NEW PROGRAM PRICES

Inflation affects all of us, and the Users' Library is no exception. Our cost of reproducing programs has gone up like everything else. But, rather than make a sweeping increase in price on all of the programs in the Library, we have decided to graduate the prices according to our reproduction costs. Many programs will still be \$6.\* The more lengthy programs will be priced accordingly at \$8, \$10, \$12, etc.\* Prices will be listed in each *Catalog*. This is the fairest pricing method that we know of, and we know you'll agree that the convenience of having all that information available is well worth the small price of each program.

## NEW PROGRAMS (CORVALLIS)

Here are some recent submittals to the Corvallis Users' Library. All of the programs featured in this issue are available worldwide, but before you order, be sure to read (above) "Ordering Programs." And, remember that where additional Memory Modules are listed as necessary to run a program on the HP-41, you do not need them if you are using an HP-41CV or a Quad-RAM.

### (41) Particulate Removal Cost #01100C (Price: \$8\*)

The costs are determined for cleaning particulate matter from stack gas by electrostatic precipitation or fabric filters. Inputs include cost parameters, gas flow rate, percent particulate removal, fabric air-to-cloth ratio, and gas temperature. The flyash resistivity, ESP plate area, bag life, and baghouse pressure drop are estimated. *Required accessories: 3 Memory Modules, and a printer is helpful.* (646 lines, 1618 bytes, 16 pages)

Author: Norman S. Charles  
Houston, Texas

\* \* \* \* \*

### (41) Smooth Earth Diffraction #01085C (Price: \$8\*)

The Smooth Earth Diffraction program predicts the radio propagation loss relative to free space for smooth earth conditions, or for conditions of uniform roughness, of a path slightly beyond the radio horizon. This program uses a simplified method, developed by Vogler (1964), for the standard Van der Pol-Bremmer diffraction theory, as modified by Norton (1941). The program has a self-check for validity. Inputs include data on the effective earth radius. *Required accessories: 1 Memory Module.* (356 lines, 707 bytes, 27 pages)

Author: John L. Roth  
Newbury Park, California

\* \* \* \* \*

### (41) Architectural Perspective #01120C (Price: \$6\*)

This program calculates two-point perspective views. Data may be input directly, or up to 239 data points may be stored in memory and/or written on magnetic cards. Data is grid-based; input and output grids may be dissimilar. Heights may be input as grid values or as elevations (in feet or meters). *Required Accessories: 1 Memory Module.* (269 lines, 476 bytes, 12 pages)

Author: Daniel R. Tindall  
Minneapolis, Minnesota

\* U.S. dollars. Orders from anywhere outside the U.S. must include a negotiable check (or money order), in U.S. dollars, drawn on a U.S. bank. All orders from anywhere outside the U.S. must include an additional 10 percent fee for special handling and air mail postage. (For example, an order for two programs = \$6 x 2 = \$12 + \$1.20 = \$13.20 total.) If you live in Europe, you should order KEY NOTES programs directly from the Geneva UPLE, but make certain you make payment as required by Users' Program Library Europe; the above \$6 fee is good only for orders to the Corvallis Library.

**(41) Flipo #01477C (Price: \$12.00\*)**

If you liked the game program "Reversi," you will flip over this one. Flipo is an implementation of a board game, best known in the U.S. as OHELLO® which is marketed by Gabriel Industries, Inc. This program offers you many options. For instance, there are three playing modes: no printer connected, printer connected and ON, and printer connected and OFF. And, you can change the playing mode at will during the game.

This program allows you to review the board and the last two plays in any playing mode, and it offers you five playing levels. The code has been optimized for execution time; a game can be completed in as little as 15 minutes, depending on the playing mode and your response time. *Required accessories: 3 Memory Modules.* (612 lines, 1,792 bytes, 40 pages)

Author: **Robert Swanson**  
Portland, Oregon

**LIBRARY CONTEST WINNERS ANNOUNCED**

In KEY NOTES V5N2 we announced the Users' Library Program Submittal Contest. In the following issue, V5N3, we announced the winners for the month of September. In this issue, we have the winning programs for October and November.

As you know, three programs were to be chosen on merit each month. You will notice that four programs are featured as the winners for the month of November. Two of these programs were contributed by the same author, and we chose to feature both of them. Here, then, are the winners for October 1981.

**(41) Analysis of Laboratory Strength Test Data #67000-99952 (Price: \$10\*)**

This package is made up of nine inter-related programs that deal with the analysis of data obtained from laboratory rock strength tests. Three programs take the Mohr-Coulomb failure criterion to determine angle of friction and cohesion. Three programs deal with nonlinear failure analysis of intact or jointed rock. One program develops the Mohr envelope, one determines material constants, and one tabulates principal stresses. Programs can be run together without re-entry of data. Programs run with or without the printer; a neat printout format is used. For those with only 3 Memory Modules, a shorter program is described. *Required accessories: 4 Memory Modules.* (862 lines, 1796 bytes, 43 pages)

Author: **John L. Gilby**  
Maidenhead, Berkshire, England  
*(Congratulations, Mr. Gilby! You have done an excellent job of documenting this program. Your example problems are clear and concise and it is handy that you have included data-review and error-correction routines. This program is a winner, for sure—Ed.)*

**(67/97) Gear Mesh Design-Spur Gears #67000-99953 (Price: \$10\*)**

Given a minimum of basic gear information, this program, calculates the data required to design a meshed pair of full-depth involute spur gears. Outputs include testing pitch ratio, backlash, contact ratio, distance between centers, and more. Also, this versatile program allows the user to manipulate the design through various inputs in order to customize the gear pair. Any potential design errors are flagged for user decision. This program does not work on the HP-41. (411 lines, 39 pages)

Author: **Michael R. Cascini**  
Cedar Rapids, Iowa  
*(Congratulations, Mr. Cascini! You thought of all the angles on this program. You have included many pages of clearly stated, typed documentation. You defined all your terms and included a flow chart of the program. Also, this program is compatible with either customary U.S. units or Metric units. It is easy to see why this program won. Anyone with a knowledge of gear mesh design will want this program in their HP-67/97 program library—Ed.)*

**(67/97) Sheep Production Model #67000-99954 (Price: \$10\*)**

This program simulates both physical and financial aspects of sheep flock management. This allows users to compare differing management strategies and different flock types and, from this information, operate their flock more efficiently. This program does not run on the HP-41. (1116 lines of programming on 5 cards and over 80 pages of documentation)

Author: **John Pauley**  
Tasmania, Australia  
*(Congratulations, Mr. Pauley! It is obvious that hours and hours of work went into preparing this splendidly documented program. You have included flow charts, term definitions, and example problems. You have a table of contents, appendices, the whole works. This is an unquestionable winner. Any sheep-farmer or agricultural extension officer will jump at the chance to have information like this at his or her fingertips—Ed.)*

Now, we have the Users' Library Program Submittal Contest winners for November 1981.

**(41) Circular Plate with Hole-Plate 2 #67000-99948 (Price: \$10\*)**

This program will provide the user with displacement, slope, and stress calculations at any radius on a circular plate with a center hole, considering the outside edge free and the inside edge either simply supported or fixed. The user may apply a uniform pressure load of any band-width, a ring load, or a combination of both

anywhere on the plate. *Required accessories: 4 Memory Modules and Printer.* (1034 lines, 1683 bytes, 22 pages)

**(41) Circular Plate with Hole-Plate 1 #67000-99949 (Price: \$10\*)**

This program is nearly the same as -99948 (above). It performs the same function on a circular plate with a center hole, considering the outside edge either simply supported or fixed and the inside edge free. *Required accessories: 3 Memory Modules and Printer.* (815 lines, 1405 bytes, 20 pages)

Author: **Steven A. Porter**  
Houston, Texas  
*(Congratulations, Mr. Porter! Both of these programs have been well thought out. Your documentation is neatly typed and includes some very explicit drawings. Your example problems are clearly stated and diagrammed. These programs are, no doubt about it, winners. Any mechanical engineer would be at a loss without these programs—Ed.)*

**(41) Physical Property Estimation #67000-99950 (Price: \$10\*)**

This program will calculate estimates of the point properties—critical temperature, critical pressure, critical volume, and acentric factor. Plus, the temperature correlated estimates of liquid density, heat of vaporization, vapor pressure, and surface tension, and the liquid and vapor properties of viscosity, and heat capacity also are calculated. Inputs required are the molecular weight, normal boiling point, and a knowledge of the molecular structure. *Required accessories: 4 Memory Modules.* (987 lines, 2087 bytes, 34 pages)

Author: **Robert Wooley**  
Midland, Missouri  
*(Congratulations, Mr. Wooley! It would take someone with a broad expertise to come up with this interesting and useful program. Your documentation is very clear, plus, you have included extensive flow-charts and tables. I'm sure that the thousands of Chemists and Chemical Engineers will appreciate all the hours of work that you put in to develop this program—Ed.)*

**(41) Buttress Design #67000-99951 (Price: \$10\*)**

Cut slopes in bedrock having an adverse direction of bedding (dip out of slope) are commonly stabilized through the construction of a fill material buttress. Soil parameters and slope dimensions are sized to prohibit translational failure parallel to the planes of bedding. *Required accessories: 4 Memory Modules.* (1006 lines, 1799 bytes, 33 pages)

Author: **Stephen Milazzo**  
Long Beach, California

(Continued)

(Congratulations, Mr. Milazzo! This is a very well documented program. Your diagrams are interesting and explicit. You have clearly defined all your terms and abbreviations. Any civil engineer will be able to recognize the enormous amount of work that you have saved them by developing this winning program. Keep up the good work—Ed.)

