The Hewlett-Packard Personal Calculator DIGEST

The HP Magazine and Product Catalog

Volume Six, 1980

NEW IN THIS ISSUE:

The HP-41C

A Calculator. A System. A Whole New Standard.

See Page 10.

A Support System You Can Count On!

When you buy a Hewlett-Packard advanced scientific or financial calculator you are buying far more than just a calculating device. You are buying the confidence that the Hewlett-Packard name brings. Confidence in workmanship, design, and software support that makes your HP calculator a working tool and not just another piece of office or lab equipment. From Owner's Handbooks to Applications Pacs—your specific needs are met by a support system you can count on! In addition to English, Owner's Handbooks and selected software packages are available in other major languages. Please check with the HP sales office or dealer nearest you for availability information.

Owner's Handbooks
HP's Owner's Handbooks are complete and helpful reference books that go far beyond the usual how-to information. Detailed operational data are provided, along with many suggestions for maximum efficiency. And there is page after page of helpful examples.

Solutions Books
Timely applications covering the broadest spectrum of disciplines are presented in 46 Hewlett-Packard Solutions Books for the HP-67/97 and HP-41C. Each book is a compilation of 10 to 15 programs selected from thousands of programs submitted by users with professional demands just like yours.

Applications Books
16 Applications Books are available for the Series E family of affordable calculators. From Real Estate to Statistics, each book contains many step-by-step programs to solve "real world" problems.

Application Pacs
Hewlett-Packard Application Pacs offer ready-to-use software for the HP-67/97 and HP-41C. Each pac offers over 15 programs accompanied by a detailed manual. There are 10 pacs with magnetic cards for use with the HP-67, HP-97, or HP-41C Card Reader. And there are 16 Application Pacs with easy plug-in modules for use with the HP-41C. Both magnetic cards and modules provide prerecorded solutions in a fast and accurate manner—the way professionals want them.

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The Hewlett-Packard Personal Calculator DIGEST

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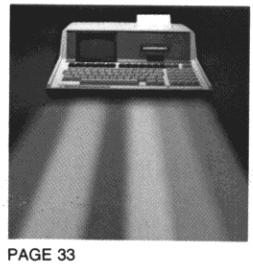
PAGE 3



PAGE 33

Features

Catalog

How to order from this catalog:

You may order any HP calculator by contacting your nearest HP Sales Office or HP Dealer. For the name of one nearest you, call our toll-free number: 800-547-3400, except from Alaska and Hawaii. (In Oregon call: 758-1010.) Outside of the United States please use regional addresses listed on the back cover.

Hewlett-Packard offers a written warranty on all of its calculators and accessories. A copy of the complete warranty statement is available upon request.

Please note: for consumer sales in the United Kingdom any warranty given shall not apply to consumer transactions and shall not affect the statutory rights of a consumer. In relation to such transactions the rights and obligation of Seller and Buyer shall be determined by statute.

Hewlett-Packard products are manufactured by Hewlett-Packard worldwide.

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Corvallis Division
Corvallis, Oregon, USA

Calculator displays in all photography simulate typical appearance.

Letters

More Back Issues

I have HP DIGEST Volumes 3-5 and I would like to congratulate you on your excellent publication. Your articles are informative and quite readable (unlike other publications of this kind where you need not only your doctorate but also a good dictionary and an encyclopedia to boot) and the detail of the comparison chart in the catalog is superb. After having read your other issues I would like to request that you send me volumes 1 and 2 to make my collection complete. Thank you for your cooperation.
Carl A. Williams
Brooklyn, New York

EDITOR'S NOTE: We are happy to send back issues of the DIGEST upon request.

First-Class

I don't want to buy anything at present (I own an HP-45 now) but do want to congratulate you on a first class company all the way around. Your products are excellent, the reliability is excellent, and the customer service is even better.

I've never gotten anything but cooperation from Hewlett-Packard, usually above and beyond the call of duty. That's so rare in American business today, and it's really appreciated. It will keep me coming back too!

I do want to remain on your mailing list indefinitely, and hope you'll soon manage to combine the HP-19C and HP-67, or else develop a printer compatible with your other models, mainly the HP-67.
Alva M. Lumpkin
Atlanta, Georgia

EDITOR'S NOTE: Have you taken a good look at the HP-97? It's fully programmable, has a card reader, buffered keyboard, and built-in printer. And it's totally portable.

RPN Comes Through Under Pressure

I have here a very good point for RPN logic that might interest you. This happened to me while I was still in high school, after I had purchased my new HP-33E. Of course, I was very proud of it, as it was my first programmable calculator.

There was an exam in my Physics course and as usual, I was using my old AOS type scientific calculator when the battery let me down. (It's never happened to me since, thanks to your self-check battery charge gauge.) Fortunately, I had brought my new HP to show my friends, but of course I didn't know how to operate it yet!

The fact is, that after a few minutes of trial and error *without* my owner's manual, I managed to efficiently use the RPN logic system. This was the first time I had ever used an HP calculator.

And some people say that RPN is complicated to learn and use!
Gaetan Hains
Montreal, Canada

Fun and Games

I am very much interested in your HP-67, which I have recently used with the Games Pac and the Standard Pac. I have thought up a few games that could be used with the HP-67 and HP-97. Would you be interested in them? I am 12 years old and I like math and science. If I made a few up and you thought they were good and put them in a future Games Pac, I think it would be good advertising in the area of how easy it is for young people to make their own programs for your calculators. What would they be worth to you? I have read Volume 3 and 4 of your HP DIGEST and I think the HP-67 is the best thing since sliced bread, along with all of your other calculators.
Nigel Luckman
British Columbia, Canada

EDITOR'S NOTE: I have forwarded your letter to the HP Users' Library. They are always happy to receive programs from our customers for review. They also make available a Contributor's Guide and blank program submittal forms upon request. (Customers residing in Europe please contact your local HP sales office for information. Regional addresses are provided on the back cover.)

An HP Day in Court

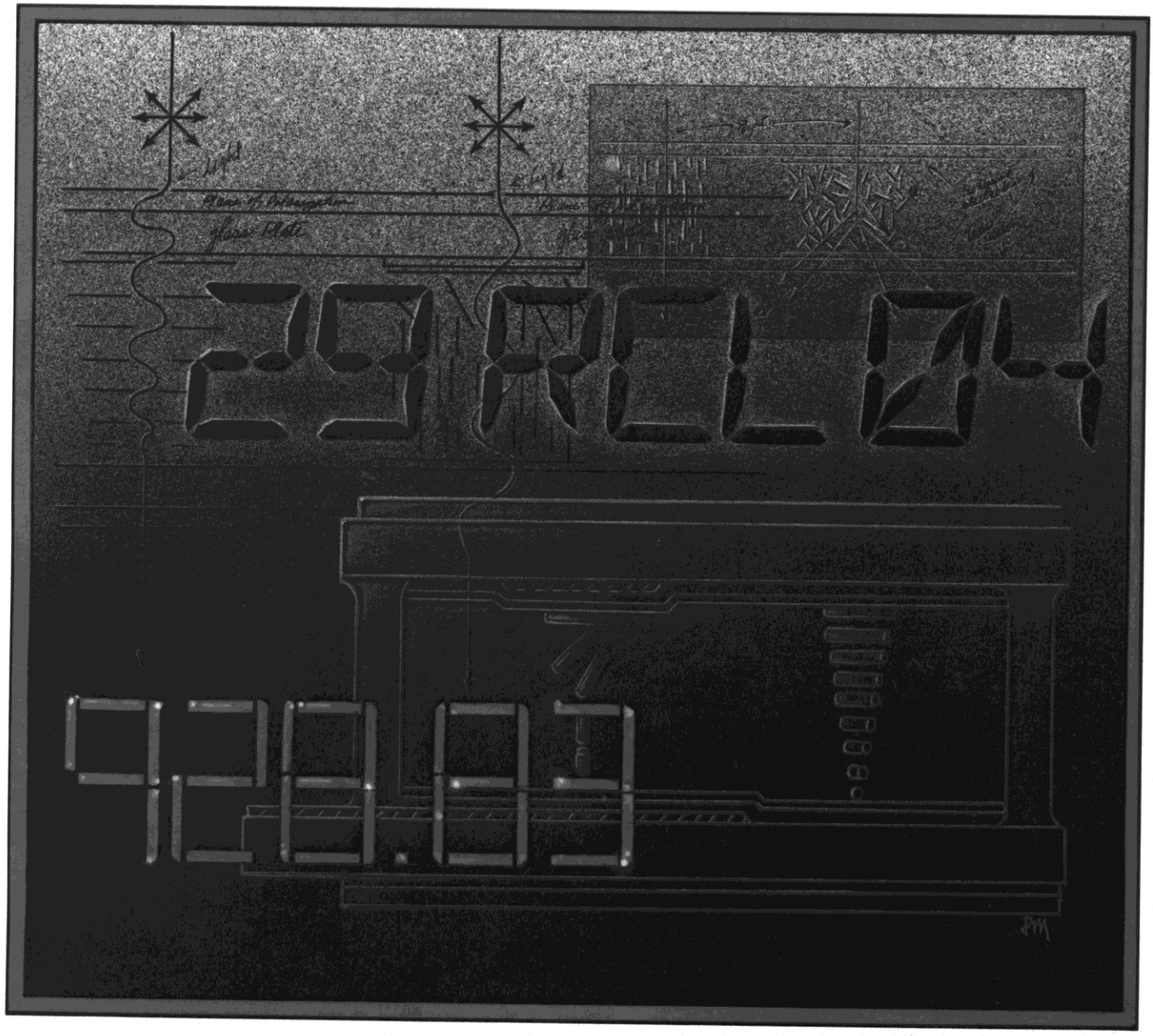
I would like to report an unexpected application of your HP-97 calculator: legal depositions.

As an expert witness in a lawsuit involving an epidemiologic investigation of a suspected food borne illness, I was able to provide an almost instantaneous response to questions concerning estimates of relative risk under varying assumptions entailing reclassification of the data using an odds-ratio program created by K. Rothman and J. Boice. The confidence intervals produced by the program aided in statistical interpretation. Interpretation of data was also enhanced by the ability to examine on-the-spot the confounding effect of various factors through an adjustment technique whereby a summary risk ratio from up to seven component 2x2 tables can be estimated in about two minutes. The print out served as an exhibit.

I believe epidemiologists are now able to give better expert witness testimony in depositions through the use of the HP-97.
Richard K. Donelson, M.D., M.P.H.
Hutto, Texas

EDITOR'S NOTE: We are always delighted to hear about unique applications such as this and encourage our readers to share them with us.

Contribute to THE HP DIGEST: The Editor would be delighted to hear of any incident or experience you may have had with an HP calculator that would be of interest to our readers. Because of space limitations, not all letters received may be used, and all letters are subject to editing. Please address your contributions to:
Editor
The HP Digest
Hewlett-Packard Company
Corvallis Division
1000 N.E. Circle Blvd.
Corvallis, OR 97330
U.S.A.



DISPLAY FUNDAMENTALS

"There are two ways of spreading light: to be the candle or the mirror that reflects it."

When Edith Wharton penned these lines in 1902, as part of *Vesalius in Zante,* she unknowingly described the ways that our modern calculators, personal information products, and digital watches show their results. One kind, the LED, generates its own light. The other, the LCD, depends on the light around it to create symbols representing numbers or letters.

Until now, all Hewlett-Packard handheld calculators have had LED displays. The new HP-41C is the first HP calculator to display results with LCD.

Although both light-emitting diodes (LED's) and liquid-crystal displays (LCD's) have been available for use in calculators for only the last few years, their underlying principles have been known to scientists for more than a half-century. In 1907, an experimenter named H. J. Round touched wires from a battery to a silicon carbide crystal and was

surprised to see yellow light given off at the junction of one of the wires. Shelved for many decades, Round's discovery eventually became the basis for the modern-day LED.

Some of the properties of liquid crystals were known even sooner; experimenters in the late 19th century noted that these complex organic substances could flow and assume the shape of their containers like liquids, but that their molecules also aligned themselves into crystalline lattices. More recently, scientists found the lattices of some liquid crystals to be affected by an electrical field, and that these lattices could in turn alter the transmission of light. The LCD was born.

Hewlett-Packard manufactures both of these types of displays for use in its calculators and other products. The design of the two devices is quite different, and each offers its own unique advantages.

The Light-Emitting Diode

The light-emitting diode does just what its name implies: It emits light. When you flick on an LED display, the digits are actually light sources, characterized by a warm red, yellow or green glow that is visible even in the dark.

Interestingly, any ordinary semiconductor diode, even the germanium "cat's whisker" of early radio fame, gives off a small amount of infrared light when the proper voltage is applied. But most commercial LED's are made of gallium arsenide (GaAs) or gallium arsenide phosphide (GaAsP) because these substances emit light that is visible to the naked eye, and because they are also fairly efficient as such light sources go.

Like any diode, the LED consists of two areas of similar material, an *n* region, whose molecules have an excess of electrons in their outermost shells, and a *p* region, whose molecules have a deficiency of electrons (or an excess of "holes" for electrons to drop into). When sufficient forward bias voltage is applied to the diode, electrons in the *n* region gain enough energy to migrate across the junction to the *p* region. There, they give up energy as they recombine with holes in the *p* region, and in the LED this energy is emitted as light. (In fact, this process is sometimes referred to as "recombination radiation.")

Semiconductors such as those used in LED construction can absorb much of the generated light, and other light is reflected back into the junction when the emitted light strikes the semiconductor-to-air interface. So in actual practice, the LED itself is ground to a domed shape, as in Fig. 1, or is fitted with a hemispherical epoxy lens to emit light as efficiently as possible.

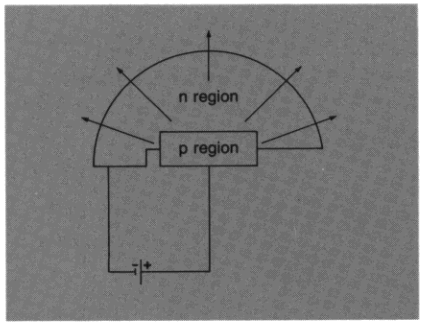


Figure 1

Unlike an incandescent light bulb, the LED does not need a vacuum in which to operate, and it gives off its light without much accompanying heat. In addition, even the tiny LED segments used in a calculator display are tough and shock-resistant.

The Liquid-Crystal Display

You can easily tell the difference between a liquid-crystal display and one made of light-emitting diodes. In some types of LCD's, the individual characters contrast dark on a reflected ambient light background, while in others, the digits are light colored against a dark background, or vice versa. Although they actually switch quite rapidly, liquid-crystal display digits never blink when changing, but rather seem to evanesce and reappear. One type of LCD makes use of two properties of some liquid crystals: when their molecules are aligned in a crystalline formation, light is allowed to pass through the lattice. And an electric field around the lattice realigns or disturbs the crystalline structure so that light is absorbed instead of transmitted.

There are many types of liquid crystal substances, most with tongue-twisting names such as p-ethoxybenzylidene-p-aminobenzonitrile and n-p-methoxybenzylidene n-butyl aniline, and the material used and the type of display depend upon the application. One of the simplest LCD's, and one which illustrates well the liquid-crystal phenomenon, is called a *dynamic scattering* display.

In the dynamic scattering display shown in Fig. 2a., a very thin film of liquid crystal material is sealed between two glass plates, 1/2000th of an inch apart. The molecules of the crystals are normally aligned in uniform lattices, and light is easily transmitted through the glass plates and the crystal material.

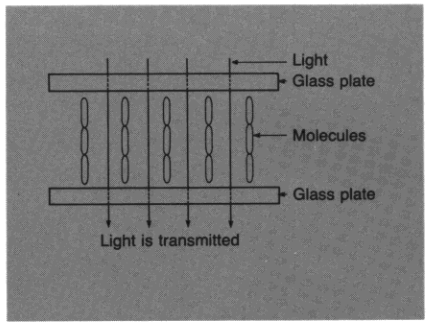


Figure 2a

However, if a transparent electrode is added to each glass plate, and an electrical field applied across them as shown in 2b, the liquid crystal molecules are forced out of their lattices and become disarrayed. Instead of being transmitted, light going through the crystal substance is scattered, and the display seems to become translucent.