The Users' Library was swamped with an extraordinary number of program submissions in December. At the time that this issue was going into production, neither the December contest winners nor the Grand Prize winners of the three marvelous HP-85 Personal Computers had been determined. We will feature these winners in the May 1982 issue (V6N2), so please bear with us until then ...

## Custom Keyboards Announced

Hewlett-Packard recently announced the introduction of the HP 82504A Custom Keyboard. Its flexible membrane completely covers the existing HP-41 keyboard and provides the final, professional touch in customizing the remarkable HP-41 calculator.

This new Custom Keyboard can be printed with any customer-designed nomenclature, including logos, trademarks, alphanumerics, and other special symbols. And up to five colors can be printed on each Custom Keyboard.

Obviously, we cannot economically produce such products as the new Custom Keyboard in small quantities of one or ten or even fifty. This new product is a special order item, and it comes in minimum quantities of 250. For more information about this exciting new product, contact your nearest Hewlett-Packard Sales Office.

(By the way, you can get a single Custom Keyboard—with the standard key configuration—by earning 1 point from the Users' Library!—Ed.)



## In the Key of HP

Most of the ideas presented in KEY NOTES are contributed by you, and they represent the ways in which you approach solutions to programming problems. This column addresses some of the common inconsistencies that the Users' Library finds in user-submitted programs. Also in this column, we answer some of the common questions that you ask, and we present some ideas that we think you will find useful.

In this issue, John Loux, a Technical Advisor in the Users' Library discusses application pacs (ROM) for the HP-41 and the utility of the COPY function. Plus, we have added some handy tips near the end of the column.

### PROGRAMS IN ROM

HP-41 application pacs and custom program modules are general-purpose packages written either by Hewlett-Packard or independent groups. Their programs and functions are permanently written in plug-in modules. These ROM-resident programs can be accessed and used in much the same way and for all of the same reasons that user-written programs can be used. Although, for all user-intensive purposes ROM (read only memory) programs are very similar to their RAM counterparts, they also differ in some important ways.

The acronym RAM stands for "random access memory" and is used most often when referring to the read/write memory of a calculator or computer. Loosely, random access means that information stored anywhere within memory can be accessed with equal ease. All user-alterable aspects of the HP-41 (programs, data, flags, the current SIZE, etc.) are maintained in RAM.

ROM is similar to RAM in that it can be randomly accessed and is capable of maintaining the same kinds of stored information. Although ROM is capable of supporting many kinds of information, its read-only nature limits its usefulness in maintaining such information as data and status. Consequently, related functions are not supported. The two types of information that are supported by ROM are user-language programs and micro-code\* functions.

Except for certain aspects of their internal representations, ROM programs are identical to RAM programs. ROM programs can be run, single-stepped through, printed on a printer, and can be randomly accessed via the GTO (go to label) and GTO. (go to step) commands. ROM programs cannot be traced,\*\* cannot be edited or deleted, cannot be positioned to by using CATALOG 2, and cannot be packed. In short, you can do nothing with a ROM

\* User language is that which the user implements when steps are keyed in program mode. Microcode is machine language; that low-level language that the machine actually implements when it performs an operation. Normally, the user cannot access or write functions in microcode.

\*\* Tracing is the ability of all HP-41 compatible printers to list the executed steps and important intermediate results of a running program.

program but run or view it while it still resides in ROM.

Because ROM is internally different from RAM, the HP-41 references it differently. One manifestation of this difference is seen in how the execution of a ROM program is represented in program memory. The programmer must key in [XEQ] [ALPHA] followed by the label characters and [ALPHA] just as would be done if a RAM alpha label were accessed, but before the calculator stores the keystrokes as a program line, it searches its memory for the label in the order of the three catalogs; i.e., CAT 1—internal RAM, CAT 2—external ROM, and CAT 3—standard functions (internal ROM). If the corresponding label does not exist in RAM but does in ROM, the calculator translates, the XEQ command into an XROM command before storing it as a program line. XROM's are provided so that the calculator will know exactly where to look for the label when the execution is performed, thereby decreasing access time. The ROM number and the function number within the ROM are recorded in the XROM statement and can be seen if the program step is viewed with the required ROM removed. The user will note that the corresponding process does NOT occur if a programmatic GTO is performed to a ROM label. Thus, every time such a GTO is encountered, the calculator must search CATALOGS 1 and 2, taking more time. Coupled with the fact that the GTO function will leave the program pointer in ROM (a generally undesirable occurrence), it becomes obvious that the use of GTO to access ROM programs should be limited.

The other kind of information that is supported by ROM is the microcode function. These functions are virtually identical to standard (CAT 3) functions, and are NOT programs. They are invoked in the same fashion that standard functions are, via an XEQ or key assignment, and their mnemonics are displayed with no preceding XEQ or XROM when their respective ROM's are attached. Function mnemonics will revert to XROM's if their resident ROM's are not plugged-in to the calculator. Functions can be distinguished from programs in CATALOG 2 by their lack of the text character (T) which precedes each program label.

### COPY

There will be times when a ROM program will not be useful as written but would be if it were modified. In this instance, having a modifiable copy of the program in RAM is desirable. Fortunately, the HP-41 supports this action with the standard function COPY. The COPY function is not programmable.

When executed, COPY prompts for a global label resident in the ROM program of interest. The input label need not be the first nor the only global label in the program. The function then makes an identical copy of the entire ROM program in RAM (if there is room), beginning at step

01 and terminating with the **END**. The copy will never write over an existing RAM program, because an **END** is always loaded before the incoming program. The **END** will be stored in program memory even if the preceding program is already terminated by an **END** and even if there is no preceding program. These solitary **END**'s can be positioned to using **CAT 1** and can be deleted just as you can delete any program step.

The resulting RAM copy is identical to the ROM version in terms of the functions represented, including any **XROM**'s that may (and probably do) exist in the ROM program. Thus, the RAM version is still ROM-dependent. This may or may not be desirable, depending on your needs. For example: if the program that is copied acts as a controller and calls ROM routines to do certain subordinate tasks, alterations to the in-RAM program may be made as long as they are compatible with the running of the called subroutines. On the other hand, if you desire to alter or write your own subroutines, you should replace the **XROM** program calls with appropriate **XEQ** statements that call your own routines. Because **CAT 1** is searched before **CAT 2** when a subroutine call is performed, your customized routine may have the same label as the ROM program label you are replacing.

Note that if you desire to **COPY** and run all or part of a ROM program without having the ROM physically attached, all **XROM**'s involved should be translated to **XEQ**'s and all called subroutines should be **COPY**'ed. Note also that any function (as opposed to program) calls must also be replaced by calls to user-written routines. If such a programmatic **XROM** is encountered without the ROM in place, the calculator will display "NONEXISTENT." To verify that this occurrence is the result of a forgotten **XROM**, simply put the calculator into program mode at the point at which the program stopped, and read the displayed step.

If the display "RAM" occurs, then the program you have just tried to **COPY** has either already been loaded into RAM (perhaps as a portion of a program that was already **COPY**'ed using another of its global labels) or another program of the same name already exists in RAM and uses the same global label.

## THE USERS' LIBRARY

**COPY**'ed programs are acceptable to the Library as long as they represent a significant change from the original program. **COPY**'ed programs should be documented as such, with the ROM name and any duplicate labels given prominence. Highlights of the differences between the contributed program and the ROM program should also be given.

Programs that make use of ROM routines as subroutines are also acceptable. The ROM functions and programs that are used should be listed and the ROM requirement must be given under the "Necessary Accessories" heading.

Following, now, are the tips we promised at the beginning of this article.

**ENTER** 100  $\div$

**Q:** What is the shortest and fastest way to divide by 100 in a program?

**A:** There are three frequently used methods for dividing by 100.

1. 100  
/  
length: 4 bytes
2. 1E2  
/  
length: 4 bytes
3. 1  
%  
length: 2 bytes

Method number 2 is faster than method number 1, but method number 3 is the shortest and fastest way to divide by 100 in a program. You can use this "percent" method to divide by other numbers, too. For instance, 1000  $\div$  becomes .1 %; 50  $\div$  becomes 2 %; and, 500  $\div$  becomes .2 %.

## ADD A LOCAL LABEL

Many of the routines and programs that we receive in the mail have in them **GTO** statements that call global labels in the same program. For example, we wrote this simple counting program.

```
01 LBL "COUNT"
02 VIEW X
03 1
04 +
05 GTO "COUNT"
```

This routine can be shortened by 4 bytes, and the execution time noticeably reduced, by adding a local numeric label (00-14) and replacing that global label **GTO** in line 05 with a local label **GTO**. Choosing to use **LBL 01**, we have:

```
01 LBL "COUNT"
02 LBL 01
03 VIEW X
04 1
05 +
06 GTO 01
```

It is always advantageous to use local labels when making jumps within a program. Global labels should be reserved for jumping between programs and for making routines and programs accessible from any part of program memory.

In short, don't use **GTO** "a global label" in a program if that global label appears in that program. Instead, add a local label before or after the global label and use: **GTO** "the local label."

For more details on this subject read **V5N2**, "In The Key of HP."

## Corvallis Library Now Accepting "SP"

Your Corvallis Users' Library will now accept well-documented programs that contain Synthetic Programming ("SP") lines. But before you rush to your files to submit such programs, make sure you read and understand the following reservations. And keep uppermost in your mind those initial words: "well-documented."

### WHAT IS IT?

"Synthetic Programming," as applied to the HP-41C or HP-41CV, is the use, in programs or manual operation, of any of the following: synthetic functions, synthetic key assignments, and nonstandard alpha strings and labels. The word "synthetic" derives from the user-initiated synthesis of HP-41 instruction bytes into combinations that are not available with normal keystrokes.

As a simple example of what we have thus far discussed, consider nonstandard alpha strings. Each HP-41 instruction byte has a corresponding alpha character. The ALPHA keyboard has keys available for 59 of these characters. However, as users of the HP 82143A Printer/Plotter function **BLDSPEC** can attest, the HP-41 display is capable of forming additional characters. And so, using Synthetic Programming techniques, any of 19 additional characters can be included in alpha displays, program text lines, and global label names. Furthermore, any of the 128 printer characters can be represented in a program text line, which can result in a significant savings in program bytes through reduced use of **ACSPEC** and of flag 13. But that's a simple example. A more elaborate example of Synthetic Programming follows...

### HOW DOES IT WORK?

The program "BYTE" provides a quick and precise means of computing the number of bytes in a user program (or between any two points in program memory), without use of the printer. At each of two different program lines, the user presses a key that he/she has assigned to the synthetic function "RCL b" (which recalls the value of the internal program counter to X). Then, "BYTE," in an execution time of less than 3 seconds, returns to X the number of bytes between the two program lines. This very useful result is impossible to obtain using normal HP-41 functions.

Look carefully at lines 10, 11, 12, 13, 26, and 32. Of this group, line 11 is a nonstandard program text line, as described above; line 32 is simply a normal "1 E3" program line, shorn of the superfluous "1" (thus saving a byte); the rest are new two-byte lines, usually called "synthetic functions." These functions provide access to the so-called "system scratch registers," which are a group of 16 registers (track 1 of a card reader **WSTS** card) including the

(Continued)

user RPN stack, the ALPHA register, the program counter and subroutine return stack, the 56 user and system flags, key assignment information, and the current memory allocation data. For example, line 13 causes the exchange of the contents of the X-register with those of the d-register, which contains the 56 user and system flags. The name "d-register" comes from the display of the associated functions. The "x<>" prefix and the "d" postfix—seen normally only in "LBL d"—have been combined into a synthetic function. There is no normal function postfix associated with the program code that results in the "t" in line 10—the use of the printer symbol "t" is just an accident. (In the HP-41 display, line 10 shows as "STO M.") Lines 13 through 26 take a number from X, swap it with the contents of the flag register, change its value by manipulating individual binary bits (i.e., by setting and clearing flags), and finally restore it to X while returning all flags to their original states.

```

01*LBL "BYTE" 20 FS?C 18
02 XEQ 01     21 SF 17
03 X<>Y      22 FS?C 19
04 XEQ 01     23 SF 18
05 -          24 FS?C 20
06 CHS       25 SF 19
07 RTN       26 X<> d
08*LBL 01    27 10
09 CLR       28 *
10 STO C     29 INT
11 "+++++"  30 LASTX
12 X<> C     31 FRC
13 X<> d     32 E3
14 FS?C 15   33 *
15 SF 13     34 DEC
16 FS?C 16   35 7
17 SF 14     36 *
18 FS?C 17   37 +
19 SF 15     38 END

```

There are numerous other examples of the capability of Synthetic Programming to expand the already impressive power of the HP-41. This makes it desirable for the Users' Library, in its role of providing a medium for users to exchange programming ideas, to accept programs containing synthetic code. However, the decision to do so had to be made with great care, because it is not possible that HP can "support" the use of Synthetic Programming in the traditional manner that HP supports its proprietary products. HP takes pride in the reliability of its calculators and the ease of their use, guaranteeing that each calculator will function and perform exactly as described in its corresponding owner's handbook. The operation of synthetic program lines cannot be assured in this traditional HP manner; first, because the corresponding internal execution processes have not been studied or documented and second, because there has always been the

chance that future improvements to the HP-41 would eliminate some or all Synthetic Programming capability. Furthermore, HP-Corvallis does not have the personnel resources to provide written or telephone instruction to customers in the mysteries of Synthetic Programming. Finally, there are "occupational hazards" associated with Synthetic Programming; misuse of synthetic functions can result in loss of memory contents or temporary system lock-up, problems which HP traditionally takes great pains to remove from their calculators. (Note: These problems can cause inconvenience, but there is no physical danger to the calculator.)

Therefore, in consideration of all of the above facts, the Corvallis Users' Library will accept HP-41 programs containing synthetic code, but only with the following reservations:

1. This new policy of Hewlett-Packard (HP) does NOT constitute an endorsement or recommendation of Synthetic Programming. Hewlett-Packard will not "support" Synthetic Programming, neither by guaranteeing that synthetic functions will operate on all present and future HP-41's, nor by providing instruction in Synthetic Programming to customers. HP will, however, refer customers to independently available references on Synthetic Programming (see below).
2. Programs containing synthetic code will be specifically and clearly identified in the Users' Library *Catalog* or in KEY NOTES, to warn potential users that the code cannot be keyed into their calculators by using standard techniques. However, customers not familiar with Synthetic Programming techniques will be able to use the card reader or wand to enter the programs into their calculators.
3. Program authors must include in their program documentation a clear and precise identification of all synthetic program lines, including specifications of the byte structure of the lines. And all inquiries about the programs will be referred directly to the authors.

#### WHERE CAN I GET MORE INFORMATION?

In KEY NOTES V4N3p8 we reviewed the book: *Synthetic Programming on the HP-41C*, by Dr. William C. Wickes. The book describes the complete theory and application of Synthetic Programming, starting from the beginner's standpoint. This 96-page book is \$11.00 postpaid, by surface mail, anywhere in the world. For air mail, add: U.S., Mexico, and Canada \$1.00; for Europe and South America \$2.00; for elsewhere \$3.00. Order it from Larken Publications; 4517 N.W. Queens Avenue; Corvallis, Oregon 97330 U.S.A. Make sure your check or money order is in U.S. dollars, drawn on a U.S. bank.

Another source of information about Synthetic Programming is the *PPC Calculator Journal*, published by the inde-

pendent users' club, PPC. For more information about PPC and a sample issue of the club's newsletter, send a self-addressed, large (folded) envelope (9 × 12 inches; 23.8 × 30.5 cm) with first-class postage for 2 ounces (56.7 grams) to: *PPC Calculator Journal*; 2545 W. Camden Place; Santa Ana, California 92704 U.S.A. If you live outside the U.S., make sure you include a legible address label and international postal coupons for 56.7 grams (2 ounces). A letter is not necessary and will only slow the response.

A third reference for Synthetic Programming is the book reviewed in KEY NOTES V5N3p9. It is: *Calculator Tips & Routines Especially for the HP-41C/41CV*, and it was edited and compiled by John S. Dearing, a member of PPC and a resident of Corvallis, Oregon. The book is 136 pages and mainly a fabulous collection of tips and routines from past KEY NOTES, HP manuals and books, the *PPC Calculator Journal*, and other sources. It includes routines that contain synthetic code, but it is not a treatise on Synthetic Programming. The book is \$15 postpaid to the U.S., Canada, and Mexico; \$20 air mail postpaid elsewhere. Make sure your payment is a check or money order in U.S. dollars, drawn on a U.S. bank. Order it from: Corvallis Software, Inc.; P. O. Box 1412; Corvallis, Oregon 97339 U.S.A.

If you are in a hurry to get one of these two books, try calling your local college bookstore or your local HP Dealer before you order by mail. Some of these stores are now carrying calculator books.

#### "Free" One-Year Subscriptions ...

At one time, several years ago, we did offer a "free one-year subscription" to HP KEY NOTES. However, for many reasons, that offer was soon changed to read: "KEY NOTES is published periodically and is presently free to you, an HP-41 owner." Or, in the case of earlier calculators, it states: "...to the owners of HP-67 and HP-97 calculators."

We bring this to your attention because of the recent addition of a subscription fee for KEY NOTES. Some readers have written to question us about the balance of their "free one-year subscription," and we have had to remind them that the card formerly packed with each new card-programmable HP calculator does NOT offer a "one-year" subscription.