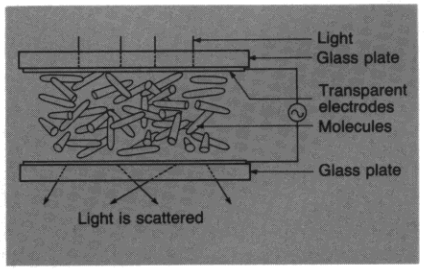


Figure 2b

The dynamic scattering display is still found on some inexpensive calculators, and in applications where power consumption is not a factor, but a more recent liquid-crystal innovation, the *field-effect* display, gives better legibility and uses only about 20% of the power of the dynamic scattering display. The new HP-41C calculator, for example, contains a twisted nematic field-effect liquid crystal display,

which employs polarized light and long nematic crystals (*nematic* is derived from the Greek word for thread) to show letters of the alphabet as well as numbers to 12 digits.

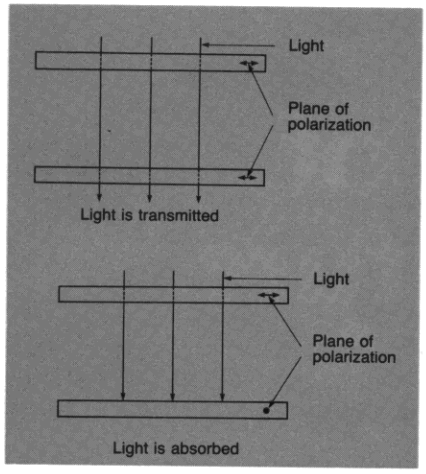


Figure 3a

Figure 3a shows a pair of polarizing screens like those used in the HP-41C. When these screens, or filters, are arranged so that their planes of polarization are the same, as on the left, light is transmitted through the screens. However, if one is rotated 90°, as shown on the right, light polarized by the first screen is absorbed by the second, and the screens appear black.

In the twisted nematic field-effect display, a thin film of liquid crystals is sealed between the two sets of polarizing screens and transparent electrodes, after the opposing plates are first chemically treated so that the crystals align themselves with their long axes at 90° angles, as shown in Fig. 3b. This crystalline

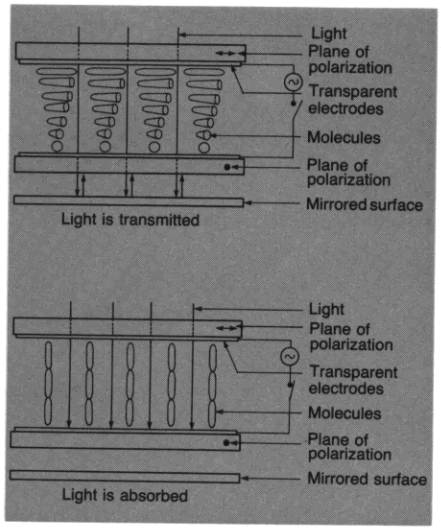


Figure 3b

alignment causes light from the first polarizing screen to be rotated 90° before it reaches the second screen, and the polarized light is transmitted completely through the display.

When an electric field is applied, the molecules become untwisted, and polarized light is no longer turned 90° by the display. Instead, light is absorbed and the display appears black. When power is removed from the electrodes, the liquid crystal molecules realign themselves so that light is once again transmitted.

The field-effect display acts like a shutter, passing the light or cutting it off. Although most calculators and watches using LCD's have black digits against a white background, a manufacturer can obtain clear digits on a black background simply by rotating one of the polarizing screens so both planes of polarization are the same. Then light is passed only when the field is applied, and absorbed when the field is turned off.

You don't really see through the display — a mirrored surface is placed behind the second polarizer, so light that passed through the display is reflected back. When a display that also shows up in the dark is desired, as in the case of a watch, a transflector — a partially reflective surface — replaces the reflector, and a tiny low-power lamp or other light source is installed behind it.

LCD vs. LED

Comparing LCD and LED displays is a bit like comparing apples and oranges; each will have its advantages — and its champions. But there are differences in application and performance that should be noted.

There's the question of light and dark, for instance. An LED display is actually a light source, and the dimmer the ambient light, the easier the LED is to read. On even the darkest of nights, the light-emitting diode display is bright and distinct.

The LCD, though, uses available light for its operation; the more ambient light that strikes the display, the darker and more distinct its digits become. This is a definite advantage outdoors and on a bright sunny day, but in a normal classroom or office the two types of displays will perform equally well.

Multiplexing

In a calculator or watch display, a single digit is made up of several segments. Whether using LED or LCD technology, a device turns on only those segments necessary to show the required number or alphanumeric symbol. To display an 8 with the character shown in Fig. 4, for example, all segments would be

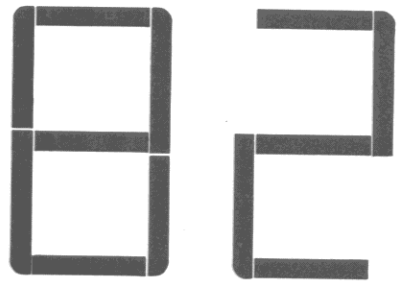


Figure 4

be turned on; to display a 2, only five segments would be turned on.

The lines carrying electrical impulses to the individual segments are multiplexed — arranged in a kind of grid so the signals for more than one segment appear on each individual line. In actual operation, not all the segments of an "on" character in the display are fully energized at any one time. Instead, the segments are "strobed" very rapidly — one segment of a character is activated, followed by another segment, then another. Largely because of the slow response time of your eye, the entire character seems to be "on" continuously.

Light-emitting diode segments can be turned on and off very rapidly — as often as 20,000,000 times each second. But LCD devices respond much more slowly, and they cannot be strobed as rapidly, nor with the same type of signals as light-emitting diodes. Because of this slow speed, and because better display life results if the drive signals to the liquid crystal material are alternating current instead of direct current, the multiplexing circuitry for the LCD is more complex than for an LED display.

Viewing Angle

With an LED display, the viewing angle — the range in degrees that

Continued on page 32.

The Fine Art of Chip Manufacture

The heart of a calculator — or, for that matter, of a computer, electronic game, automobile skid control, digital watch, and many other modern electronic marvel — is a beetle-sized bit of metal and silicon with a black plastic carapace and a dozen or more slender gold legs. This device, called an integrated circuit, or "chip," contains thousands of the tiny transistors which, with on or off activation, provide the complex logic signals necessary for those twinkling ten-digit answers in the calculator display.

Manufacture of these MOS/LSI (for Metal-Oxide Semiconductor/Large-Scale Integration) chips is a highly specialized art that demands close tolerances and a degree of cleanliness normally reserved for hospitals.

Although each IC undergoes nearly 300 separate operations before it is ready to be installed in its host calculator, a much simplified manufacturing process is shown on these pages.

1. Circuit Design

After a logic design has been created for a particular integrated circuit, and the microcode containing the mathematical routines has been programmed into it, a circuit designer uses a computer to lay out a blue print for the chip, showing every transistor and interconnecting link. From this blueprint, reduced more than a thousand times, photomasks are made that will later

cover portions of the chip during manufacture.

2. Mask Alignment and Exposure

A photomask for the first layer of the chip is placed over a silicon wafer which has first been polished

to a mirrorlike sheen and then covered with a very thin glasslike layer followed by a photosensitive material. Each mask and silicon wafer is large enough to make hundreds of individual chips, and 400X magnification is used to ensure razor-fine tolerances — within one-half micrometer or better. After alignment, the photosensitive material not covered by the mask is exposed to high-intensity ultraviolet light.

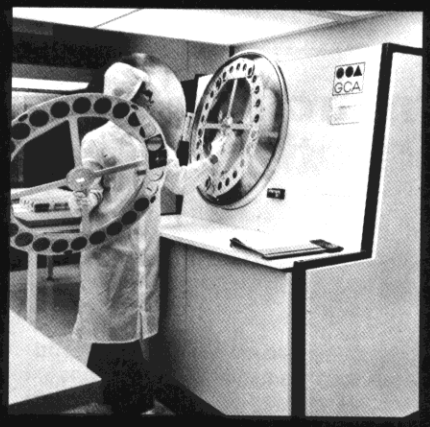
3. Development and Etching

The unexposed photosensitive material, or resist, is washed away, leaving unprotected areas on the glasslike substance. The silicon wafers then float on air bearings through a wet chemical bath where these unprotected areas are etched away, leaving the tiny mazelike patterns of the chips on each wafer.

In the N-MOS process shown on these pages, there are eight levels; hence, eight separate masks are used, each followed by a similar exposure and etching procedure.

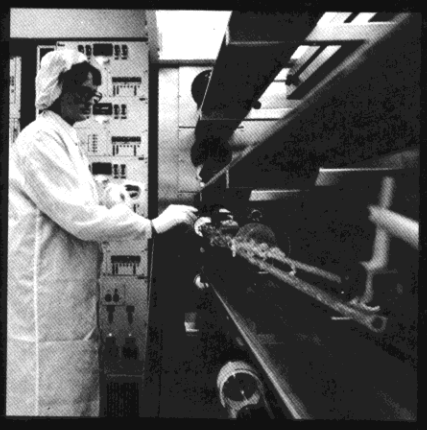
4. Doping

Some layers consist of metal that is deposited onto the discs by "sputtering," while other layers require "doping" — the addition of impurities or ions. At this station, a



carousel of wafers is being loaded into a machine that implants ions on the wafers where the pattern has been etched away in a previous masking process.

This repeated masking, exposure, etching, and doping is like building up an intricate jigsaw puzzle—with eight layers.



5. Diffusion of Impurities

Another way of adding necessary impurities to a specific layer is by diffusion. Here a rack of wafers is being prepared for a high-temperature diffusion furnace, where unmasked areas will be exposed to a phosphorous compound at over 1000° Celsius.

6. Testing

When all mask layers have been applied, the dice (the individual integrated circuits) built up on the silicon wafer are tested for proper functioning. At this station, a test is being performed that checks the basic operation of the circuit elements of each die; those dice that fail this extensive series of tests are marked for later culling.

7. Sawing

The silicon wafers are now sawed into individual dice on this diamond-edged saw, which operates at extremely fine tolerances. After sawing, the dice are again checked visually for nicks, bubbles, or areas that might later produce problems.

8. Die Sorting

This operator must wear a grounding strap on her wrist to prevent static discharge as she separates the sensitive good dice from the previously-marked bad ones. The delicate "chips" of silicon and metal might be damaged by tweezers or needlenose pliers, so a vacuum wand is used to handle them.

9. Bonding

After sorting, several good dice are attached to a frame containing the necessary electrical leads, and

these leads are then bonded to points on the dice themselves. Under the microscope, even the 1-mil gold wire used for bonding looks like a thick cable. One slip and thousands of tiny transistors could be destroyed.

10. Encapsulation

Finally, the dice, still on the lead frame, are placed in this injection-molding machine and their plastic cases are formed around them. Then the wire leads are bent and

clipped, and each IC is labeled, thoroughly retested, and shipped to stock, ready to go to work getting answers in a Hewlett-Packard calculator. ■

Buyer's Guide

Preprogrammed Financial.

Many business people are significantly extending their professional capabilities by switching from simple four-function calculators to advanced calculators. The preprogrammed calculator is an ideal step-up, even for people whose skills in math and statistics are rusty or altogether lacking. With a few simple keystrokes, the preprogrammed calculator provides fast and accurate solutions to a wide range of financial and statistical problems, many involving complex computations. If you are interested in the advantages of a preprogrammed financial calculator, you should study the data on these two instruments:

HP-37E
Business. Page 18.

HP-92
Desktop Investor. Page 25.

Keystroke Programmable Financial.

The financial keystroke programmable is ideal for financial analysts, real estate agents, bankers, and other business professionals because it offers two basic methods of problem solving. Most everyday time and money problems can be solved using the wide variety of built-in functions. For more complex and repetitive financial computations keystroke programming is particularly helpful. And you don't even have to be able to write your own programs. Applications Books provide the solutions. With keystroke programming you can save hours of time wasted in long, tedious calculation. And once a program is keyed into the calculator there is no possibility of human error. And if you use a few programs frequently, the Continuous Memory feature which allows you to retain programs and data even with the calculator switched off, may be especially useful. If keystroke programming sounds logical for you, look at the information on these two calculators:

HP-38E
Advanced Financial Programmable. Page 19.

HP-38C
NEW!

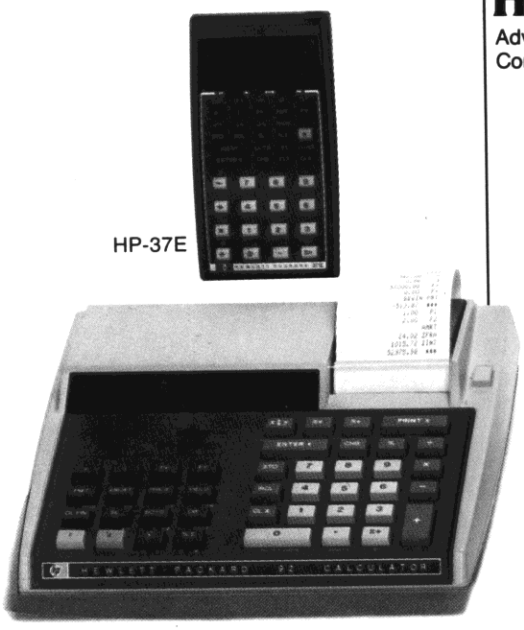
Advanced Financial Programmable with Continuous Memory. Page 19.

Preprogrammed Scientific.

A preprogrammed calculator is the first advanced instrument many engineers and scientists use, and it is ideal for those whose work does not often require complex or repetitive computations. It is also often an ideal choice for engineering students who want to shorten the time required for problem solving. If you are interested in a preprogrammed scientific, you should look at the data on these two calculators:

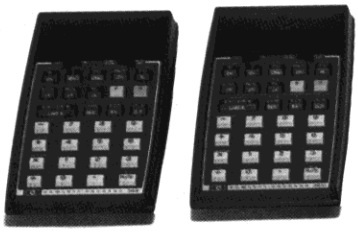
HP-31E
Scientific. Page 17.

HP-32E
Scientific with Statistics. Page 17.

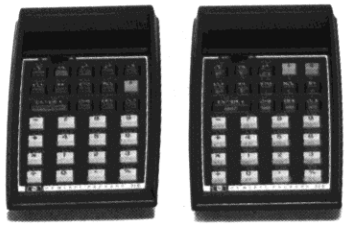


HP-37E

HP-92



HP-38E HP-38C



HP-31E HP-32E

Selecting the right calculator is no longer a simple matter of evaluating features, functions and price. With the wide range of advanced instruments available today, proper selection now depends largely on a careful analysis of your professional needs and—more importantly—your personal growth. Indeed, the selection of a calculator which you feel may be somewhat in advance of your current needs, can significantly speed your growth by expanding your problem-solving capabilities. The information in this BUYER'S GUIDE should make it easy for you to select the HP calculator that will do the best possible job for you.

Keystroke Programmable Scientific.

The keystroke programmable is invaluable for those who frequently deal with complex or repetitive scientific computations. A keystroke programmable can solve these problems automatically when it is programmed to do so. Then, all you have to do is key in your data and let the calculator run the entire computation. For those who use a few programs frequently, the Continuous Memory feature may be especially useful. This feature makes it possible to retain programs and data even when the calculator is turned off. If keystroke programming sounds logical for you, look at the information on these three calculators:

HP-33E

Programmable Scientific. Page 16.

HP-33C

NEW!

Programmable Scientific with Continuous Memory. Page 16.

HP-34C

NEW!