Today, and in the foreseeable future, the only free subscription to KEY NOTES is the one offered if you are a member of the Corvallis Users' Library in 1982 or if you join the Users' Library in 1982. We have not made commitments past 1982 because of rapidly changing postage, freight, and printing costs. Perhaps later this year we can be more specific about multi-year subscriptions at reduced rates. But don't worry, because we will surely let you know of any changes in KEY NOTES.

## The Issue on Back Issues

Because many new owners of HP-41 hand-held computers want to retrieve the information presented in earlier issues of KEY NOTES, we will make back issues available starting March 1, 1982. However, because it is economically and physically unfeasible to reprint all of the back issues of KEY NOTES, we are going to offer from Volume 3 Number 3 to Volume 5 Number 3 as relevant back issues. The V3N3 issue introduced the HP-41C, so coverage back to that point should satisfy most new subscribers to KEY NOTES.

Below are the contents of each available back issue, followed by a price schedule.

### V5N3 SEP-DEC 1981 (16 pages)

- Library Corner
- First Contest Winners Announced
- Toward More Secure Bar Code
- PPC Conference Held Here
- Library Contest Continues
- In the Key of HP (HP-41 Functions)
- Book Reviews
- Back Issues of KEY NOTES
- Tenth Anniversary Calendar Ready
- Routines, Techniques, Tips, Et Cetera
- KEY NOTES Subscription Plan

### V5N2 MAY-AUG 1981 (16 pages)

- Library Corner
- Do You Really Know Your HP-67/97?
- HP-41 "Bush Computer"
- Library Contest Announced
- More Software = More Solutions
- In the Key of HP (Discussion on Labels)
- Magnetic Card Erasure
- Petroleum Fluids Pac Released
- Routines, Techniques, Tips, Et Cetera
- Tenth Anniversary Calendar Announced
- KEY NOTES Subscription Plan

### V5N1 JAN-APR 1981 (16 pages)

- Library Corner
- KEY NOTES Going to Subscription
- Quad RAM Questions
- Generating Bar Code
- HP-41 Flags—Part 2
- Custom Services Sells Solutions
- Routines, Techniques, Tips, Et Cetera
- HP-41 Subroutines
- HP-41 Function List

### V4N3 SEP-DEC 1980 (12 pages)

- Library Corner
- "Petals Around the Rose"
- HP-41C Flags—Part 1
- Is the HP-65 Dead?
- "Roll" Your Own Bar Code
- "I Owe It All to My HP"
- It's "That" Time Again!
- Book Reviews
- "25 Words" (More or Less!)
- New Products, New Prices

### V4N2 JUN-AUG 1980 (12 pages)

- Wand Functions
- New HP-41C Power Source
- Library Corner
- How Small Can You Write?
- Efficient Use of HP-41C Status, Data, and WALL Cards
- A Special Program (HP-67/97)
- The Wizard of Programming
- Book Reviews
- "25 Words" (More or Less!)

### V4N1 MARCH 1980 (12 pages)

- Important HP-41C Information
- Fitting 67/97 Programs Into the HP-41C
- "25 Words" (More or Less!)
- Russian Calculators?
- Library Corner
- About Batteries ... Continued
- Accessories Hot Line
- Indirect Addressing
- Book Reviews
- We Get Letters

### V3N4 NOVEMBER 1979 (12 pages)

- Library Corner
- HP-41C Tips and Techniques
- (67) Twenty-Element  $4 \times 5$  Matrix
- Book Reviews
- HP-41C Tips From an Owner
- Randomly Yours
- We Get Letters
- "25 Words" (More or Less!)
- HP-41C Owner's Handbook Addendum

### V3N3 AUGUST 1979 (12 pages)

- The HP-41C Defined
- A Users' View of the HP-41C
- The Designer's View
- HP-67/97 Compatibility
- Software for the HP-41C
- Library Corner
- Another Excellent "Calculator" Book
- Random Numbers, Means, Regressions etc.
- About Batteries
- More About Merging (HP-67/97)
- "25 Words" (More or Less!)

For the convenience of "newcomers," the column "25 Words (More or Less!)" was the forerunner of the present column, "Routines, Techniques, Tips, Etc." These columns contain programming information for the HP-67/97 and the HP-41.

Prices for KEY NOTES back issues are as follows. All prices include first-class or air mail. Payment must accompany your order and must be a check or money order in U.S. dollars drawn on a U.S. bank. Or you may use your American Express, VISA, or MasterCard account; be sure to include your account number and card expiration date. Your order will be promptly mailed in an envelope.

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5	\$7.00	\$9.00
6	\$8.00	\$10.00
7	\$9.00	\$11.00
8	\$10.00	\$12.00

Remember, these back issues will NOT be available until March 1, 1982.

Do you have an application for an HP-67/97 or HP-41 that is unusual, clever, or interesting? We'd like to hear about it.

## KEY NOTES Corrections

Before the V5N3 issue of KEY NOTES, our collection of stamps from Ireland and Scotland was a little low. But, thanks to an error that appeared on page 12 in column a, we now have plenty of Irish and Scottish stamps. It is great to know that KEY NOTES is read *carefully* by so many people throughout the world, especially those who know where Loch Ness *actually* is located!!

Also, in column a on page 12, there is a typographical error in the second contribution by Roland Waldi. The trigonometric keystrokes for the algebraic function  $X/\sqrt{1-X^2}$  should be  $\boxed{\text{SIN}^{-1}}$ ;  $\boxed{\text{TAN}}$ . And, when you are using these simplified trigonometric expressions, remember that X must be less than 1 if  $1-X^2$  appears in the algebraic expression or if your calculator is set to radians (RAD) mode.

In Vally Lambrechts routine (p 14a), line 11 should be the card reader function RSUB. That XROM 30,04 is the XROM code for this function, as you can find on page 32 of your HP82104A Card Reader Owner's Handbook.

## Cube-Puzzlers Rescued!

In the last issue (V5N3p16) we told you about, and showed you, "Kolb's Cube." (Got a lot of comments about it, too!) So what does one do for an encore to that remarkable creation? Fortunately, we received an absolutely remarkable HP-41 program that "solves" Rubik's Cube. (We have several, but this one is superb.) And if you recognize the author's name, you'll realize he is one of the winners of the Users' Library Program Submittal Contest, reported elsewhere in this issue.

Congratulations, Mr. Gilby, your program not only works but also shines as a living example of excellent documentation. Here's the abstract.

### (41) Rubik Cube Solution #01342C (Price \$12\*)

Rubik's magic cube has taken the world by storm, recently. This program solves the famous cube from any position. The user enters the initial colours of the faces and the HP-41 proceeds to solve the cube, using three subroutines. The output is a series of instructions informing which face should be rotated. The program is fully illustrated, and the notation used is explained so that it will now be simple to solve the cube. This solution will not break any world records, however, because it is relatively slow. *Required accessories: 4 Memory Modules and Card Reader (Printer optional); and, of course, a Rubik Cube!* (1213 lines, 1918 bytes, 36 pages)

Author: **John L. Gilby**  
Maidenhead, Berkshire, England

\* U.S. dollars. See note at bottom of page 3.

## (Ton yhW)<sup>-1</sup>

Why not sell your software through Hewlett-Packard Dealers?

- Can you identify needed professional solutions?
- Can you write quality software?
- Do you have the resources (time, media duplication, order taking, brochures, etc.) to sell your solutions in volume through HP Dealers?
- Can you support your product after the sale?

If so, you may qualify for the HP PLUS Program (KEY NOTES V5N2p5c). First Principles Software did. First Principles is a new, full-time venture (about a year old) for Pat Imbimbo, a registered engineer. His seven Civil Engineering programs for the HP-41 deal with such problems as hydrology and retaining wall construction. Pat is looking to build on these initial programs to offer a range of software in Civil Engineering and construction. (See the new Users' Library *Catalog* for more information on these programs.)

HP PLUS software was developed by an independent software supplier for operation on HP computer systems. The supplier is solely responsible for its software and support services. HP is not the manufacturer or co-developer of such software or support. HP disclaims any and all liabilities for and makes no warranties, expressed or implied, with respect to this software. Distribution of this product or information concerning this product does not constitute endorsement of the product, the supplier, or support services. The customer is responsible for selection of the software he or she purchases.

HP is interested in *all* professional HP-41 solutions. Of particular interest are wand-based inventory, cassette-based statistics, sales management, in-flight aviation, taxes, and agriculture. Interested parties should contact:

Jack Peters (Dept. 5360)  
Hewlett-Packard Company  
1000 N.E. Circle Blvd.  
Corvallis, OR 97330  
(503) 757-2000 Ext. 2207

## Editorial

If you are reading KEY NOTES for the first time, welcome to our elite group. If this is your first "paid-subscription" issue, thank you for your faith in, and support of, KEY NOTES. We have some interesting surprises for you in 1982, and I am certain that you will find your investment in KEY NOTES a wise choice.

Mr. Edward R. Bettinardi of Denver, Colorado, tried a recommendation from V5N1p6c and found to his dismay that it didn't work. We are grateful that he took the time to inform us of his discovery. In the referenced issue, we reported on an eraser kit that removed "permanent ink" from magnetic cards. By "permanent," we

meant "India ink," used in drawing and drafting trades. Unfortunately, that eraser kit removes *only* India ink. It will not touch such inks as that used in Sanford and some Pilot and Schwan felt-tip pens. When they named *those* inks as "permanent," they were serious! Thanks, again, Mr. Bettinardi, for telling us about that problem.

## LETTERS TO KEY NOTES

When you address letters to KEY NOTES, you should refrain from including anything not associated with the newsletter. Questions about the calculator or its operation should be addressed to Customer Support and questions about the Users' Library should be addressed to that function. Also, questions about future products cannot be answered; Company policy permits me to discuss only those products that have been released. Federal regulations also prohibit discussing future products.

Letters to the editor should be addressed to:

Henry Horn, Editor  
HP KEY NOTES  
Hewlett-Packard Co.  
1000 N.E. Circle Boulevard.  
Corvallis, Oregon 97330 U.S.A.

We cannot guarantee a reply to every letter, but we do guarantee that every letter will be read by the editor or technical editor (Ted Wadman), and as many as possible will be answered in KEY NOTES or in a personal response. Please be sure to put your return address on the face of your letter. Letters sometimes get separated from envelopes.

## READER FEEDBACK

You send us many letters that extol the virtues of KEY NOTES, so we know that you *like* the newsletter. However, never hesitate to write and tell us about what you *would like* to see in a future issue—or issues. We are open to all and any suggestions.

## HP-67/97 Routines and Tips

This idea came to us some time ago from William Pinnick of Columbus, Ohio. It is applicable to many situations.

(67/97) One of the beautiful aspects of the HP-67 and HP-97 calculators is the ability to increment and decrement the I-register to control program flow and looping. This ability is significantly enhanced by indirect increment statements and indirect decrement statements for additional looping control.

As an example, I believe I have found the lowest possible number of statements necessary to control three levels of looping—only 18 steps! Assuming *all loops begin at the same value* and count down, a unique exit is achieved by the DSZ step for the three counters: I, primary register O, and secondary register O. The positions of these three counters make them uniquely suited for this purpose; thus, the program is:

```
*LBLA ST00
ST0E *LBL1
ST00 ST0I
*LBL0 *LBL2
F#S
```

Beginning after LBL2, key in the body of the nested loop, making calculations based on the changing values of the I-register, primary register O, and secondary register O. The I-register changes most rapidly, primary register O second, and secondary register O changes most slowly. After the calculations, close the loops with:

```
RTN
DSZ I
DSZ I
DSZ I
RTN
```

The initial counter value must be in the X-register when the nested-loop begins.

This routine was sent to us from Benton, Illinois, by Robert M. Blake. It refers back to the last issue of KEY NOTES (V5N3).

(67/97) In response to David Whyatt's request (V5N3p12b), perhaps the following routine will be beneficial.

```
001 *LBL9 014 X>Y?
002 ST0I 015 ST09
003 4 016 CLX
004 X#I 017 DSP9
005 X#0? 018 RTN
006 DSZ I 019 *LBL9
007 ENT+ 020 -
008 ABS 021 ST0I
009 LOG 022 ISZ I
010 X#0? 023 *LBL8
011 GT08 024 R↓
012 INT 025 DSP I
013 ROLI 026 RTN
```

The major advantages of this routine being it is shorter by 11 program lines. Also, it needs only two labels, one storage register (I), and it does not use flags. The time it takes to return a decimal number is equal to Mr. Whyatt's; however, whole numbers are returned much quicker.

(The purpose of this routine is to format data in the form F5.X, meaning only 5 spaces will be occupied by the digits, the sign (if there is one), and the decimal point. Thus, 26.8842 is displayed as 26.88, -26.8842 is displayed as -26.9, and 2.68842 is displayed as 2.688. The format assumes X to be less than 10,000 and at least 0.00005. The field length can be changed by changing line 003; for instance, F7.X would require line 003 to be 6—Ed.)

## Routines, Techniques, Tips, Etc...

The routines and techniques furnished in this column are contributed by people from all walks of life and with various levels of mathematical and programming skills. While the routines might not be the ultimate in programming, they do present new ideas and solutions that others have found for their applications. *You might have to modify them to fit your personal application.*

It is probable that you will find this next routine to be a useful addition to your catalog of programs. It was submitted by **Serge Drogi** of Stavold, France.

(41) Just a word to the HP-41 users. It is possible to calculate a probability with the Binomial Law [(?): in french "loi Binomiale"] without using any register outside of the stack. So, this program will be a good example of the advantages of RPN to all users.

The expression is:

$$P(k) = \frac{n! p^k (1-p)^{(n-k)}}{k!(n-k)!}$$

It is interesting to search for what happens in the stack. At the beginning the stack must be set up with: X:k, Y:p, Z:n and at the end, the answer, P(k), is in X.

```
01*LBL "BINLAN" 16 CLX
02 X<>Y 17 LASTX
03 STO T 18 -
04 X<>Y 19 FACT
05 Y+X 20 ST/ Y
06 X<>Y 21 CLX
07 LASTX 22 LASTX
08 RDN 23 1
09 FACT 24 R+
10 ST+ Y 25 -
11 CLX 26 X<>Y
12 LASTX 27 Y+X
13 R+ 28 *
14 FACT 29 .END.
15 ST/ Z
```

Here is a routine that will please those of you who own a printer. It is a simple but useful routine that was sent to us from Piacenza, Italy, by **Steve Tendon**.

(41 with printer) This "special-build-special" routine makes special character building easy. First of all, I have named each dot of the print column (see page 62 of your printer manual) with a letter, like this:

- A
- B
- C
- D
- E
- F
- G

Instructions for use are as follows:

1. Load program.
2. USER (on); ASN "SPBLDSP" and

"BLDSPEC" to, for example, **SIN** and **COS**, respectively.

3. Press SPBLDSP.
4. Press the letter-keys that correspond to the dots you want to darken (if it is a blank column skip this step).
5. Press BLDSPEC.
6. Repeat steps 3, 4, and 5 until all columns have been input; print the special character with ACSPEC, ADV; or with ACSPEC, PRBUF, etc.

```
01*LBL "SPBLDSP" 15 GTO 00
02 0 16*LBL E
03 STOP 17 16
04*LBL A 18 GTO 00
05 1 19*LBL F
06 GTO 00 20 32
07*LBL B 21 GTO 00
08 2 22*LBL G
09 GTO 00 23 64
10*LBL C 24*LBL 00
11 4 25 ST+ Y
12 GTO 00 26 RDN
13*LBL D 27 STOP
14 8
```

**John Hendricks**, who lives in San Carlos, California, developed this quick and useful routine to enhance your HP-41 printouts.

(41 with printer) This routine converts and prints, with an HP 82143 Printer/Plotter, a degrees, minutes, and seconds X-register value to the form DD°MM'SS.F" without utilizing any storage registers.

For HhhMM'SS, substitute 104, ACCHR for lines 08 through 15.

```
01*LBL "PRDMS" 24 *
02 CF 28 25 ENTER+
03 CF 29 26 INT
04 FIX 0 27 CLA
05 INT 28 ARCL X
06 ACX 29 ACA
07 LASTX 30 CLX
08 2 31 39
09 SKPCOL 32 ACCHR
10 6 33 RDN
11 ACCOL 34 FRC
12 9 35 1 E2
13 ACCOL 36 *
14 ACCOL 37 SF 28
15 ACCOL 38 SF 29
16 RDN 39 FIX 1
17 ACCOL 40 CLA
18 RDN 41 ARCL X
19 SKPCOL 42 ACA
20 RDN 43 34
21 ABS 44 ACCHR
22 FRC 45 PRBUF
23 1 E2 46 .END.
```

Here is a routine that is 83 bytes long, but has the potential of saving many registers in a program that handles a lot of data. It is similar to a routine, by **Leonard Cordwell**, that we printed in V5N2. This version was sent to us by **Nai Chi Lee** of Stony Brook, New York.

(41) This routine can pack positive integers from 0 to 999,999. (However, due to round-off error in LOG, the two numbers must not both be 999,999). It is 83 bytes long, but can be reduced by using local labels. To pack, place number abcdef in X and uvwxyz in Y. Then XEQ "IN." The resulting number in X is of the form: a.bcdefuvwxyz.

If the number uvwxyz is less than 100,000, it is normalized by adding 1E5 to it. This is flagged by the negative sign.