Advanced Programmable Scientific with Continuous Memory. Page 15.

HP-34C

HP-33E

HP-33C

Fully Programmable.

The fully programmable is a powerful, flexible and comprehensive advanced calculator. Complex programs can be stored permanently on small magnetic cards and used in the calculator over and over again. Prerecorded program cards are available for a number of areas such as business, math, statistics, medicine, surveying, electrical engineering and many others. If you are looking for a calculator that will provide you with maximum capability, check the data on these two instruments:

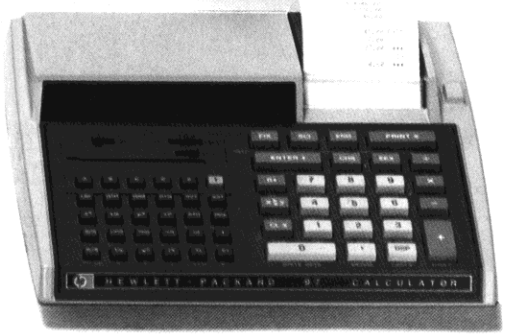
HP-67

Handheld Fully Programmable. Page 20.

HP-97

Desktop Fully Programmable Printing. Page 21.

HP-67



HP-97

Alphanumeric Fully Programmable.

The alphanumeric fully programmable is the most powerful, yet the easiest to use of all advanced calculators. The optional plug-in peripherals provide an unprecedented combination of program memory lines and data storage registers. Yet the alphanumeric capabilities and customization features offer a friendly and easy-to-use fully programmable. The alphanumeric fully programmable is a powerful and versatile modular system specifically designed to accommodate unique calculating needs today, with easy adaptation as these needs change. If you are interested in the advantages of a powerful calculating system, you should look at the information on the HP-41C:

HP-41C

NEW!

Alphanumeric Fully Programmable. Page 10.

HP-41C

HP-41C

Alphanumeric Fully Programmable

A Calculator. A System. A Whole New Standard.

The Calculator.

The new HP-41C incorporates the latest in calculator technology to give you the most powerful personal calculator Hewlett-Packard has ever designed. Power that begins with 63 data storage registers or up to 400 lines of program memory and can expand to 319 registers for data storage or over 2,000 lines of program memory. Or any combination. While at the same time, the HP-41C sets a new standard in ease-of-use. Its alphanumeric capabilities provide communication in words as well as numbers, so operation is simple even for the novice. And you can customize the keyboard to meet special needs. Add to this Continuous Memory, new heights in programming ease and sophistication, the added capabilities of optional peripherals, and RPN logic, and you have the HP-41C—a genuine contribution to calculator technology from Hewlett-Packard.

Communication with the HP-41C.

The HP-41C's alphanumeric capability lets you name and label programs, functions, variables, constants—and prompt for data with words or sentences. Status annunciators indicate mode conditions. Messages pinpoint calculation errors and ten different tones provide aural feedback. And the HP-41C utilizes a liquid-crystal display (LCD) that is easy to read whether you're in the office or out in bright sunlight.

Customization to Your Own Design.

There are over 130 separate operations in the function library and 58 functions right on the keyboard. And, you can reassign any standard function, any programs you've written, or programs provided in the Application Modules—to any keyboard location you wish. Blank keyboard overlays let you notate these assignments.

Continuous Memory Saves Everything.

Continuous Memory preserves all your program, data and key assignments even when the calculator is turned off. As a result, you can program frequently needed calculations once and call them up again and again. This new capability means reduced power consumption and longer battery life.

Enhanced Programmability.

With the HP-41C there is no complicated language to learn. And alpha capability lets you label programs with easy-to-remember names. Each program is autonomous and each can have up to 99 local labels for branching within a program. The HP-41C also features: up to 6 levels of subroutines, 10 conditional tests, 56 internal flags, powerful loop control, indirect addressing, and local and global branching.

Optional Peripherals.

Adding any or all of the optional plug-in peripherals and modules to the HP-41C expands its capabilities to keep pace with your growing computational requirements.

Physical Specifications:

■ Length:	14.4 cm (5.7")
■ Width:	7.9 cm (3.0")
■ Height:	3.3 cm (1.3")
■ Weight:	210 g (7.4 oz)

For a complete list of key features and functions, see the Comparison Chart on page 28.

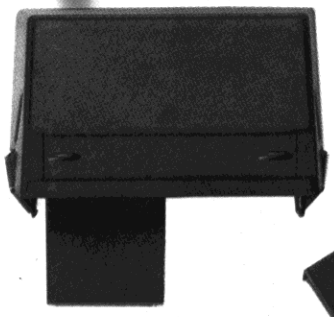
The HP-41C Alphanumeric Fully Programmable Calculator comes complete with:

- HP-41C Owner's Handbook and Programming Guide
- A tough pliable carrying case
- Four type N batteries
- Overlay packet
- HP-41C Quick Reference Card
- HP-41C Standard Applications Book
- Module Holder
- A free, one year subscription to *HP Key Notes*, the HP programmable calculator user's newsletter.
- Subscription form for the Hewlett-Packard User's Library.

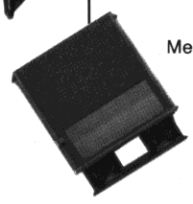
The System.

Expand System Capabilities.

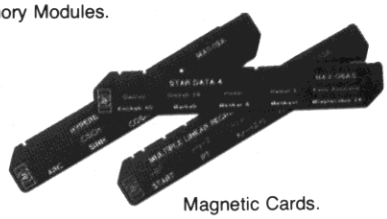
Standing alone, the HP-41C is a powerful programmable problem-solving calculator. Adding the optional plug-in peripherals and modules easily gives the HP-41C increased capability and adds new dimensions in flexibility. It can become a printing calculator, can save hundreds of programs on magnetic cards, or can even become a "specialized"



The Card Reader.



Memory Modules.



Magnetic Cards.

problem-solving machine. You can plug in any number of options, up to four, in any combination that you need.

Self-Contained Peripherals.

Each quick-connect peripheral and module is self-contained, with its own set of functions that can be added to the calculator's existing function library. And each is fully portable, coming complete with what you need for immediate use—including comprehensive instructions.

Memory Modules

These handy Memory Modules can actually quintuple the HP-41C's memory. Just plug-in as many as you need—up to four—to increase data storage and program memory. Each memory module contains 64 data storage registers or up to 400 lines of program memory or any combination you select.

Like the calculator itself the memory modules have Continuous Memory. When installed in the HP-41C, a module maintains data and program lines even when the calculator is turned off.

Card Reader

The HP-41C Card Reader is a valuable option which lets you save programs and data on small magnetic cards. This extra-smart card reader keeps track of cards as they are read and it even prompts you for the next card. A security feature permits a program to be run but not reviewed or altered. An added bonus is that it also accepts program cards from the HP-67 and HP-97, although some programs may require additional memory modules.

Printer

The HP-41C Printer is a whisper-quiet thermal printer which easily plugs into the calculator. It gives you numeric upper- and lower-case alpha, and double-wide characters as well as special characters you may design. And it performs high resolution plotting routines.

Optical Wand

The wand allows you to load programs and data into the HP-41C quickly and easily. Plugged into one of the HP-41C ports the wand reads bar codes from a printed page, translating these codes into HP-41C program and data information and loading it into the calculator. Long programs can be loaded in a matter of seconds. HP-41C Solutions Books and Users' Library programs will be available with printed bar codes. (Wand and bar codes available later this year.)

Application Modules

Each preprogrammed Application Module turns the HP-41C into an answer machine for a particular discipline. Whether you're an engineer or technician, student or scientist, business person or professional, you'll find an Application Module to solve problems in your area of interest. Each comes with a comprehensive manual as well as a keyboard overlay. Areas of application include: Aviation, Clinical Lab and Nuclear Medicine, Circuit Analysis, Financial Decisions, Mathematics, Securities, Statistics, Stress Analysis, Structural Analysis, Surveying, and others . . .

A Whole New Standard

The HP-41C is more than a breathtaking list of functions and options. It is a whole new standard in personal calculators. Its power, flexibility, and ease-of-use are the result of a remarkable synthesis of the finest state-of-the-art developments and traditional Hewlett-Packard human engineering.

The Printer.

The Optical Wand.

HP-41C Software

When you buy the HP-41C, you have available a new standard in customer support. You will soon be able to choose from 16 Application Pacs or 26 Solutions Books to find the solutions for your need. HP-41C software has been carefully designed to effectively increase your problem-solving potential by adding power, flexibility, and versatility to your calculator. And HP-67 and HP-97 magnetic card pacs are compatible, although some programs require additional memory modules. By utilizing any of these software solutions you can make your calculator a highly specialized tool in seconds.

HP-41C Application Pacs

HP-41C Application Pacs are complete with detailed manuals including examples, and plug-in Application Modules that increase the versatility of the HP-41C—adding to your personal decision-making potential.

Choose from:

Aviation

(00041-15018)
- Flight Management
- General Aircraft Weight and Balance
- Determining In-Flight Winds
- Flight Plan
- Position by One or Two VORs
- Course and Speed Corrections

Clinical Lab and Nuclear Medicine

(00041-15024)

Clinical Chemistry
- Beer's Law
- Body Surface Area
- Creatinine Clearance
- Blood Acid-Base Status
- Oxygen Saturation and Content
- Red Cell Indices

Nuclear Medicine
- Total Blood Volume
- Thyroid Uptake
- Radioactive Decay Corrections

Radioimmunoassay

Statistics
- Basic Statistics
- Chi-square Evaluation and Distribution
- t Statistics
- t Distribution

Circuit Analysis

(00041-15006)
- General Network Analysis
- Ladder Network Analysis

Financial Decisions

(00041-15004)
- Compound Interest Solutions
- Internal Rate of Return
- Compound Interest Solutions
- Internal Rate of Return
- Modified Internal Rate of Return (FMRR)
- Net Present Value
- Loan Amortization Schedules
- Depreciation Schedules
- Bond Price and Yield
- Days Between Dates

Mathematics

(00041-15003)
- Matrix Operations
- Solution to f(x) = 0 on an Interval
- Polynomial Solutions/Evaluation
- Numerical Integration
- Differential Equations
- Fourier Series
- Complex Operations
- Hyperbolics
- Triangle Solutions
- Coordinate Transformations

Securities

(00041-15026)
- Bond/Note Price and Yield
- Routines for Option Writers Using the Black-Scholes Evaluation Method
- Warrant and Option Hedging
- Yield on Call Option Sales
- Butterfly Options
- Bull Spread Option Strategy
- Convertible Security Analysis
- Convertible Bond Investment Analysis
- Stock Portfolio Valuation
- Bond Speculation Using Margin

Statistics

(00041-15002)
- Basic Statistics for Two Variables
- Moments, Skewness and Kurtosis
- Analysis of Variance (One Way)
- Analysis of Variance (Two Way, No Replications)
- Analysis of Covariance (One Way)
- Curve Fitting (Linear, Exponential, Logarithmic, and Power Curve)
- Multiple Linear Regression
- Polynomial Regression
- t Statistics
- Chi-Square Evaluation
- Contingency Table
- Spearman's Rank Correlation Coefficient
- Normal and Inverse Normal Distribution
- Chi-Square Distribution

Stress Analysis for Mechanical Engineers

(00041-15027)
- Section Properties
- Beams
- Simply Supported Continuous Beams
- Columns
- Mohr Circle Analysis
- Strain Gage Data Reduction
- Soderberg's Equation for Fatigue
- RPN Vector Calculator

Structural Analysis for Civil Engineers

(00041-15021)
- Section Properties
- Beams
- Simply Supported Continuous Beams
- Settling of Continuous Beams
- Continuous Frame Analysis
- Steel Column Formula
- RPN Vector Calculator
- Reinforced Concrete Beam
- Concrete Columns
- Effective Moment of Inertia for Concrete Sections

Surveying

(00041-15005)
- Traverse, Inverse and Sideshots
- Compass Rule Adjustment
- Transit Rule Adjustment
- Intersections
- Curve Solutions
- Horizontal Curve Layout
- Vertical Curves and Grades
- Resection
- Predetermined Area
- Volume by Average End Area
- Volume of a Borrow Pit
- Coordinate Transformation

Machine Design

(00041-15020)
- Circular Cams
- Generation of a Four Bar System
- Progression of a Four Bar System
- Progression of a Slider Crank
- Gear Forces
- Standard External Involute Spur Gears
- Helical Spring Design
- Forced Oscilator with Arbitrary Function
- Coordinate Transformation
- Points on a Circle
- Circle by Three Points
- Unit Conversions

Thermal and Transport Science

(00041-15019)
- Unit Management System
- Equations of State
- Polytropic Processes for an Ideal Gas
- Isentropic Flow for Ideal Gases
- Conduit Flow
- Energy Equation for Steady Flow
- Heat Exchangers
- Black Body Thermal Radiation

Home Management

(00041-15023)
- Home Budgeting
- Travel Expense Record
- Stock Portfolio Evaluation
- Your Financial Calculator
- Remaining Balance and Accumulated Interest
- Tax Free Individual Retirement Account (IRA) or Keogh Planning
- The True Cost of an Insurance Policy
- Checking Account Reconciliation
- Home Owner's Equity Analysis

Games

(00041-15022)
- Super Bagles
- Biorhythms
- Craps
- Hangman
- Pinball
- Space War
- Submarine Hunt

Additional Application Pacs under Development:

Navigation

(00041-15017)
Provides an integrated set of programs to solve the classic navigation problems of dead reckoning and celestial navigation.

Real Estate

(00041-15016)
Programs for the real estate investor including Internal Rate of Return, Depreciation, Compound Interest Solutions, and Income Property Analysis.

HP-41C Solutions Books

HP-41C Solutions Books provide complete step-by-step keystroke listings, to help provide you with answers to your general or specialized programs. (Printed bar codes available later this year.)

Choose from:

Business

Business Statistics/Marketing/Sales (00041-90094)
- Forecasting Using Exponential Smoothing
- Seasonal Variation Factors (SEVAR)
- Multiple Linear Regression
- Normal, t and f Distributions
- Grouped Statistics
- Moving Average
- Breakeven Analysis
- Compertz Curve
- Experience (learning) Curve for Manufacturing Cost
- Price Elasticity of Demand

Home Construction Estimating (00041-90096)
- Concrete Volume
- Linear to Board Feet Conversions and Costing

- Framing Board Feet
- Lumber Estimate
- Shingle Estimate
- Wall and Ceiling Areas Estimate
- Wallpaper Estimate
- Drywall and Insulation Estimate
- Sheathing and Subfloor Estimate
- Painting Estimate
- Wood Floor Estimate

Lending, Savings and Leasing (00041-90086)
- Constant Payment to Principal Loan
- APR With Fees/Discount
- Rules of 78's
- Amortization Schedule
- Add-on to APR with Odd Days
- Savings Plan
- Interest Conversions
- Lease with Additional Payments in Advance
- Skipped Payments
- Compounding Periods Different from Payment Periods
- Compound Interest Solutions

Real Estate (00041-90136)
- Ellwood Analysis
- Analysis of Income Property
- Wrap-Around Mortgage
- Amount of Equity at Any Time
- Mortgage Yield
- Mortgage Pricing
- Investment Analysis for Property and Land
- Residential Analysis (Rent or Buy)
- Variable Analysis of Real Estate Investment
- IRR
- Shopping Center Rent Projections

Small Business (00041-90137)
- Hourly Payroll
- Invoicing
- Account Posting
- Percentages and Proportions with Tabulator
- Retail Inventory Monitor
- Estimating Inventory
- Inventory Ordering
- Order Point Calculations
- Working Capital Needs—Bardahl Formula
- Depreciation Schedules
- Breakeven Analysis

Taxes 1979 (00041-90222)
- 1979 Alternative Minimum Tax—Joint Returns
- 1979 Maximum Tax—Joint Returns
- 1979 Single Taxpayers Income Averaging, Tax Table A and Schedule X
- 1979 Married Individuals Income Averaging, Tax Tables B and C, Tax Rate Schedule Y
- 1979 Head of Household Income Averaging, Tax Table D and Tax Rate Schedule Z
- 1979 New Jobs Credit
- 1979 Estates and Trusts Tax Rate Schedule, State Death Taxes Credit Table, Estate and Gift Tax Table
- 1979 Corporate Tax Rate Schedule

Computation

Geometry (00041-90084)
- Sine Plate Solutions
- V Notches and Long Radii
- Internal and External Tapers
- Points of Tangency with Circles and Arcs
- Line-Line Intersection
- Points on a Straight Line
- Grid of Points: Calculates All Points
- Grid of Points: Calculates Discrete Points
- Tangent Circle to Two Straight Lines with a Given Radius
- Distance Between Lines in Space

High-Level Math (00041-90083)
- Sine, Cosine, Exponential Integrals
- Eigen Values/Vectors of 3rd Order Systems
- Eigen Values for 3rd Order System
- Chebyshev, Legendre, Hermite, and Laguerre Polynomials
- Sixteen-Point Gaussian Quanratune
- Gamma Function
- Bessel Functions, Error Function
- Characteristic Equation of a 4 x 4 Matrix
- 4 x 4 Matrix Operations

Test Statistics (00041-90082)
- One Sample Test Statistics for the Mean
- Test Statistics for the Correlation Coefficient
- Differences Among Proportions
- Behrens-Fisher Statistics
- Kruskal-Wallis Statistic
- Mean-Square Successive
- The Run Test for Randomness
- Intraclass Correlation Coefficient
- Fisher's Exact Test for a 2 x 2 Contingency Table
- Bartlett's Chi-Square Statistic
- Mann-Whitney Statistic
- Kendall's Coefficient of Concordance

Engineering

Antennas (00041-90093)
- Loaded Vertical Antennas
- Loaded Dipole Antennas
- Gain of a Horizontal Rhombic Antenna at Zero Azimuth
- Azimuth Pattern of Cylindrical Array of Antennas
- Colinear Antenna Gain and Pattern
- Beam Pattern for Uniform Array
- Radar Antenna Beamwidth and Gain
- Antennas
- Parabolic Antenna Calculations
- RF Path Loss, dB
- Antenna Gain or Power of a Remote Transmitter
- Planar Phased Array Radar Beam Positions
- Shortwave Transmission Path Calculations

Chemical Engineering (00041-90100)
- Straight Fin Efficiency
- Conservation of Energy
- Hydrocarbon Combustion
- Heat Transfer through Composite Cylinders and Walls
- Von Kármán Analogy for Heat and Mass Transfer
- Equations of State
- Reversible Polytropic Process for an Ideal Gas
- Conduit Flow
- Fluid Transport Numbers
- Single Stage Equilibrium Flash Calculation
- Weak Acid/Base Titration Curve

Civil Engineering (00041-90089)
- Steel Column Formula
- Reinforced Concrete Beams
- Stress in Thick-Walled Cylinders
- Properties of Special Sections
- Compressive Buckling
- Vectors
- Beams Fixed at Both Ends
- Simply Supported Beams
- Cantilever Beams
- Bolt Torque

Control Systems (00041-90092)
- Frequency Response of a Transfer Function
- Bode of Transfer Function that has Each Pole and Zero Given
- Bode of Third Order Over Fourth Order Transfer Function
- Bode of Third Order Over Third Order Times S**N Transfer Function
- Routh Test for Continuous and Discrete Time System Stability
- Convert Frequency Response—Open Loop, Closed Loop
- Aid to Root Locus Plots I—Real Poles
- Aid to Root Locus Plots II—Complex Poles
- Classical Control Gains
- First Order Regulator
- Second Order Regulator

Electrical Engineering (00041-90088)
- RC Timing
- Frequency Response of a Transfer Function
- Transistor Amplifier Performance
- Class A Transistor Amplifier Bias Optimization
- Active Filter Design
- Butterworth Filter Design
- Chebyshev Filter Design
- Bode Plot of Butterworth and Chebyshev Filters
- Transmission Line Calculations
- Transmission Line Impedance

Fluid Dynamics and Hydraulics (00041-90139)
- Conduit Flow
- Flow with a Free Surface
- Pipe Slide Rule
- Forces at Bends and Fittings
- Valve Sizing
- Pipe Network Analysis
- Restriction Metering Orifice Calculation
- Energy Equation for Steady Flow
- Compressible Flow in Ducts
- Flood Routing and Hydrographs

Heating, Ventilating, and Air Conditioning (00041-90140)
- Overall Heat Transfer Coefficient
- Insulation Break Even Analysis
- Air Flow in Circular Ducts
- Air Duct Conversion
- Equations of State
- Black Body Thermal Radiation
- Psychrometric Properties
- Heat Exchangers
- Decibel Addition and Subtraction
- Temperature Conversions

Mechanical Engineering (00041-90090)
- Gear Forces
- Stress on an Element
- Equations of State
- Soderberg's Equation for Fatigue
- Spring Constant
- Progression of a Slider Crank
- Free Vibrations
- Interference Fits
- Linear or Angular Deformation
- Constant Acceleration

Solar Engineering (00041-90138)
- Solar-Beam Irradiation
- Sun Altitude, Azimuth, Solar Pond Absorption
- Energy Equivalents—Fuels and Prices
- Solar Shading Angles
- Heat Exchangers
- View Factor
- Sun Almanac
- Heat Transfer
- Black Body Radiation

Other

Calendars (00041-90145)
- Calendar Date/Julian Date Conversion
- Day of Year—Day of Week
- Number of Weekdays between Two Dates
- In What Year is a given Date an M-Day
- Number of M-Days between Two Dates and Nth M-Day of Month
- Holidays
- Religious Holidays
- Chinese Years to/from Gregorian Years
- New Moon and Full Moon Day of Month
- Calendar Printout

Cardiac/Pulmonary (00041-90097)
- Pulmonary Functions
- Body Surface Area
- Blood Chem I
- Blood Chem II
- Cardiac Outputs
- Cardiac Shunts
- Contractility and Stroke Work
- Lung Diffusion
- Valve Area
- Ventilator Calculations

Chemistry (00041-90102)
- pH of Weak Acid/Base Solutions
- Acid-Base Equilibrium (Diproctic)
- Weak Acid/Base Titration Curve
- Equations of State
- Van Der Waals Gas Law
- Beer's Law and Absorbtivity Calculations
- Activity Coefficients from Potentiometric Data
- Crystallographic to Cartesian Coordinate Transformations
- Kinetics using Lineweaver-Burk or Hofstee Plots
- Mixture Viscosities
- Vapor Pressure, Bubble and Dew Point Calculation
- Single-Stage Equilibrium Calculation

Games (00041-90099)
- Hexapawn
- Wari
- Nim_K
- Dice
- 3-D Tic Tac Toe
- Hunt the Wumpus
- Simon
- Planet Lander
- Orbital Lander
- Scatter
- Flip-Flop

Optometry I (General) (00041-90143)
- Aniseikonia
- Crossed Prism Resultant
- Obique Cylinder Sum
- Low Vision; Determination of Activity Demand from Letter Size and Working Distance
- Contact Lens, Telescope Calculations
- Calculation of Needed Magnification, Add, and Working Distance
- Effective, Equivalent and Neutralizing Power
- Lens Power Needed at New Vertex Distance
- Positional Effective Power
- Pratt, Sheard, Percival Methods of Near R_x
- Four Accomodative R_x's and their Average

Optometry II (Contact Lens) (00041-90144)
- Back Vertex Power of PMMP Contact Lens
- Effective Power of Spectacle Lens at Corneal Plane
- Residual Cylinder Induced at Tear/Cornea Interfaced by Contact Lens
- Cylinder Induced by Toric Contact Lens
- Contact Lens Power Necessary to Correct Ametropia
- Toric Contact Lens Parameters
- Tabb Contact Lens of 1st Approximation
- May-Grant Contact Lens of 1st Approximation
- Roggenkamp Specification for Prism Ballast Front Toric or Prism Ballast Contact Lens
- Brungardt I
- Brungardt II

Surveying (00041-90141)
- Spiral Curve Layout
- Two Instrument Radial Survey
- EDM Slope Reduction
- Stadia Reduction
- Three Wire Leveling
- Azimuth of the Sun
- Taping Reduction
- Triangle Solutions
- Traverse for Auto Adjust Routines
- Auto Adjust for Compass Rule
- Auto Adjust for Crandall's Rule

Physics (00041-90142)
- Black Body Thermal Radiation
- Black Hole Characteristics
- Special Relativity Conversions
- Three-Dimensional Special Relativity
- Einstein's Twin Paradox
- Delta-V Orbit Simulator
- Equations of Motion
- Isotope Overlap Corrections
- Semi-Empirical Nuclear Mass Formula
- Clebsch-Gordon Coefficients and 3j Symbols Evaluation
- 32-P Remaining on MM.DDYYYY Given

(Solutions Book titles and program listings subject to change without notice.)

Series E

What is Series E?

Series E is Hewlett-Packard's complete family of affordable scientific and financial calculators specifically designed for the student and the professional. Eight calculators make up the Series E family—from the basic HP-31E to the advanced HP-38C. Whether business or science, student or professional, there is a Series E for every need!

Proven Performance from the Logical Choice

RPN

Series E uses RPN—the computer-like logic that is recognized as the most powerful and efficient logic system for solving complex problems. With RPN, or Reverse Polish Notation, you simply treat problems the same way as if you were solving them with pencil and paper. The simplicity of RPN as well as its superior speed in operation, make it the logical choice for user satisfaction.

Time-Tested Function Sets

The most widely used functions are already preprogrammed into Series E calculators. This means that to get many complex answers you need press only one key. Solutions to problems like finding the net present value or determining a definite integral are pushbutton easy. And all Series E calculators have internal accuracy up to 10 digits—so you can have confidence in your answers.

Continuous Memory

Several Series E models offer Continuous Memory—a feature pioneered by Hewlett-Packard in 1975 and still an industry standard today. With Continuous Memory, frequently needed calculations and functions are programmed once and remain intact even when the calculator is turned off. It saves time by eliminating program reloading and makes possible the addition of specialized functions.

Total Design Engineering

Designed To Be Used

All Series E calculators fit your hand comfortably. There's no twist or play in the case. When you press a key, you'll notice a quiet, positive click. This "positive tactile feedback" lets you know that the calculator has executed your keystroke, thereby eliminating the need to continually monitor the display. The size and shape of the keys let you easily read the symbols on them. The spacing minimizes the chance of pressing more than one key at a time—a distinct possibility on a small keyboard with many keys. The battery compartment door is designed to open easily (but not accidentally), without using a coin or key. And low-level battery indicators help prevent the frustration of an unexpected power loss.

Easy-To-Read Display

To help you read large numbers more easily, commas or periods are automatically inserted, just as you would write them yourself. And the large, bright red digits are tilted forward for easy reading from any working angle.

Instant Problem-Spotting

An internal self-test routine is built right into Series E calculators. At the press of two keys, the calculator quickly checks all of its internal circuitry, then flashes -8,8,8,8,8,8,8,8,8,8, to reassure you of correct operation. Also, if you make a mistake in your calculations, special error codes appear in the display to help you track it down.

Software...Of Course!

Handbooks that Help

HP's Owner's Handbooks have long been respected for the clear and thorough manner of presentation. Complete step-by-step documentation makes it easy for you to understand all of your calculator's capabilities—and then to apply that capability to your "real-life" problems.

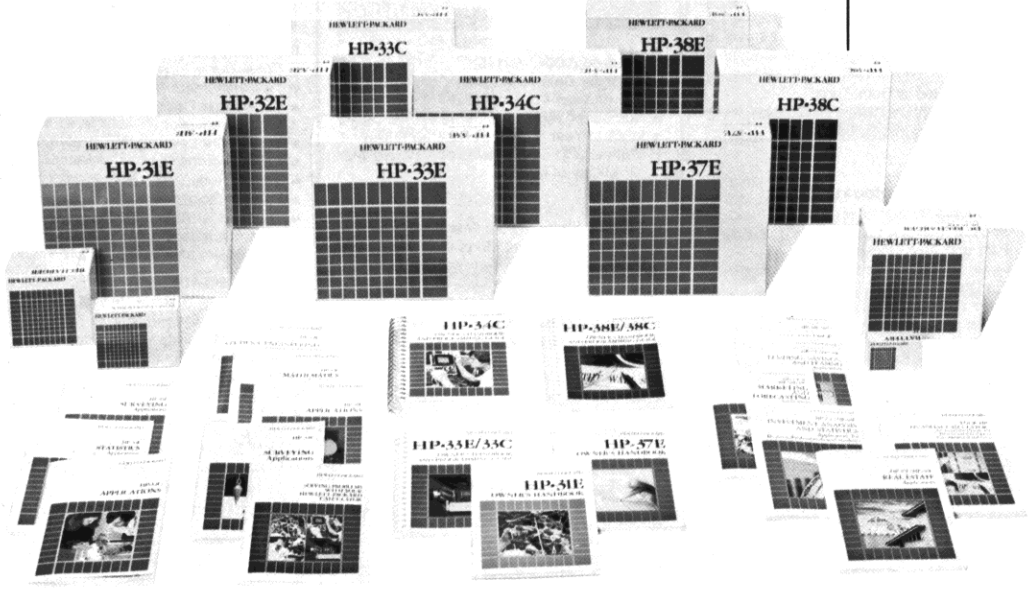
Software Solutions

Sixteen Applications Books are available for the Series E family. Such subjects as: Mathematics, Surveying, Real Estate, Student Engineering, and Investment Analysis & Statistics are among the many offerings. Applications Books provide simple explanations and list the step-by-step procedures necessary to arrive at the solutions you need.

And Afterwards . . .

All Series E calculators come with a one-year warranty. And should your calculator need service or repair, you'll be in good hands. HP's service and repair facilities reflect the highest level of customer support—and rapid turnaround time.

Series E is all of this and much, much more. It's rigid quality assurance testing to ensure the high standards expected from Hewlett-Packard. It's continual support to meet your expanding needs. It's a full line of accessories which give you the flexibility and convenience you desire. It's **Excellence by Design** from Hewlett-Packard.



HP-34C

Advanced Programmable Scientific with Continuous Memory

New computer-strength Solve and Integrate keys plus the most advanced keystroke programming for scientific students and professionals.

The totally new HP-34C offers more problem-solving power than ever before available in the Series E line. Two unique new keyboard functions—Solve and Integrate—to find roots and definite integrals of the most complex problems. Dynamic Memory Allocation automatically shifts available memory between storage registers and program lines—depending upon where it's needed. Advanced programming capability provides flexibility and power for a wide range of problems. And Continuous Memory, so you can key data and programs in once, and retain them even when the calculator is turned off.

Solve and Integrate.

The Solve and Integrate operations are the most advanced and powerful ever found on a handheld calculator. Yet both feature an ease of operation that must be seen to be appreciated. Solve finds the real roots of equations, and Integrate finds the definite integrals of any function which can be keyed into program memory. To use either Solve or Integrate begin by simply keying in the function you wish to evaluate. Then . . .

. . .to find a root, enter two guesses and put Solve to work for you. Even if your guesses don't bracket the root, Solve's sophisticated algorithm expands the search automatically. The HP-34C's ability to find a root is one of the most advanced ever created—even compared to full scale computers. Imagine, *this* power in a personal, handheld product!

. . .to calculate an integral, enter the limits of integration and let the HP-34C take care of the laborious computations. The HP-34C's ability to find an integral was previously found only in large computer systems—it has never been this easy.

Dynamic Memory Allocation.

The HP-34C's memory allocation begins with 70 lines of program memory and 21 data storage registers. When you need more than 70 lines of program memory, the HP-34C *automatically* converts data registers, one at a time, to a maximum of 210 program lines—as you need them. And you don't have to remember current memory allocation. The HP-34C does that for you.