To unpack, just place the "combined number" in X and XEQ "OUT." The original two numbers are returned to X and Y respectively.

```
01*LBL "IN" 26*LBL "OUT"
02 1 E5 27 ENTER+
03 / 28 ABS
04 X<>Y 29 LOG
05 1 E2 30 INT
06 STO T 31 10+X
07 / 32 ST/ Y
08 FRC 33 X<> L
09 ST* Z 34 X<>Y
10 RDN 35 SIGN
11 LASTX 36 X<0?
12 INT 37 ST- L
13 1 E9 38 X<> L
14 / 39 ABS
15 + 40 1 E5
16 ! 41 *
17 X<>Y 42 INT
18 X<Y? 43 LASTX
19 ST- L 44 FRC
20 X<Y? 45 1 E6
21 X<> L 46 *
22 R+ 47 ST+ Z
23 10+X 48 RDN
24 * 49 .END.
25 RTN
```

(This is a nice routine Mr. Lee. However, if you find that 319 registers are not enough, we recommend the new *Extended Functions/Memory Module and Extended Memory Module—Ed.*)

In V5N2p12c we published a routine, DV, by **William J. Quinlan, Jr.** of Evanston, Illinois, that creates a divider bar of any length composed of any character on an HP-41 printout. Not satisfied with the methods used in the routine, **Klaus Veil** of Zurich, Switzerland, rewrote it, incorporating Swiss workmanship and the characteristics of flag 22.

(Continued)

(41 with printer) I enclose my version of the DV routine which shows off the features of the HP-41. When the calculator prompts you with SIZE↑CHAR, key in the length of bar you desire, ENTER, the number that corresponds to the special character you wish to use, then press R/S. If you just press R/S when it prompts with SIZE↑CHAR, a 24-character bar will be created in default.

```
01*LBL "DV"      00 31
02 CF 22         09*LBL 01
03 "SIZE↑CHAR"  10 ACCHR
04 PROMPT       11 DSE Y
05 FC? 22       12 GTO 01
06 24           13 PRBUF
07 FC? 22       14 .END.
```

Westchester, Illinois, is the home of Kenneth Rubin. Mr. Rubin sent us this statistical routine.

(41) The following HP-41 routine computes permutations and combinations of N items taken R at a time. (Those of us who have done our homework will remember that  $R \leq N \leq 69$ .) By virtue of the stack-lift-enabling property of PROMPT, I believe only two ENTER statements are needed. (Alternatively, key in N, ENTER, ENTER, R, ENTER, and omit lines 02-07.) Only the stack is used.

```
01*LBL "PRN"     12 RDN
02*LBL 01        13 FACT
03 "R?"         14 R↑
04 PROMPT       15 /
05 ENTER↑       16 RTN
06 "R?"         17*LBL "CMB"
07 PROMPT       18 XEQ 01
08 ENTER↑       19 R↑
09 RDN          20 FACT
10 -            21 /
11 FACT         22 RTN
```

When the HP-41 is running a program and it encounters a GTO or XEQ statement that calls a local label (00-99, A-J, and a-e), it searches ahead for the label, and then it records the distance to the label (in bytes) with the GTO or XEQ statement. This process is sometimes referred to as "compiling," and it speeds-up future executions of the program. (See V5N2p6c, "In the Key of HP," for more information on labels.)

Packing the program erases the recorded distances in GTO and XEQ statements. After PACKING, the first few executions of a program will generally take longer because the calculator must search for any local labels. When all of the GTO or XEQ statements have been executed once, the program is again compiled and the calculator doesn't have to search for local labels until the program is packed or lines are added.

James LeMay, who lives in Houston, Texas, recently wrote to remind us that if we PACK and then compile our programs before recording them on cards, then our programs will execute faster when they are read into the calculator, because local label searches aren't performed in compiled programs. The easiest way to compile a program is to execute it several times, making sure to consider every local branch in the program. Another way that compiling can be done is to position the calculator to each GTO or XEQ statement that calls a local label, then press R/S; let the program run until the "goose" jumps ahead 1 step in the display, then again press R/S. After all of the local branches are compiled, the program is ready to record on a card.

However, you will be able to enjoy the benefits of recording compiled programs (more rapid execution) only if you do not PACK or GTO.. after reading the program into the calculator.

Ramer Streed had these comments that pertain to a routine we printed in the last issue. Mr. Streed is from North Mankata, Minnesota.

(41) Arnold Hinrichs' display routine to shorten the waiting time for calculations (V5N2p13a) seems to be more complex than necessary. After the first result is obtained, [XEQ] VIEW X or AVIEW and let the program continue to run. Then place a STOP in the program just prior to the AVIEW or VIEW statement that displays the next result. When the program is restarted, the next result is displayed immediately. NOTE: Flag 21 must be clear for this to work.

From the way this program runs, the HP-41 must have a display register that is independent of the X- and ALPHA-registers.

(Actually, Mr. Streed, the display is not a "register" in the normal sense of the word. It is a separate entity from the memory and stack registers, and it will hold a value, but there is no RAM allocated for the display. It is a function of the display driver in the central processing unit—Ed.)

Next, we have these comments from Anderstorp, Sweden. They were contributed by Peter Josefson.

(41) After having read KEY NOTES V5N1, I tested Patrick Shibli's "Scrolling-Routine" on page 12 and discovered this: Whenever a VIEW or AVIEW instruction is in operation (the "flying goose" is replaced with something else), any ignored operational error (flag 25) causes the display to scroll to the right at each following label, just like the "flying goose" usually does. This goes on until STOP, END, or PSE is executed.

However, the GTO "?" instruction in Mr. Shibli's routine causes the HP-41 to search for the NONEXISTENT LBL "?" before it continues. This delay can easily be avoided by replacing GTO "?" with, say, RCL nn, where nn is a nonexistent register. Here, the HP-41 "knows" instantaneously that the register

does not exist and, therefore, the display (max 12 letters!) starts scrolling without noticeable delay.

(Another fast way to create an error (that clears flag 25) is SF nn, where nn is a nonexistent flag—Ed.)

Frank Wales, of Glaskow, Scotland, recently wrote us to correct an error that appeared in KEY NOTES, V5N2.

(41) Having come across an error in the last issue that I didn't notice on first reading, I thought I had better tell you about it. It concerns what was said about testing complex conditions (V5N2p12c). Claude Roeltgen states that if you have two conditionals A and B and you wish to construct the relationship "IF A OR B THEN instruction;" then you can express this as: 01 inverse of A; 02 B; 03 instruction. This is correct. For example, the relationship: IF (X>Y)? or FS?00) then XEQ 05, is created by:

```
01 X≤Y? (inverse of first condition)
02 FS?00
03 XEQ 05.
```

However, Mr. Roeltgen also states that the relationship "IF A AND B THEN instruction" can be constructed by: 01 A; 02 inverse of B; 03 instruction. This is incorrect. The truth table would be:

A	B	instruction performed?
0	0	1
0	1	1
1	0	0
1	1	1

while the truth table for the AND relationship should be:

A	B	instruction performed?
0	0	0
0	1	0
1	0	0
1	1	1

(Very sharp eye, Mr. Wales. The shortest routine that I could come up with for the "IF A AND B THEN instruction" relationship looks like this:

```
01 inverse of A
02 GTO 01
03 B
04 instruction
05 LBL 01
```

and I'm anxious to see a shorter version—Ed.)

Recently, we received two letters dealing with the subject of root-finding routines. The first letter was sent to us by R. H. Miller of Oakland, California. Mr. Miller reminded us that the HP-41C Standard Applications Handbook has an error in the listing of the "Root Finder" program; steps 44 and 45 should be switched to result in: 44 1E-8; 45 X>Y?. This error was corrected in the May 1981 printing of this handbook.

The second letter was from Fredrick Öberg of Linköping, Sweden. He enclosed

a root finder routine that he uses with his HP-41.

(41) This routine is a very tiny root-finder, using the "Regular Falsi" method. It is a useful routine that is a part of the normal status of my calculator. It will stop when an accuracy equal to the FIX is achieved. It requires two guesses. The function, in the form  $F(X)=0$  is to be programmed into memory under the global label "Y". The keystrokes are: guess 1 [ENTER], guess 2 [XEQ] [ALPHA] ROOT [ALPHA]. This routine has proved very useful in math tests at school.

```
01*LBL "ROOT" 17 RCL 03
02 STO 01 18 *
03 X<>Y 19 -
04 STO 02 20 X<>Y
05 XEQ "Y" 21 ENTER+
06 STO 03 22 X<> 03
07 RCL 01 23 X=Y?
08*LBL 00 24 GTO 01
09 VIEW X 25 -
10 STO 01 26 /
11 XEQ "Y" 27 RND
12 STO Y 28 GTO 00
13 RCL 02 29*LBL 01
14 * 30 RCL 01
15 RCL 01 31 RTN
16 STO 02
```

Now, from Rochester, New York, we have this contribution by Jefferey Smith. This is a nice routine for obtaining a vector magnitude or the hypotenuse of a right triangle. It is a monadic function, meaning that it places X in LASTX and preserves the Y, Z, and T registers.

(41) Some of your readers who are interested in coordinate geometry might like the following routine, which will compute  $\sqrt{X^2+Y^2}$ . The Y, Z, and T registers are unaffected and the original X is placed in the LASTX-register. Pressing [A] while in user mode will initiate the computation. User-definable key [a] may be used to conveniently swap the X and LAST X registers. The trigonometric mode doesn't matter, but very large numbers tend to degrade the accuracy of the result.

```
01*LBL "MAG" 04*LBL a
02 R-P 05 X<> L
03 P-P 06 RTN
```

Here's a set of routines that was sent to us by Gary G. Price of Madison, Wisconsin. Those who don't have the Math Pac, but would like to have the hyperbolic functions programmed into their HP-41 will find this set of routines useful.

(41) The following are suggestions for your "routines" column in HP KEY NOTES. They are routines to compute the hyperbolic functions with an HP-41. Their features include:

1. Each makes no calls to others, so persons who routinely need one or two need not tie-up program memory with superfluous ones.
2. Each requires only the stack and leaves at least the Y-register intact. The Math Pac uses register 00.
3. Each has been honed to minimize the number of bytes required.
4. Labels that are more verbose than necessary are used here to show correspondence to the routines available in the Math Pac.

```
01*LBL "TANH" 28*LBL "ASINH"
02 ST+ X 29 ENTER+
03 E+X-1 30 X+2
04 RCL X 31 1
05 2 32 +
06 + 33 SQRT
07 / 34 +
08 RTN 35 LN
09*LBL "ATANH" 36 RTN
10 LNI+X 37*LBL "COSH"
11 LASTX 38 E+X
12 CHS 39 1/X
13 LNI+X 40 LASTX
14 - 41 +
15 2 42 2
16 / 43 /
17 RTN 44 RTN
18*LBL "SINH" 45*LBL "ACOSH"
19 E+X-1 46 ENTER+
20 RCL X 47 X+2
21 LASTX 48 1
22 E+X 49 -
23 / 50 SQRT
24 + 51 +
25 2 52 LN
26 / 53 RTN
27 RTN
```

And, in response to this set of hyperbolics, the technical staff of KEY NOTES combined the SINH, COSH, and TANH routines into the program below called HYP.

(41) With this program keyed into your HP-41, simply [XEQ] [ALPHA] HYP [ALPHA] to turn the [SIN], [COS], and [TAN] keys into [SINH], [COSH], and [TANH]. (The function of the keys changes but the white plastic letters on the keys stay the same.) If you don't wish to have TANH available, then save some program space by deleting lines 01-03, and 15-19. If you would like to call these functions as subroutines from other programs, then add the following global labels: LBL "TANH" above LBL J; LBL "SINH" above LBL H; and LBL "COSH" above LBL I.

```
01*LBL J 12 +
02 ENTER+ 13 2
03 SF 00 14 /
04*LBL H 15 FC?C 00
05 SF 01 16 RTN
06*LBL I 17 X<>Y
07 E+X 18 XEQ I
08 ENTER+ 19 /
09 1/X 20*LBL "HYP"
10 FS?C 01 21 SF 27
11 CHS 22 RTN
```

The Time Module for the HP-41 makes all those timer routines that we have published in past issues of KEY NOTES obsolete (Whew!!). This is not to say that they won't have nostalgic value; sure, the children will love to see how we used to turn our calculators into timers.

This next routine is not a timer routine. It was sent to us by Basil Allsop, from Kikuyu, Kenya. You might be able to use this idea to spice-up some of your programs.

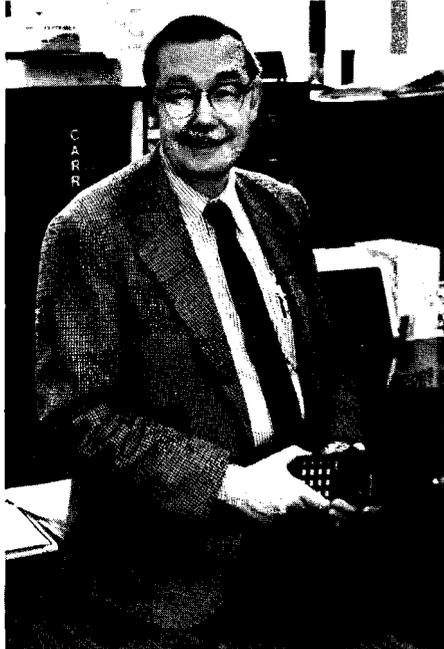
```
01*LBL "+ " 09 R-P
02 SF 25 10*LBL 01
03 " 0 0 0 0 0 0 " 11 TONE 4
04 VIEW 12 P-R
05 GTO "? " 13 R-P
06*LBL 00 14 GTO 00
07 TONE 5 15 RTN
08 P-R
```

(Steps 08, 09, 12, and 13 really don't do anything but slow the execution of the program. If SF 99 is used at step 05 instead of GTO "?", the slow global label search is avoided—Ed.)

And, for you HP-65 owners who say we never give you anything, we have this routine. It was contributed by Bob Flye of Longview, Washington.

(65) This routine converts slope distance and percent slope to horizontal distance. Place the slope distance in the Y-register and the percent slope in the X-register.

```
LBL 23
A 11
EEX 43
2 02
f 31
R-P 01
R+ 35 08
X>Y 35 07
f-1 32
R-P 01
RTN 24
```



## Where is the First HP-35?

Why is the gentleman in this photograph smiling? You would smile, too, if you had, in *your* hands, the very first HP-35 calculator sold in January 1972! Would we fool you about that? Read on ...

Late last year, as we were approaching the tenth anniversary of Hewlett-Packard calculators, we thought of various ways to celebrate the event. So we looked through the records and found the very first sale for an HP-35. Lo and behold! The owner is Dr. Russell J. Donnelly, a Professor of Physics at the University of Oregon in Eugene, Oregon, which is but a short 40 miles south of Corvallis.

So we invited Dr. Donnelly up to Corvallis and shot this photograph of him and his trusty HP-35. It is somewhat "worn" in some areas, but it works just as well as the day it was purchased. And, no it is NOT for sale—for any price. In fact, it now resides in a bank, safe and sound for posterity.

Not only is it a coincidence that the "first" HP-35 is so close to "home," but also that the owner's son works for Corvallis Division!

## New Accessories Released

The following accessories are now available for the HP-41 Calculator/Computer System and the HP Interface Loop (HP-IL).

**HP 82175A Black Thermal Paper.** Box of 6 rolls. For use with the new HP 82162A or older HP 82143A Thermal Printer/Plotters. This is NOT recommended for the HP-97.

**HP 82176A Digital Mini-Cassettes.** Box of 10. For use with the new HP 82161A Digital Cassette Drive. Tapes support a standardized

information format. Cassettes have increased capacity (131,072 bytes) compared to a magnetic card (224 bytes).

**HP 82167A 0.5 Meter HP-IL Cable**

**HP 82167B 1.0 Meter HP-IL Cable**

**HP 82167D 5.0 Meter HP-IL Cable**

These accessories should now be at your local HP Dealer. Remember: if you order from the factory, you will have to pay an additional \$3.50 handling charge.

## Even More About Batteries

### FACTS ABOUT PACKS

The HP 82120A Rechargeable Battery Pack that became available in June of 1980 is an economical power source for those who use a card reader with an HP-41 or for any heavy user of the HP-41, with or without peripherals. The pack is more compatible with the HP-41 and card reader than are the N-cell alkaline batteries because the nickel-cadmium batteries in the pack maintain a higher voltage throughout the discharge cycle, and the card reader demands a relatively high available voltage. The N-cell alkaline batteries are an excellent power source when the card reader is not used because they offer many, many hours of steady, lower-voltage power. When the HP-41 is used alone, or with peripherals other than the card reader, it makes very efficient use of the low-voltage power supplied by the N-cell alkalines. For the average user without a card reader, the N-cell alkalines may prove to be the most economical power source.

### COMMON QUESTIONS

Here are answers to five of the most common questions about batteries in the HP-41:

1. How long will my rechargeable battery pack last?

Under normal conditions, a battery pack will last from 500 to 1000 charge cycles. One full charge cycle constitutes fully charging the battery pack and using the calculator until the BAT indicator comes on. Once fully charged, a battery pack will provide the user with approximately 10 hours of continuous operation on an HP-41 with no attached peripherals before requiring a recharge. With the continuous use of peripherals, the hours that the battery pack provides will decrease. Six charge cycles will approximately equal the life of one set of N-cell alkalines if you use the HP-41 continuously in a running program with no attached peripherals. Two charge cycles will approximately equal the life of one set of N-cell alkalines if you use the HP-41 continuously with the card reader. And, if you use the HP-41 continuously with the wand, then five charge cycles will approximately equal the life of one set of N-cell alkalines. These numbers are only approximations, but they are valuable for determining which power source is the most economical for you.

2. How can I get the maximum life from my rechargeable battery pack?

Fully charge the battery pack. Disconnect the calculator from the recharger and use the calculator until the BAT indicator comes on in the display, then repeat the cycle. The battery in your car will last the longest if it is never thoroughly discharged, but this isn't the case with nickel-cadmium batteries. Once you start the discharge cycle it is best to continue to use the calculator until BAT comes on before recharging. Don't let nickel-cadmium batteries go completely dead, though. This may cause the polarity of one or more of the cells to reverse, which makes the pack impossible to recharge.