Programming and Editing.

Each fully-merged program instruction, whether one, two, or three keystrokes, requires only one line of program memory. This means the HP-34C's maximum of 210 program lines are comparable to as many as 370 program lines on other calculators. And editing is no problem. The HP-34C's editing keys let you easily review programs and insert or delete instructions as needed.

More Programming Features.

The HP-34C's 12 reusable address labels let you easily create branches and subroutines. With the conditional test set of four x/y comparisons, four x/0 comparisons, four flags, plus the increment/decrement loop counter, you can program the HP-34C to make a wide range of program control decisions. And, with the versatile I-register, you can indirectly address data and program locations.

Continuous Memory.

Continuous Memory provides tremendous value in time-saving and convenience. It also extends the functional capability of your calculator by allowing you to customize it to meet your specific needs.

Applications Book Support.

The solutions you require may already exist in the four applications books available for the HP-34C. Subjects covered include mathematics, statistics, surveying, and student engineering.

Compare the HP-34C's new functions to any other and see if you don't agree—Hewlett-Packard has made another major contribution to technical problem-solving.

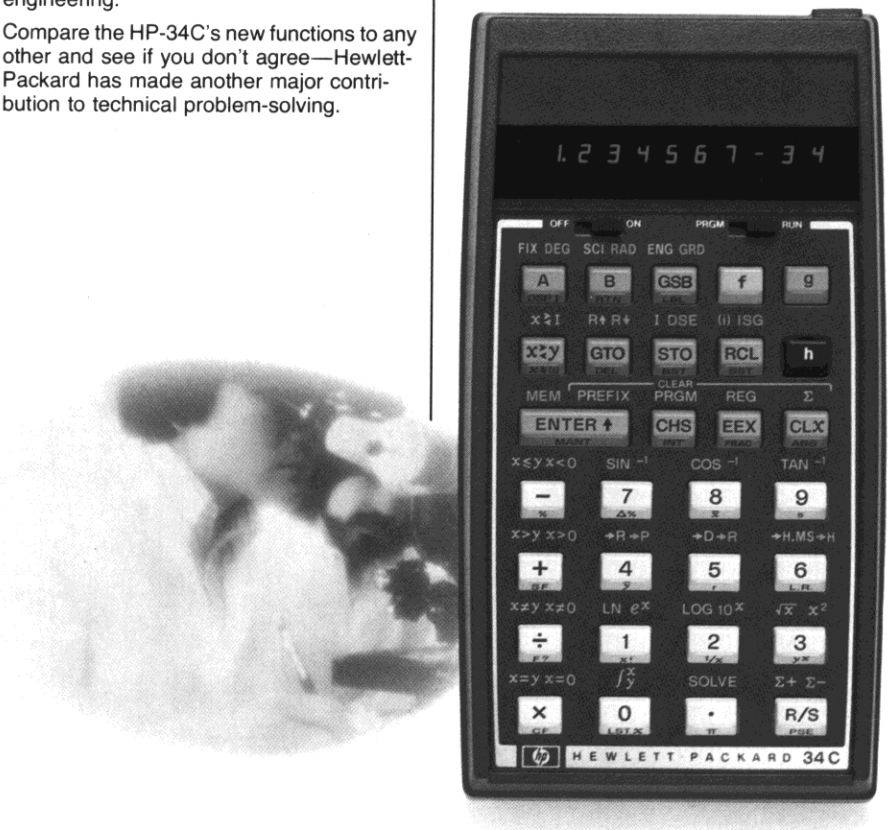
Physical Specifications:

- Length: 140 mm (5.6")
- Width: 75 mm (3.0")
- Height: 30 mm (1.2")
- Weight: 220 g (7.7 oz)

For a complete list of key features and functions, see the Comparison Chart on page 28.

The HP-34C Advanced Programmable Scientific with Continuous Memory comes complete with:

- HP-34C Owner's Handbook and Programming Guide
- Solving Problems with your Hewlett-Packard Calculator
- HP-34C Standard Applications Book
- HP-34C Quick Reference Card
- Recharger/AC Adapter
- Rechargeable Battery Pack
- Soft Carrying Case



HP-33E
Programmable Scientific

HP-33C
Programmable Scientific with Continuous Memory

Extraordinary problem-solving power plus versatile keystroke programmability to solve repetitive problems quickly and easily.

The HP-33 is designed to give you more calculating power, more ease-of-use features, at a lower price than any comparable calculator we've ever offered.

Programming is Easy.

Programming the HP-33 is simple—just switch to PRGM and press a problem-solving series of keystrokes to be remembered by the calculator. Then switch to RUN, key in any known data, and hit the run/stop key. The HP-33 does the rest, executing those keystrokes in a few seconds over and over, as many times as you like. There's no complicated programming language to learn, no elaborate "start-up" procedures to memorize.

49 Lines of Program Memory.

The HP-33 remembers your program in a special memory—49 lines of it. And no matter whether a keyboard operation is one, two or three keystrokes, it occupies only a single line of memory, so you can easily load programs of 100 keystrokes or more.

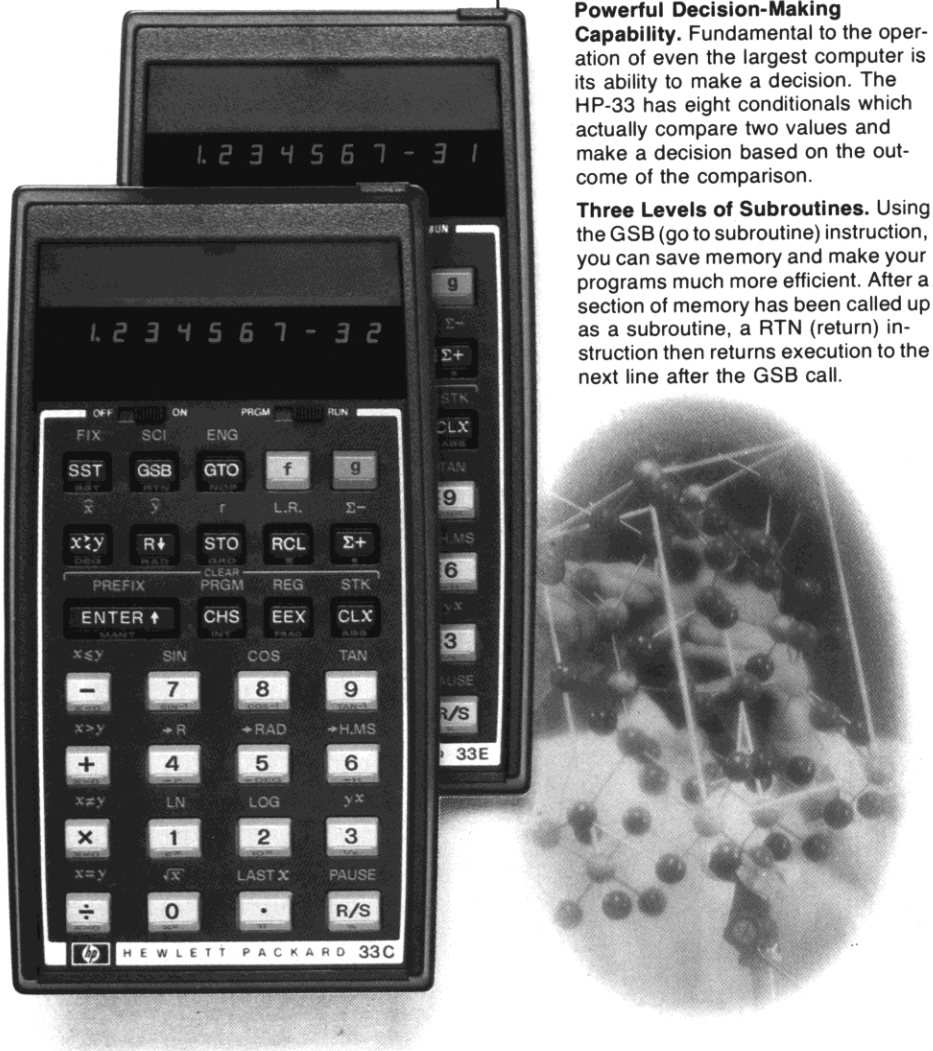
More Programming Features.

Besides 49 lines of fully-merged program memory, the HP-33 has a variety of specialized functions to make your programming useful, powerful, and even more fun:

Go To. The GTO (go to) command transfers an executing program to a specified line of memory—permitting you to create branches and loops in your programs. And for editing, you can also use GTO from the keyboard to go to any line number

Powerful Decision-Making Capability. Fundamental to the operation of even the largest computer is its ability to make a decision. The HP-33 has eight conditionals which actually compare two values and make a decision based on the outcome of the comparison.

Three Levels of Subroutines. Using the GSB (go to subroutine) instruction, you can save memory and make your programs much more efficient. After a section of memory has been called up as a subroutine, a RTN (return) instruction then returns execution to the next line after the GSB call.



Fast, Easy Editing. Besides being able to go to any line number with GTO, you can also use SST and BST to single-step or back-step through a program, *without* execution, to any point you want in program memory. Changing a program is easy too—you just key in a new instruction and it automatically replaces the old one.

Pause. The PAUSE function in a program actually lets you see a result or an intermediate answer for a second before resuming execution.

Eight Addressable Storage Registers.

In addition to the 49-line program memory, the four-register stack, and the LAST X register, the HP-33 has 8 addressable storage registers for data. And you can perform storage register arithmetic on these addressable registers too.

Continuous Memory.

The HP-33C has all the functions and capabilities of the HP-33E with the added feature of Continuous Memory which:
Saves Time. You can key a program once, then use it for months.
Extends Functional Capability. Customize your calculator to meet your specific needs.
Reduces Errors. Fewer entries mean fewer errors.
Prolongs Battery Life. The less your calculator is turned on, the longer it lasts between recharges.

Applications Books Support.

The solutions you require may already exist in the four applications books available for the HP-33. Subjects covered include mathematics, statistics, surveying, and student engineering.

Physical Specifications:

■ Length:	140 mm (5.6")
■ Width:	75 mm (3.0")
■ Height:	30 mm (1.2")
■ Weight:	220 g (7.7 oz)

For a complete list of key features and functions, see the Comparison Chart on page 28.

The HP-33E and HP-33C Programmable Scientific Calculators come complete with:

- HP-33E/HP-33C Owner's Handbook
- Solving Problems with your Hewlett-Packard Calculator
- HP-33E/HP-33C Standard Applications Book
- HP-33E/HP-33C Quick Reference Card
- Recharger/AC Adapter
- Soft carrying case
- Rechargeable Battery Pack

HP-32E
Scientific with Statistics

HP-31E
Scientific

HP-32E

The HP-32E is designed for students and professionals who need sophisticated statistics, as well as a thorough scientific capability, at the touch of a key. The manager, statistician or anyone who must reduce and interpret data will find the HP-32E the ideal calculator.

One or Two Variable Means and Standard Deviations.

At the press of a key you can calculate the means of one or two variables. And the HP-32E can also give you the sample standard deviations of these sets of data.

Linear Regression and Linear Estimate.

The HP-32E calculator easily computes linear regression, calculating the slope and y-intercept of a least-squares line for data. And you can also calculate the correlation coefficient to measure for "goodness of fit". In addition, the HP-32E linear estimate function can actually predict new values along the line.

Normal Distribution.

The HP-32E is equipped with the normal and inverse normal distribution functions—it can compute the area under a standard normal distribution curve to the left of x, and it can also compute x given the area under the curve.

Data Accumulation and Correction.

$\Sigma+$ automatically accumulates Σx, Σy, Σxy, Σx^2, and Σy^2 in designated storage registers. Correcting a data pair is easy, too, with $\Sigma-$.

15 Addressable Storage Registers.

To help you store and recall the data, results, constants, or statistical information, the HP-32E is equipped with 15 addressable storage registers. And you can perform arithmetic on the contents of any of them. The HP-32E also has a LAST X register which automatically preserves the contents of the display present before the last operation.

Trigonometric Functions Including Hyperbolics.

Besides providing sine, cosine, and tangent and their inverses, the HP-32E also computes hyperbolic trigonometric function (sinh, cosh, tanh and their inverses).

Rectangular/Polar Conversions and Vector Arithmetic.

The HP-32E quickly converts rectangular coordinates (x,y) to polar coordinates (r, θ), or vice versa. And vector arithmetic is easy using the rectangular/polar functions with the accumulation functions $\Sigma+$ and $\Sigma-$.

Three Display Modes.

The large numbers in the bright red LED display can be seen in fixed, scientific, or engineering mode (in engineering mode the exponent of 10 is always a multiple of three). You can always see the full 10-digit mantissa, regardless of display mode by pressing the MANT key.

HP-31E

The HP-31E is the ideal entry level calculator for students and professionals who require uncompromising scientific capability in a no-nonsense format.

Mathematical Functions.

Functions like: exponentials, reciprocals, square roots, pi, and percent are all available at the press of a key. And of course, the HP-31E adds, subtracts, multiplies, and divides—all with 10-digit accuracy.

Trigonometric Capability.

The HP-31E quickly and accurately computes sine, cosine, and tangent—all with a choice of decimal degrees, radians, or grads mode. And you can convert directly between degrees and radians, too.

Rectangular/Polar Conversion.

The HP-31E converts directly between rectangular coordinates (x,y) and polar coordinates (magnitude r, angle θ).

Logarithms.

Common and natural logarithms, as well as antilogarithms, are generated at the touch of a key by the HP-31E.

Metric Conversions.

The HP-31E gives you instant keystroke conversions between inches and millimeters, Fahrenheit and Centigrade, and pounds and kilograms.

Four Addressable Storage Registers.

Besides the four-register automatic memory stack, the HP-31E contains four *addressable* storage registers for selectively storing and recalling constants, results, or other data.

Two Display Modes.

A choice of two display modes—fixed or scientific—lets you view any number as either a full, 10-digit (or less) mantissa or as a mantissa of up to seven digits followed by a two-digit exponent of 10. No matter what display you've selected, the HP-31E internally maintains full 10-digit accuracy. And you can see the full 10-digit mantissa at any time by simply pressing the MANT key.

Selective Clearing Options.

You can clear the entire calculator, clear only the storage registers, or clear only the automatic memory stack.

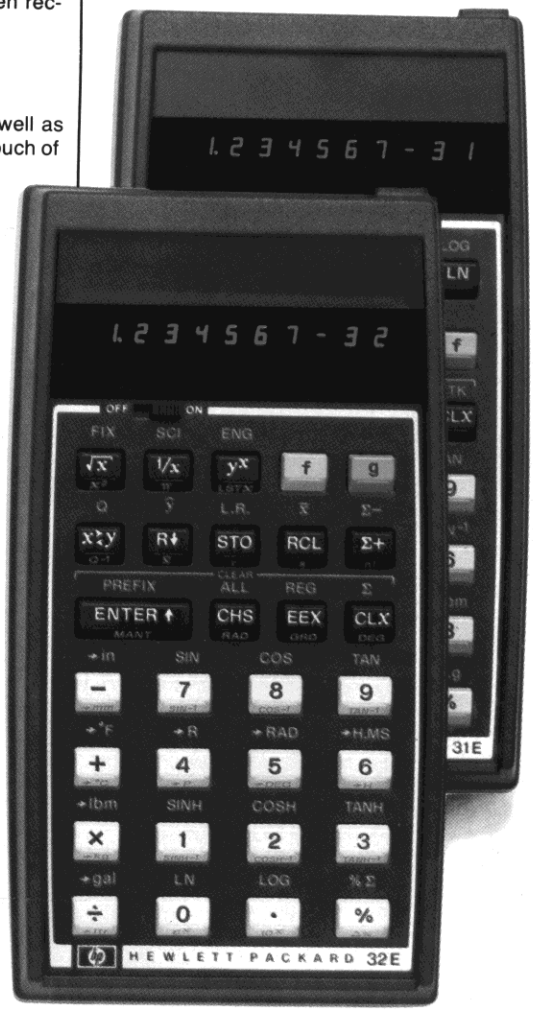
HP-31E and HP-32E Physical Specifications:

- Length: 140 mm (5.6")
- Width: 75 mm (3.0")
- Height: 30 mm (1.2")
- Weight: 220 g (7.7 oz)

For a complete list of key features and functions, see the Comparison Chart on page 28.

The HP-31E and HP-32E come complete with:

- Owner's Handbook
- Solving Problems with your Hewlett-Packard Calculator
- Recharger/AC Adapter
- Rechargeable battery pack
- Soft carrying case



HP-37E Business

Provides an ideal combination of the financial, retail, and statistical capabilities you need in modern business.

The HP-37E is a Hewlett-Packard Series E calculator designed specifically for the residential real estate, retailing, and business communities who need to make fundamental business and financial decisions quickly and accurately.

Simple, Complete Financial Functions.

For time and money problems, all you need to do is key in any three or four of the values for n (number of compounding periods), i (interest rate), PV (present value), FV (future value), and PMT (payment)—in any order. Then press the key for the unknown value to solve for *that* value. And if you want to change one of your inputs, you can do it with a single keystroke. Ordinary or annuity due problems can also be directly calculated at the flip of a switch. The HP-37E's ability to modify the variables in a problem makes it ideal for those "what if?" situations so common in business.

Easy-to-Use Cash Flow Sign Convention.

With the HP-37E you can state any financial problem in a simple, intuitive manner, so you don't have to remember handbook instructions. Problems are entered in terms of cash flows. Cash outflows are negative and cash inflows are positive, both when you enter data and when you display results. With this system you can easily solve complex problems such as the yield of a loan with a balloon or the payment on a lease with a buy back option.

Amortization Schedules.

The HP-37E calculates an amortization schedule (the accumulated interest amount paid toward principal and the remaining balance) for any number of time periods.

Retail-Style Percent Functions.

Whether you're solving for percent, percent change, or percent of total, you'll appreciate the logical, consistent operation of the HP-37E. And the unique PRICE function calculates the selling price if you know the cost and the margin.

Seven Addressable Storage Registers.

Besides the five financial registers and the Hewlett-Packard four-register automatic memory stack, the HP-37E is equipped with seven other memories in which you can store or recall constants, answers, or any number you want to save during your calculations.

Statistics at Your Fingertips.

For research and analysis, the HP-37E is packed with useful statistical functions. The $\Sigma+$ key automatically accumulates the values needed to calculate the means (averages) and standard deviations for one or two sets of data.

The HP-37E also provides a linear regression, or trend line function and can compute the correlation coefficient. A factorial function is also available.

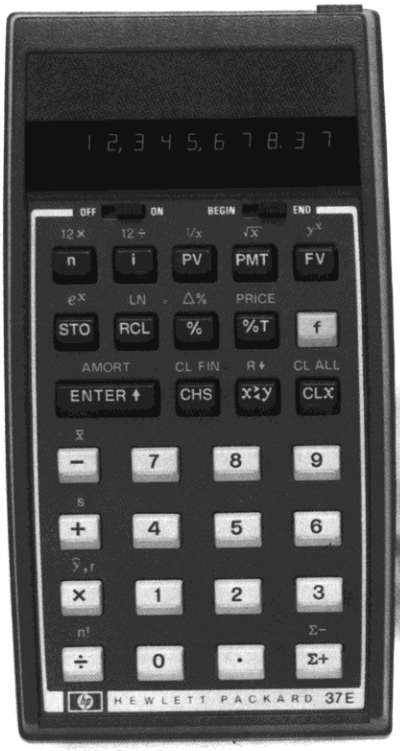
Physical Specifications:

■ Length:	140 mm (5.6")
■ Width:	75 mm (3.0")
■ Height:	30 mm (1.2")
■ Weight:	220 g (7.7 oz)

For a complete list of key features and functions, see the Comparison Chart on page 28.

The HP-37E Business Calculator comes complete with:

- HP-37E Owner's Handbook
- Your HP Financial Calculator: An Introduction to Financial Concepts and Problem-Solving
- Recharger/AC Adapter
- Rechargeable battery pack
- Soft carrying case
- Coupon for your choice of one of the following applications books:
  Real Estate
  Real Estate II (Income Property Analysis)
  Investment Analysis & Statistics
  Lending, Savings, & Leasing
  Marketing and Forecasting



HP-38E
Advanced Financial Programmable

HP-38C
Advanced Financial Programmable with Continuous Memory.

An unparalleled array of built-in financial functions—plus keystroke programmability to solve repetitive problems quickly and easily.

The HP-38 is a powerful financial calculator with the ability to "remember" all the keystrokes in a calculation and to repeat them over and over again at the touch of a key. It provides capabilities that are invaluable to managers, financial analysts, consultants, commercial real estate agents, and advanced business students. The HP-38 offers all the financial capability of the HP-37E and more

Powerful Discounted Cash Flow Analysis.

The HP-38 calculates net present value (NPV) and internal rate of return (IRR) even with uneven cash flows. NPV and IRR let you weigh a leasing situation against buying, balance the worth of an investment against desired yield, or compare investment alternatives.

Easy, Instant Programming.

The HP-38 is so easy to use you'll be writing programs in minutes—or keying in prewritten programs available from one of the optional applications books. With the calculator in the Program mode, it remembers the series of keystrokes you key in. Then, to run the program, just return to Run mode and key in your data. After that, everytime you run the program, the HP-38 executes the entire sequence of keystrokes in seconds. It's that easy! By programming the HP-38 you can save hours of time wasted in long, tedious calculation. And once that program is written into the calculator, there is no possibility of human error.

Dynamic Memory Allocation.

The HP-38 shares its memory space between program memory and data memory. When the HP-38 is first turned on it contains 8 lines of memory for your program and 20 addressable storage registers. As you write a program longer than 8 lines, memory is automatically converted from data storage to program memory (at a ratio of 1 to 7) until you've reached a maximum of 99 lines, with 7 storage registers still remaining. And remember, any keyboard operation occupies one line of program memory even though it may take one, two, or three keystrokes to perform.

A Handy 2000-Year Calendar.

The built-in HP-38 calendar can easily calculate the actual number of days between two dates on a 360- or 365-day year, day of the week, or a past or future date.

Statistics at the Press of a Key.

The HP-38 offers all of the statistical capability of the HP-37E plus linear estimate of x for a known y and x_w (weighted average).

Continuous Memory.

The HP-38C has all the functions and capabilities of the HP-38E with the added feature of Continuous Memory which:
Saves Time. You can key a program once, then use it for months.
Extends Functional Capability. Customize your calculator to meet your specific needs.
Reduces Errors. Fewer entries mean fewer errors.
Prolongs Battery Life. The less your calculator is turned on, the longer it lasts between recharges.

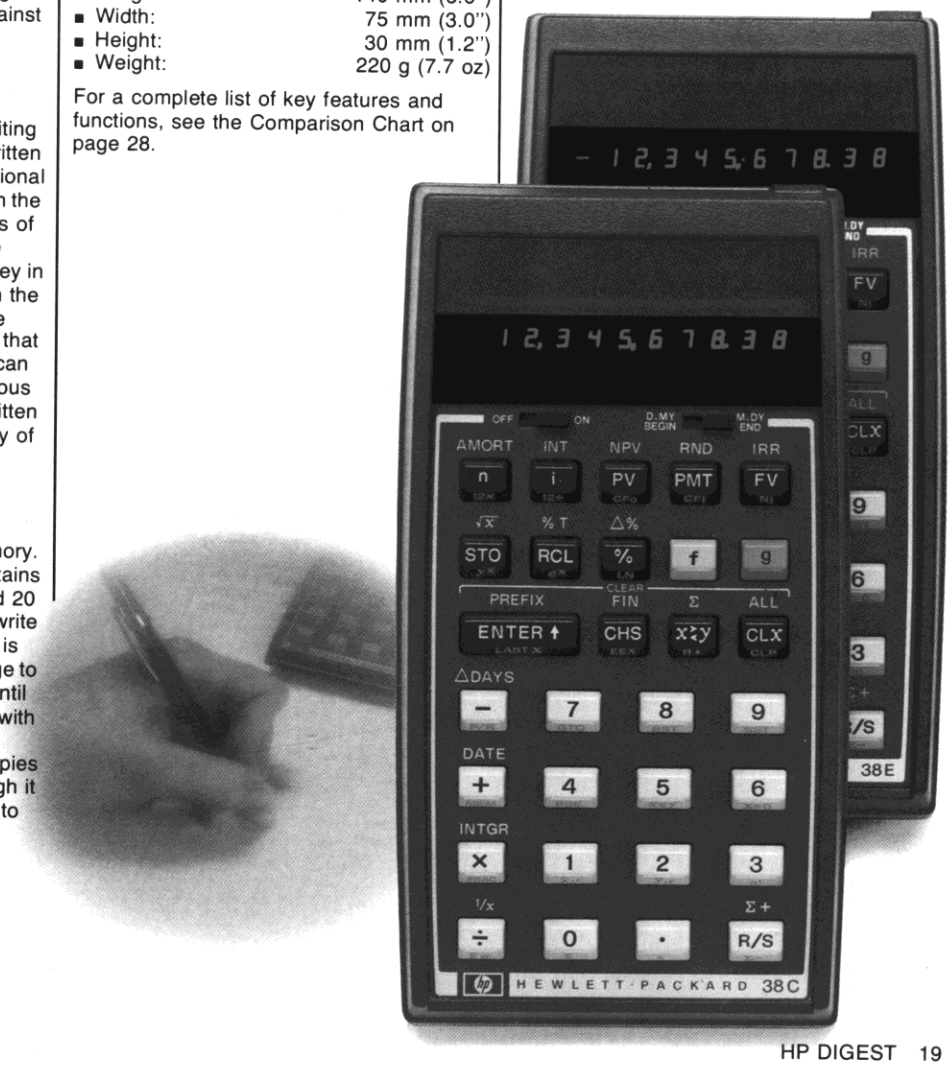
Physical Specifications:

- Length: 140 mm (5.6")
- Width: 75 mm (3.0")
- Height: 30 mm (1.2")
- Weight: 220 g (7.7 oz)

For a complete list of key features and functions, see the Comparison Chart on page 28.

The HP-38E and HP-38C Advanced Financial Programmable Calculators come complete with:

- HP-38E/HP-38C Owner's Handbook and Programming Guide
- Your HP Financial Calculator: An Introduction to Financial Concepts and Problem-Solving
- Recharger/AC Adapter
- Rechargeable battery pack
- Soft carrying case
- Coupon for your choice of one of the following applications books:
  Real Estate
  Real Estate II
  Investment Analysis & Statistics
  Lending, Savings & Leasing
  Marketing & Forecasting
  Personal Finance



HP-67

Handheld Fully Programmable

Proven Performance in Fully Programmable Calculators.

This proven performance calculator is designed for the most demanding professionals and students who require programming power and versatility to handle multiple and lengthy business and scientific programs. The HP-67 provides the identical power of the HP-97 in the classic handheld size.

Exceptional power easily handles your lengthy, repetitive problems.

The HP-67/97 lets you write programs of up to 224 lines. Every function (one, two or three keystrokes) is merged to take only one line of program memory. And there are 26 data storage registers to provide the memory you need for your problems. You can record the contents of either program memory or the data storage registers on a magnetic card. Later, you can load all or part of them back into the calculator. The "smart" card reader of the HP-67/97 can handle either job. The HP-67 and HP-97 are also completely compatible. Programs recorded on one unit may be loaded and executed on the other.

So easy to use you'll write programs the first day.

Keystroke programming makes programming the HP-67/97 as simple as pressing the keys needed to calculate answers manually. Merged operations further simplify the task (and expand memory power) by letting you see the complete operation right in the display.

Because many programs require editing of some kind, we added useful features enabling you to easily review programs forward or backward, to easily jump to any line in the program, and to easily insert lines or delete them. RPN logic and the four-register automatic memory stack combine for more efficient problem solving. And RPN logic also helps when you program, because you don't use parentheses that waste valuable program memory.

And there are no pending operations that make editing difficult. RPN lets you slide through the most complicated programs the same easy way it lets you slide through complex calculations — with complete confidence.

The HP-67 and HP-97 give you exceptional programming power you won't outgrow.

"Smart" magnetic card reader.

With the magnetic card reader in both the HP-67 and the HP-97 you can load the entire program memory, or selected portions, either manually or under program control.

You can record data from all registers onto a magnetic card. You can also load every data storage register or selected registers.

When recording programs, the HP-67 and HP-97 automatically record the angular mode setting, the display setting and the status of the four flags.

10 User-definable Keys.

There are ten user-definable keys you can use for any special function you may require —such as defining portions of your program for subroutines or branches. In addition, there are ten numerical labels (LBL 0 thru LBL 9).

GTO **GSB**

You can perform a direct branch or subroutine to a label specified.

A GSB instruction can also be used with a subroutine to a depth of three levels.

Conditional Branching.

$x \neq y$, $x = y$, $x \leq y$, $x > y$,

$x \neq 0$, $x = 0$, $x < 0$, $x > 0$

These keys allow your program to make decisions for you by testing the values in the X- and Y-registers or by testing the value in the X-register against zero as indicated.

Flags

You can use the four flags in the calculator for tests in your programs. They can be set, cleared, or tested.

Indirect Addressing.

GTO **(i)** **GSB** **(i)**

You can perform a direct branch or subroutine to a label specified by the current positive number in the I-register using these keys. When the number in the I-register is a negative number these instructions perform a direct branch (GTO (i)) or a subroutine (GSB) (i)) backward the number of lines specified.

STO **(i)** **RCL** **(i)**

You can also use the I-register to specify the address of a storage register for storing and recalling data or for storage register arithmetic.

ISZ **(i)** **DSZ** **(i)**

You can also increment (ISZ (i)) or decrement (DSZ (i)) the contents of the storage register specified by the value in the I-register and then test against zero.

HP-97

Desktop Fully Programmable Printing

The HP-97 provides battery-operation and thermal printing—in one self-contained unit.

The HP-97 Fully Programmable Printing Calculator combines exceptional programming power and the great usefulness of a quiet thermal printer. What's more, the HP-97 operates on batteries as well as AC—so you can have a printed record whenever and wherever you need it. In addition, there's an extra-large display for easy readability and a buffered keyboard so data may be keyed in at high speed.

Quiet thermal printer lists your programs on tape for checking and editing.

With the HP-97, you can list a program, (line number, key mnemonic and, optionally, the keycode), contents of the automatic memory stack, or the contents of the data storage registers. And you have three printing modes to choose from.

The printer is a valuable aid in editing programs or long calculations. You don't have to remember what you've done or what remains to be done. You see everything at once clearly, on tape.

Compact in design and light in weight for easy portability.

Total weight of the HP-97 without AC adapter/recharger is only 1.13 kg (2½ pounds). It's so small it will fit into a standard briefcase so you can take it with you, and operate it in airplanes, taxis, anywhere. For security, a built-in metal tab lets you secure it to your desk easily with a cable or bolt.

An unparalleled program of owner support.

You can supplement your own programs with the extensive HP program library. The Standard Application Pac, with 15 programs in various disciplines, comes free with either calculator.

To get a better idea of the capabilities of the HP-67 and HP-97 in relation to your own needs, take the time to review the programs listed in the HP Application Pacs and Solutions Books. In many cases one of our professionally programmed and documented solutions may already exist to solve your problem.

Also available are a one-year subscription to the Users' Library and a free Newsletter to keep you abreast of current information.