3. What if I want to leave the calculator and charger continually plugged into the wall; at my desk, for instance?

Leaving the calculator and recharger plugged in is common, and it will not harm the batteries or recharger. This maintains a full charge in the batteries. But, remember, when you unplug the calculator overnight it starts into the discharge cycle and it's best to use it until BAT comes on.

4. Why don't I get the full expected operating time from my battery pack?

The operating time from your battery pack depends on several factors—ambient temperature, age (the number of charging cycles), the type of operations being performed (programming vs. simple addition vs. printing), etc. Also, nickel-cadmium batteries can develop a condition called "memory" that is a temporary loss of charging capacity. To illustrate, suppose your calculator is kept on the recharger continually, except for a 20-minute period each day when it is used on battery power alone. Over a long period of time (months), the batteries will begin to "remember" the capacity that they are expected to deliver each day—20 minutes—and they will deliver no more than that amount. If you alternate using the recharger and battery power for random periods, then no harm is done. It is only the repeated discharge cycles of the same duration that produce the "memory" effect. Full charging capability can be restored to a good battery with several full charge cycles as described in question 2.

5. What do I do if the card reader stops in the middle of reading a card because of a low battery? I can't turn off the calculator, and I am not supposed to remove the card reader while the calculator is on.

Remove the card from the card reader with a firm steady pull on either end of the card. It may take a little force but it won't harm the card or the card reader. You should now be able to turn off the calculator. Turn the calculator back on. If the BAT annunciator doesn't come on, then you can continue to use the calculator alone for some time. Don't try to read a card again until the charger is plugged-in or fresh batteries have been installed.

## KEY NOTES Subscription Plan

You were informed in the last two issues that, because of skyrocketing inflation, we would soon be charging a subscription fee for HP KEY NOTES. This notice and a Subscription Order is being repeated in this *last free issue* for those who might have missed it or who are reading KEY NOTES for the first time. In February 1982, Volume 6 Number 1 will be mailed **ONLY TO THOSE WHO SUBSCRIBE BEFORE THAT TIME**. Below are more details.

### FOR U.S. AND CANADA

In the United States and Canada the subscription fee will be \$5\* for one year. For that fee you will receive four issues of KEY NOTES a year.

We will accept subscriptions any time after November 1, 1981. Just fill in the Subscription Order, then mail it (or a photocopy) and a check or money order for \$5\* to the Users' Library in Corvallis (address on back cover).

All copies of HP KEY NOTES distributed in the U.S. and Canada will be sent by first-class mail. (By U.S., we mean any address with a U.S. Post Office ZIP code.)

If you are a member of the Corvallis Users' Library and live in the U.S. or Canada, you will receive HP KEY NOTES *free* for the first year (1982).

On January 1, 1982, all current members of the Corvallis Users' Library will be added to the HP KEY NOTES subscription mailing list for one year—free of charge.

Such people do not have to send in the Subscription Order. We will automatically put you on subscription for 1982. Also, everyone who joins the Users' Library in 1982 will receive a free one-year subscription to HP KEY NOTES.

### FOR EUROPE (UPLE)

If you live in Europe and receive HP KEY NOTES through the Users' Program Library Europe (UPLE) in Geneva, Switzerland, you will presently continue to receive HP KEY NOTES, and you will receive it free in 1982. The issues you receive will be printed in the U.S. and bulk-shipped by air freight to the Amsterdam mailing house. **INDIVIDUAL COPIES CANNOT BE OBTAINED FROM CORVALLIS** unless you are a paid-up member of the Corvallis Users' Library. If and when this plan changes, you will be notified in advance.

You do not have to send in the Subscription Order.

### FOR ALL OTHER COUNTRIES

If you live in Mexico, South America, Africa, Australia, New Zealand, or Asia, or in any country not covered above, please fill in the Subscription Order on this page and mail it to the nearest Hewlett-Packard office. This will assure that you will continue to receive HP KEY NOTES in 1982. If you cannot determine where to send the form, send it to Corvallis, and we will see that it gets to the right location. Depending on where you live, you might be asked to pay a mailing fee in order to continue receiving HP KEY NOTES.

Of course, if you live anywhere outside the U.S. and are a member of the Corvallis Users' Library, you do not have to send in the Subscription Order. You will receive HP KEY NOTES in 1982 as part of your Library subscription.

### FOR THE FUTURE

Effective January 1, 1982, we will include a copy of the current KEY NOTES and an invitation to subscribe to it inside each HP-41, HP-67, and HP-97 carton.

### AND FINALLY . . .

We want you to know that, as a result of this subscription plan and future plans, KEY NOTES will only get better. You will get it on a regular schedule. There are still a few "bugs" to iron out of some overseas shipments, but we are making progress. Right now, Europe receives KEY NOTES five times faster than just a year ago. And perhaps we can improve on *that* record.

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Our thanks to all of you who have already sent your checks and orders. As of November 2 (the start of our fiscal year) we have begun entering KEY NOTES subscriptions for 1982.

## HP KEY NOTES Subscription Order

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# Stock Plotting on the HP-41

Oak Park, Illinois, is the home of **James Grandstaff**. He has developed this routine for use on the HP-41 with the HP 82143A Thermal Printer/Plotter, and it will work with the new HP-IL compatible printer, the HP 82162A Thermal Printer/Plotter.

(41 with printer) While reading HP KEY NOTES, V5N2p12, I came across the item by **W. W. Trotti, Jr.** I wrote a similar subroutine for plotting a weekly stock chart. The subroutine prints the weekly dates, month by month, on the X-axis and the stock values on the Y-axis. It stops to prompt the user for each Y-value. The calendar function takes care of leap years and year-end roll-overs in the graph.

To use this routine:

- In the X-register, place the date that corresponds to the first stock value you want to plot. The form of the date is MMDD.YYYY (NOT the standard form). For example, 102.1981 starts the stock graph at January 2, 1981.

- XEQ  ALPHA DATE  ALPHA
- XEQ  ALPHA PRPLOT  ALPHA

The calculator will proceed to ask seven questions and then start prompting for data. Respond to the questions in the following manner:

QUESTION	ANSWER
NAME?	STOCK
Y MIN?	minimum stock price
Y MAX?	maximum stock price
AXIS?	purchase price (between YMIN and YMAX)
X MIN?	day of the month for first entry (between 1-31)
X MAX?	100
X INC?	7 (days per week)

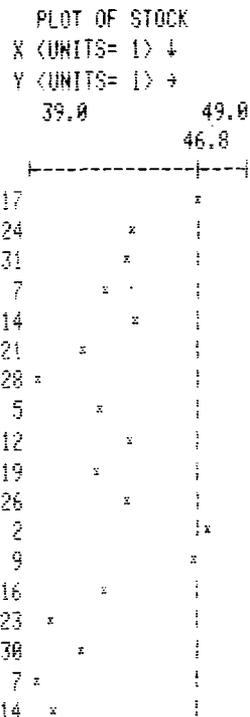
```

01*LBL "STOCK" 47 STO 13
02 STO 12      48 RTN
03 7           49*LBL 02
04 ST+ 06     50 X=Y?
05 XEQ 00     51 SF IND 15
06 7          52 RDN
07 ST- 06     53 RTN
08 RCL 12     54*LBL 03
09 STOP      55 1 E2
10 RTN       56 RCL 06
11*LBL 00     57 +
12 RCL 13     58 RCL 17
13 RCL 06     59 FRC
14 X<=Y?     60 +
15 RTN       61 1 E-4
16 -         62 +
17 CHS      63*LBL "DATE"
18 STO 06    64 STO 17
19 1         65 28
20 ST+ 14    66 STO 16
21 13        67 RDN
22 RCL 14    68 1 E2
23 X=Y?     69 /
24 XEQ 03    70 INT
25*LBL 01    71 STO 14
26 .1        72 LASTX
27 STO 15    73 FRC
28 RDN       74 1 E2
29 2         75 *
30 XEQ 02    76 INT
31 ISG 15    77 STO 06
32 4         78 LASTX
33 XEQ 02    79 FRC
34 6         80 1 E4
35 XEQ 02    81 *
36 9         82 4
37 XEQ 02    83 MOD
38 11        84 X=0?
39 XEQ 02    85 SF 00
40 31        86 29
41 STO 13    87 FS?C 00
42 RCL 16    88 STO 16
43 FS?C 00   89 RCL 14
44 STO 13    90 XEQ 01
45 30        91 .END.
46 FS?C 01
    
```

Here is a plot of HP stock from August 17, 1981 to December 14, 1981.

```

NAME ?
STOCK          RUN
Y MIN ?       39.00  RUN
Y MAX ?       49.00  RUN
AXIS ?        46.75  RUN
X MIN ?       17.00  RUN
X MAX ?       100.00 RUN
X INC ?       7.00   RUN
    
```



## HP KEY NOTES

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Programming and operating tips, answers to questions, and information about new programs and developments. Published periodically for owners of Hewlett-Packard fully programmable personal calculators. *Reader comments or contributions are welcomed. Please send them to one of the following addresses.*

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