HP-67 Physical Specifications:

- Calculator length: 152.4 mm (6″)
- Calculator width: 81 mm (3.2″)
- Calculator height: 18 to 34 mm (0.7 to 1.4″)
- Calculator weight: 298 g (10.5 oz.)
- Recharger weight: 241 g (8.5 oz.)
- Shipping weight: 2.3 kg (5.1 lb.)
- Operating temperature range: 10°C to 40°C (50°F to 140°F)
- Charging temperature range: 10°C to 50°C (50°F to 122°F)
- Storage temperature range: —40°C to 55°C (—40°F to 131°F)
- AC Power Requirement: 86-127V or 172-154V, 50 to 60 Hz
- Battery Power Requirement: 3.75 Vdc nickel cadmium rechargeable battery pack.

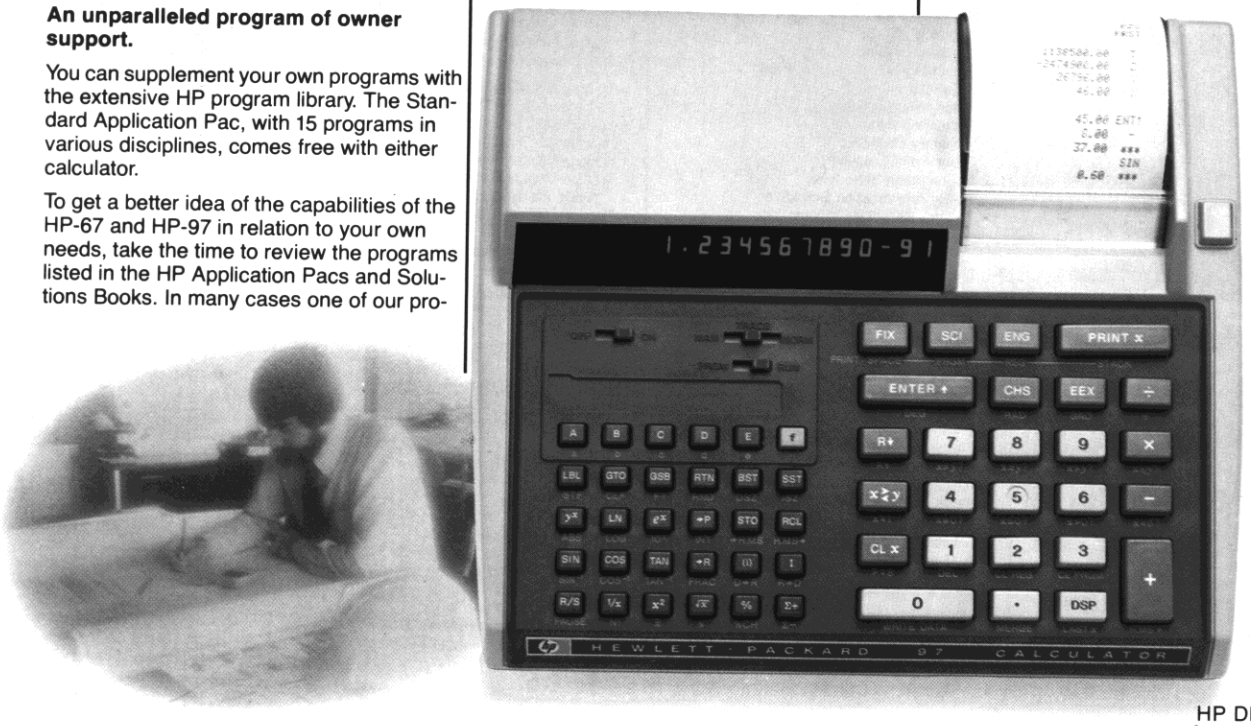
HP-97 Physical Specifications:

- Calculator width: 228 mm (9″)
- Calculator depth: 203 mm (8″)
- Calculator height: 63 mm (2.5″)
- Calculator weight: 1.13 kg (2.5 lb.)
- Recharger weight: 268 g (9.5 oz.)
- Shipping weight: 4.3 kg (9.5 lb.)
- Paper temperature range 10°C to 40°C (50°F to 104°F)
- AC Power Requirement: 90-120V or 220 ± 10%, 50 to 60 Hz
- Battery Power Requirement: 5.0 Vdc nickel cadmium rechargeable battery pack

For a complete list of features and functions, see the Comparison Chart on page 28.

The HP-67/97 Fully Programmable Calculators come complete with:

- Illustrated Owner's Handbook and Programming Guide.
- Quick Reference Card. (HP-67 only)
- Standard Pac complete with 40 cards, card holder, and manual.
- Battery pack that under normal use provides about 3 hours of continuous operation.
- Recharger/AC adapter that lets you operate the calculator on AC while the battery pack is recharging.
- Soft carrying case.
- Programming pad.
- Users' Library and newsletter subscription card.
- 2 rolls of thermal paper (HP-97 only).



HP-67/97 Software

Solutions Books

These HP-67/97 books contain between 10 and 15 programs each in diverse areas such as business, math, statistics, medicine, physical science, life science and others. Simply record the programs on your own magnetic cards and you have an application pac in your chosen field. Listed below are samples of just a few of the many programs available in each Solutions Book.

Business

- **Options/Technical Stock Analysis (00097-14009)**
  - Put & Call Option Fair Values (Black-Scholes)
  - Call Option Evaluation
  - Routines for Option Writers
  - Empirical CBOE Call Pricing
  - Warranty & Option Hedging
  - Bull Spread Option Strategy
  - Butterfly Options
  - Stock Price 30-Week Moving Average with Data Storage
  - Exponential Smoothing
  - Multiple Linear Regression
  - Curve Fitting, Selecting Best Function
- **Portfolio Management/Bonds & Notes (00097-14010)**
  - Stock Portfolio Valuation
  - Portfolio Data Card
  - Stock Portfolio Beta Coefficient Analysis
  - True Annual Growth Rate of an Investment Portfolio
  - Convertible Bond Portfolio Premium Evaluation
  - Yield on Call Option Sales
  - Bond Price and Yield
  - Days Between Dates
  - Bond Yield to Maturity
  - Interest at Maturity/Discounted Securities
  - U.S. Treasury Bill Valuation
  - Convertible Security Analysis
- **Real Estate Investments (00097-14012)**
  - Mortgage Yield
  - Mortgage Pricing No. 1
  - Mortgage Pricing No. 2
  - Yearly Amortization Schedule
  - Amount of Equity at Any Time
  - Ellwood Income Valuation for Income Property Appraisal
  - Income on Property Analysis
  - Return on Equity Rental Property
  - Real Estate Investment Analysis
  - Internal Rate of Return
  - Depreciation Schedules
- **Taxes 1979 (00097-14004)**
  - 1979 Alternative Minimum Tax—Joint Returns
  - 1979 Maximum Tax—Joint Returns
  - 1979 Single Taxpayers Income Averaging, Tax Table A and Schedule X
  - 1979 Married Individuals Income Averaging, Tax Tables B and C, Tax Rate Schedule Y
  - 1979 Head of Household Income Averaging; Tax Table D and Tax Rate Schedule Z
  - 1979 New Jobs Credit
  - 1979 Estates and Trusts Tax Rate Schedule, State Death Taxes Credit Table, Estate and Gift Tax Table
  - 1979 Corporate Tax Rate Schedule
- **Home Construction Estimating (00097-14033)**
  - Concrete Volume
  - Linear to Board Feet Conversion & Costing
  - Framing Board Feet
  - Lumber Estimate
  - Shingle Estimate
  - Wall & Ceiling Areas Estimate
  - Wallpaper Estimate
  - Drywall & Insulation Estimate
  - Sheathing & Subfloor Estimate
  - Painting Estimate
  - Wood Floor Estimate
- **Marketing/Sales (00097-14032)**
  - Forecasting Using Exponential Smoothing
  - Financial Trend Analysis
  - Seasonal Variation Factors (SEVAR)
  - Price Elasticity of Demand
  - Experience (Learning) Curve for Manufacturing Cost
  - Breakeven Analysis
  - Income Statement (P & L) Analysis
  - Internal Rate of Return—Groups of Cash Flows
  - Sales Force Requirements
  - Cost & Price Computations
- **Home Management (00097-14031)**
  - Income Tax Planning—I
  - True Cost of Insurance Policy
  - Automobile Cost/Tire Cost Comparison
  - Comparison Shopping
  - Time & Charges Running Total
  - Reconcile Checking Account
  - Savings Account Compounded Daily
  - Accumulated Interest/Remaining Balance
  - Stock Portfolio Valuation & Data Card
  - True Annual Growth Rate of an Investment Portfolio
  - Diet Planning
- **Small Business (00097-14039)**
  - Hourly Payroll
  - Invoicing
  - Account Posting
  - Percentages & Proportions with Tabulator
  - Retail Inventory Monitor
  - Estimating Inventory
  - Inventory Ordering
  - Order Point Calculation
  - Depreciation Schedules
  - Yearly Amortization Schedule
  - Federal Corporate Income Tax
  - Working Capital Needs—Bardahl Formula

Engineering

- **Antennas (00097-14021)**
  - Loaded Vertical Antennas
  - Loaded Dipole Antennas
  - Gain of a Horizontal Rhombic Antenna at Zero Azimuth
  - Azimuth Pattern of Cylindrical Array of Antennas
  - Colinear Antenna Gain & Pattern
  - Beam Pattern for Uniform Array
  - Radar Antenna Beamwidth & Gain
  - Antennas
  - Parabolic Antenna Calculations
  - RF Path Loss, dB
  - Antenna Gain or Power of a Remote Transmitter
  - Planar Phased Array Radar Beam Positions
  - Radar Parameter Unit Conversions
  - (Television) Antenna Length & Channel Frequency
- **Thermal & Transport Sciences (00097-14023)**
  - Psychrometric Properties
  - Psychrometric Calculations for Water in Air
  - Equations of State
  - Isentropic Flow for Ideal Gases
  - Saturated Steam Properties
  - Conduit Flow
  - Parallel & Counter Flow Heat Exchangers
  - Energy Equation for Steady Flow
  - Flow with a Free Surface
  - Pipe Slide-Rule
  - Force at Bends & Fittings
- **EE (Lab) (00097-14025)**
  - Wire Table
  - Ohm's Law
  - Reactance Chart (Nine Equations)
  - Coil Calculations
  - Complex Impedance Calculator—AC Circuit Calculator
  - Wye-Delta Transformations
  - RC Timing
  - Series R-L-C Circuit Analysis Program
  - Passive High & Lowpass Composite Filter Design
  - "L" Attenuator (Generator Impedance Greater than Load Impedance)
  - 1% Resistor Value Subroutine
  - Wheatstone Bridge
- **Industrial Engineering (00097-14035)**
  - Discounted Cash Flow/Present Value Analysis
  - Depreciation Schedules
  - Invoicing & Inventory Control
  - Production Monitor & Record
  - Learning Curve
  - x & R Control Chart
  - Single- & Multi-Server Queues
  - Two-Way Analysis of Variance with Replications Fixed Effects Model
  - Multiple Linear Regression for 3 Independent Variables
  - Simultaneous Equations in Six Unknowns
- **Beams & Columns (00097-14027)**
  - Compressive Buckling
  - Eccentrically Loaded Columns
  - Reinforced Concrete Beams
  - Concrete Beam Deflection
  - Torsion-Concentrated Load-Steel Beams (Wide Flange)
  - Torsion-Uniform Load-Steel Beams (Wide Flange)
  - A.I.S.C. Steel Column Formula
  - Concrete Columns Ultimate Strength Design
  - Column Strength
  - Beam on Elastic Foundation with Point Load—Any Location
- **Control Systems (00041-90092)**
  - Frequency Response of a Transfer Function
  - Bode of Transfer Function That Has Each Pole & Zero Given
  - Bode of Second-Order Over Third-Order Transfer Function
  - Bode of Second Order Over Second-Order Times s**n Transfer Function
  - Pole-Zero to Group Delay
  - Routh Test for Continuous & Discrete Time System Analysis
  - Convert Frequency Response—Open Loop, Closed Loop
  - Aid to Root Locus Plots I—Real Poles
  - Aid to Root Locus Plots II—Complex Poles
  - Classical Control Gains
  - First Order Regulator
  - Second Order Regulator

Computation

- **High-Level Math (00097-14011)**
  - Eigenvalues for 3rd Order System
  - Eigenvalues/Vectors of 3rd Order Systems
  - Matrix Algebra
  - Characteristic Equation of a 4 x 4 Matrix
  - One Card Determinant & Inverse of a 5 x 5 Matrix
  - Simultaneous Equations in Six Unknowns
  - Roots of Polynomials
  - Miscellaneous Special Functions A
  - Miscellaneous Special Functions B
  - Incomplete Gamma Function
  - Incomplete Beta Function
  - Incomplete Elliptic Integrals
- **Test Statistics (00097-14008)**
  - One Sample Test Statistics for the Mean
  - Test Statistics for the Correlation Coefficient
  - Differences Among Proportions
  - Behrens-Fisher Statistic
  - Kruskal-Wallis Statistic
  - Mean-Square Successive
  - The Run Test for Randomness
  - Intraclass Correlation Coefficient
  - Fisher's Exact Test for a 2 x 2 Contingency Table
  - Bartlett's Chi-Square Statistic
  - Mann-Whitney Statistic
  - Kendall's Coefficient of Concordance
- **Geometry (00097-14007)**
  - Sine Plate Solutions
  - V Notches & Long Radii
  - Internal & External Tapers
  - Points of Tangency with Circles & Arcs
  - Line-Line Intersection/Grid Points
  - Points on a Straight Line
  - Grid of Points: Calculates All Points
  - Grid of Points: Calculates Discrete Points
  - Tangent Circle to Two Straight Lines with a Given Radius
  - Distance Between Lines in Space

Other

- **Chemistry (00097-14006)**
  - pH of Weak Acid/Base Solutions
  - Acid-Base Equilibrium (Diprotic)
  - Weak Acid/Base Titration Curve
  - Equations of State
  - Van Der Waals Gas Law
  - Beer's Law & Absorbtivity Calculations
  - Activity Coefficients from Potentiometric Data
  - Crystallographic to Cartesian Coordinate Transformations
  - Kinetics Using Lineweaver-Burk or Hofstee Plots
  - Mixture Viscosities
  - Vapor Pressure, Bubble & Dew Point Calculation
  - Single-Stage Equilibrium Calculation
- **Energy Conservation (00097-14029)**
  - Air Cooling System Design
  - Black Body Thermal Radiation
  - Economic Insulation Thickness
  - Heat Transfer through Composite Cylinders & Walls
  - Steady State Conduction Heat Transfer, Heat Load & Logarithmic Mean Temperature Difference

To concentrate the capabilities of the HP-67 or HP-97 in your field of interest you can select from a variety of preprogrammed solutions. Choose a Solutions Book with documented programs or an Application Pac with programs prerecorded on magnetic cards.

Sun Altitude, Azimuth, Solar Pond Absorption
Total Daily Amount of Solar Radiation
Transient Temperature Distribution in a Semi-Infinite Solid
Temperature or Concentration Profile for a Semi-Infinite Solid with Convection Boundary Condition
Conservation of Energy

- **Games (00097-14013)**

Risk
Blackjack with a Permanent Bank
Bell-Fruit (Mills Standard)
Turn the Die
Word Encoder
Word Game Subroutine
Hangman Word Game
Pro Football Simulation
Electronic Contract Bridge Score Pad
Duplicate Bridge Score with Running Totals

Application Pacs

With HP-67/97 Application Pacs, the solutions you require may already exist. Application Pacs contain 15 to 26 preprinted, prerecorded program cards, a program card holder and a manual of complete documentation. You save significant time because no researching, programming, debugging or documenting is needed.

EE Pac

(00097-13131)

- Network Transfer Functions
- Reactive L-Network Impedance Matching
- Class A Transistor Amplifier Bias Optimization
- Transistor Amplifier Performance
- Transistor Configuration Conversion
- Parameter Conversion: S⇌Y, Z, G, H
- Fourier Series
- Active Filter Design
- Butterworth or Chebyshev Filter Design
- Bode Plot of Butterworth and Chebyshev Filters
- Resistive Attenuator Design
- Smith Chart Conversions
- Transmission Line Impedance
- Microstrip Transmission Line Calculations
- Transmission Line Calculations
- Unilateral Design: Figure of Merit, Maximum Unilateral Gain Circles
- Bilateral Design: Stability Factor, Maximum Gain, Optimum Matching
- Bilateral Design: Gain and Stability Circles, Load and Source Mapping

Business Decisions Pac

(00097-13144)

- Internal Rate of Return
- Internal Rate of Return—Groups of Cash Flows
- Discounted Cash Flow Analysis—Net Present Value
- Direct Reduction Loans—Sinking Fund
- Accumulated Interest/Remaining Balance
- Wrap-Around Mortgage
- Constant Payment to Principal Loan
- Add-on Rate Installment Loan/Rule of 78's.
- Savings Plan-Leases
- Advance Payments
- Savings—Compounding Periods Different from Payment Periods
- Simple Interest/Interest Conversions
- Depreciation Schedules
- Days Between Dates
- Bond Price and Yield
- Interest at Maturity/Discounted Securities
- Linear Regression—Exponential Curve Fit
- Multiple Linear Regression
- Break-Even Analysis
- Invoicing
- Payroll
- Inventory

Clinical Lab and Nuclear Medicine Pac

(00097-13165)
Clinical Chemistry

- Beer's Law
- Protein Electrophoresis
- LDH Isoenzymes
- Body Surface Area
- Urea Clearance
- Creatinine Clearance
- Amniotic Fluid Assay
- Blood Acid-Base Status
- Oxygen Saturation and Content
- Red Cell Indices

Nuclear Medicine

- Total Blood Volume
- Schilling Test
- Thyroid Uptake
- Radioactive Decay Corrections

Radioimmunoassay

- Radioimmunoassay

Statistics

- Basic Statistics
- Chi-Square Evaluation and Distribution
- t Statistics
- t Distribution

CE Pac

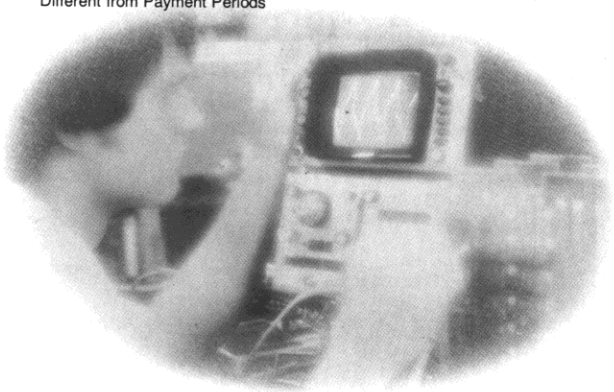
(00097-13195)

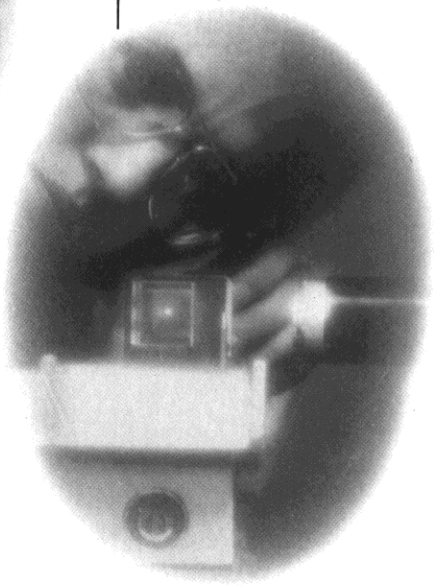
- Vector Statics
- Section Properties (2 Cards)
- Properties of Special Sections
- Stress on an Element
- Bending or Torsional Stress
- Linear or Angular Deformation
- Cantilever Beams
- Cantilever Beams—Trapezoidal Load
- Simply Supported Beams
- Simply Supported Beams—Trapezoidal Loads
- Beams Fixed at Both Ends
- Beams Fixed at Both Ends—Trapezoidal Loads
- Propped Cantilever Beams
- Propped Cantilever Beams—Trapezoidal Load
- Six-span Continuous Beams
- Steel Column Formula
- Reinforced Concrete Beams
- Bolt Torque

Navigation Pac

(00097-13205)

- Estimated Time of Arrival
- Great Circle and Rhumb Line Navigation





More Software

- Dead Reckoning
- Velocity Triangle and Course to Steer
- Star Sight Planner (2 cards)
- Almanac Interpolater
- Sun Line of Position
- Star Line of Position (7 cards)
- Bearing Line of Position
- Two-Angle Line of Position
- Fix from Two Lines of Position
- Radar Plotting Closest Point of Approach
- Beating to Windward
- Distance by Horizon Angle

Surveying Pac

(00097-13175)

- Traverse, Inverse and Sideshots
- Traverse Adjustment
- Intersections
- Curve Solutions
- Horizontal Curve Layout
- Spiral Curve Layout
- Vertical Curves and Grades Resection
- Two Instrument Radial Survey
- EDM Slope Reduction
- Stadia Reduction/3-Wire Leveling
- Taping Reduction/Field Angle Check
- Azimuth of the Sun
- Predetermined Area
- Earthwork
- Coordinate Transformation
- State Plane Coordinates—Lambert
- State Plane Coordinates—Transverse Mercator
- State Plane Coordinates—Alaska Zones 2–9

Stat Pac

(00097-13111)

General Statistics

- Basic Statistics for Two Variables
- Factorial, Permutation, and Combination
- Moments, Skewness, and Kurtosis (For Grouped or Ungrouped Data)
- Random Number Generator
- Histogram

Analysis of Variance

- Analysis of Variance (One Way)
- Analysis of Variance (Two Way)
- Analysis of Covariance (One Way)

Distribution Functions

- Normal and Inverse Normal Distribution
- Chi-Square Distribution
- t Distribution
- F Distribution

Curve Fitting

- Multiple Linear Regression
- Polynomial Approximation

Test Statistics

- t Statistics
- Chi-Square Evaluation
- Contingency Table
- Spearman's Rank Correlation Coefficient

Quality Control

- x and R Control Chart
- Operating Characteristic Curves

Queueing Theory

- Single- and Multi-Server Queues

Math Pac

(00097-13121)

- Factors and Primes
- GDC, LCM, Decimal to Fraction
- Base Conversions
- Optimal Scale for a Graph; Plotting
- Complex Operations
- Polynomial Solutions
- 4 x 4 Matrix Operations (2 cards)
- Solution to f(s) = 0 on an Interval
- Numerical Integration
- Gaussian Quadrature
- Differential Equations
- Interpolations
- Coordinate Transformations
- Intersections
- Circles
- Spherical Triangles
- Gamma Function
- Bessel Functions, Error Function
- Hyperbolics

ME Pac

(00097-13155)

- Vector Statics
- Section Properties (2 cards)
- Stress on an Element
- Soderberg's Equation for Fatigue
- Cantilever Beams
- Simply Supported Beams
- Beams Fixed at Both Ends
- Propped Cantilever Beams
- Helical Spring Design
- Four Bar Function Generator (2 cards)
- Progression of Four Bar System
- Progression of Slider Crank
- Circular Cams
- Linear Cams
- Gear Forces
- Standard External Involute Spur Gears
- Belt Length
- Free Vibrations
- Vibration Forced by $F_0 COS\omega t$
- Equations of State
- Isentropic Flow for Ideal Gases
- Conduit Flow
- Heat Exchangers (2 cards)

Games Pac

(00097-13185)

- Game of 21
- Dice
- Slot Machine
- Submarine Hunt
- Artillery
- Space War
- Super Bagels
- Nim
- Queen Board
- Hexapawn
- Tic-Tac-Toe
- Wari
- Racetrack
- Teaser
- Golf
- The Dealer
- Bowl Scorekeeper
- Biorhythms
- Timer

* Note—67/97 programs will also work in the HP-41C. Lengthy programs may require additional memory modules.

HP-92 Desktop Investor

Offers solutions for accounting and financial professionals.

The HP-92 Desktop Investor is a personal-sized financial calculator that offers preprogrammed solutions for institutional investors, financial consultants, real estate analysts, loan officers, leasing salesmen, accountants and other professionals examining investment alternatives.

The HP-92 Desktop Investor solves problems involving time and money. Compound Interest. Balloons. Internal rate of return for 30 uneven cash flows. Net present value. Bonds and notes. And three kinds of depreciation.

Invaluable Printer provides a Complete Record.

The whisper-quiet printer on the HP-92 gives you the answers quickly and quietly—with descriptive labels.

Easy-to-use Cash Flow Sign Convention.

The HP-92 Desktop Investor is remarkably easy to use. The sign convention lets you state any problem in a simple, intuitive manner, so you don't have to remember handbook instructions. Problems are entered in terms of cash flows. Cash out-flows are negative and cash in-flows are positive, both when you enter data and when you display results.

Financial Functions that Solve Real-World Problems.

The HP-92 solves complicated "real-world" problems involving compound interest, residuals and salvages, partial payments and balloons, wrap-around mortgages, even internal rates of return based upon uneven cash flows.

Simple, Complete Financial Functions.

For time and money problems, all you need to do is key in any three or four of the values for n (number of compounding periods), i (interest rate), PV (present value), FV (future value) and PMT (payment)—in any order. Then press the key for the unknown value to solve for that value. And if you want to change one of your inputs you can do it with a single keystroke. Ordinary or annuity due problems can also be directly calculated at the flip of a switch. The HP-92's ability to modify the variables in a problem makes it ideal for those "what if?" situations so common in business.

Discounted Cash Flow Analysis for 30 Uneven Cash Flows.

The HP-92 calculates the NPV and IRR for up to 30 uneven cash flows. So you can evaluate whether to lease or buy equipment, balance the worth of an investment with uneven cash flows against desired yield, or compare investment alternatives based on their net present value.

Amortization Schedules at the Press of a Key.

The HP-92 can print a complete amortization schedule showing each period of a fully amortized loan with the amount paid to interest and principal as well as the remaining balance on the loan.

Bond and Note Computations—Quickly and Accurately.

The HP-92 calculates price, yield, or accumulated interest on bills, notes, bonds, certificates, debentures, warrants, certificates of deposit, and other interest-bearing obligations—and the HP-92 meets the standards for accuracy set by the Securities Industry Association.

Useful Percent Functions.

The HP-92 gives you the most useful percent functions: Percent, Percent of Sum, and Percent of Change.

Three Kinds of Depreciation Schedules.

Using the HP-92 Desktop Investor, you can quickly and easily compute depreciation using the straight line, sum-of-the-years' digits, or declining balance method and you can solve for the crossover.

Powerful Statistical Functions.

The HP-92 contains statistical functions for research and analysis. Both linear and non-linear trends can be closely examined, and mathematic models can be generated to make forecasts.

A Built-In Calendar.

The calendar functions of the HP-92 can determine a future or past date given the number of days from a known date. It will also print the day of the week for any date, and it calculates the exact number of days between dates.

Physical Specifications:

- Width: 22.9 cm (9.0")
- Length: 20.3 cm (8.0")
- Height: 6.4 cm (2.5")
- Weight: 1.1 kg (40 oz)

For a complete list of key features and functions, see the Comparison Chart on page 28.

The HP-92 Desktop Investor comes complete with:

- HP-92 Owner's Handbook
- HP-92 Applications Book
- Recharger/AC Adapter
- Rechargeable battery pack
- Two rolls of thermal paper
- Soft carrying case

Accessories

Optional Accessories

A. Modules

Expands computational capabilities.

- HP-41C Memory Module 82106A
- HP-41C Standard Module 00041-15001

B. DC Adapter/Recharger

Lets you recharge and operate your calculator in your car, boat or plane. Includes two power cables: one for plugging into an automobile cigarette lighter receptacle and one for fastening directly to a 12-volt DC battery.

- HP-31E, HP-32E, HP-33E, HP-33C, HP-34C, HP-37E, HP-38E, HP-38C 82144A
- HP-21, HP-22, HP-25, HP-25C, HP-27 82055A
- HP-35, HP-45, HP-55, HP-65, HP-67, HP-70, HP-97 82054A

C. Reserve Power Pac

Keeps a spare battery pack fully charged. Comes complete with a spare battery pack. A built-in light emitting diode tells you that the battery pack is recharging.

- HP-31E, HP-32E, HP-33E, HP-33C, HP-34C, HP-37E, HP-38E, HP-38C 82103A
- HP-35, HP-45, HP-55, HP-65, HP-67, HP-70, HP-80 82004A
- HP-21, HP-22, HP-25, HP-25C, HP-27, HP-29C 82028B
- HP-91, HP-92, HP-97, 82143A Printer 82037A

D. Security Cradle/Cable

When leaving your HP calculator unattended in the office or lab you can help guard it against theft or unauthorized borrowing by means of a ruggedly constructed security cradle or cable. The security cradle may be attached to your desk via: four corner screws, center screw attachment allowing 360° rotation, removable six-foot steel cable, or extremely hard to remove adhesive tape. (All are supplied.)

- Security Cradle for HP-65, HP-67 82015A
- Security Cradle for HP-21, HP-22, HP-25, HP-25C, HP-27, HP-29C 82029A
- Security Cradle for HP-35, HP-45, HP-55, HP-70, HP-80 82007A
- Security Cable for HP-10, HP-19C, HP-91, HP-92, HP-97, 82143A Printer 82044A

E. Hard Leather Case

Using your HP calculator outdoors? Help protect it by carrying it in this hard leather field case. It guards your calculator against normal environmental conditions in the field—dust, dirt, rain, snow, bumps and jars. Calculator removal is easy with the snap open flap and contoured front opening.

- HP-35, HP-45, HP-55, HP-70, HP-80 82006A
- HP-65, HP-67 82016A

Replacement Accessories

A. Battery Pack

- HP-31E, HP-32E, HP-33E, HP-33C, HP-34C, HP-37E, HP-38E, HP-38C 82109A
- HP-10, HP-19C 82052A
- HP-21, HP-22, HP-25, HP-25C, HP-27, HP-29C 82019B
- HP-35, HP-45, HP-55, HP-65, HP-67, HP-70, HP-80 82001A
- HP-91, HP-92, HP-97, 82143A Printer 82033A

B. Recharger/AC Adapter

- HP-31E, HP-32E, HP-33E, HP-33C, HP-34C, HP-37E, HP-38E, HP-38C 82087B (110 Vac)
- HP-21, HP-22, HP-25, HP-25C, HP-27, HP-29C 82041A (110 Vac) 82026A (110/220 Vac)
- HP-35, HP-45, HP-55, HP-65, HP-67, HP-70, HP-80 82002A (110/220 Vac)
- HP-10, HP-19C, HP-91, HP-92, HP-97, 82143A Printer 82059B (110 Vac)

Outside of the U.S. please contact

Designed to protect and increase the versatility of Hewlett-Packard calculators.

the sales office or dealer nearest you for ordering information on this valuable accessory. Regional addresses appear on the back cover of the DIGEST.

C. Soft Case
- HP-31E, HP-32E, HP-33E, HP-33C, HP-34C, HP-37E, HP-38E, HP-38C
  82110A
- HP-67 (black leather)
  82017A
- HP-91, HP-92, HP-97
  82035A
- HP-41C
  82111A

Supplies

A. Thermal Printing Paper (6 rolls)
- HP-10, HP-19C
  82051A
- HP-91, HP-92, HP-97, 82143A Printer
  82045A

B. Program Card Holders (3)
- HP-65, HP-67, HP-97, 82104A Card Reader
  00097-13142

C. Program Pad
- HP-19C, HP-25, HP-25C, HP-29C, HP-33E, HP-33C, HP-34C, HP-38E, HP-38C, HP-55, HP-65, HP-67, HP-97
  00097-13154

D. Blank Program Cards
- HP-65, HP-67, HP-97, 82104A Card Reader
  - 40 card pac with holder
    00097-13141
  - 120 card pac with 3 holders
    00097-13143
  - 1000 card pac without holders
    00097-13206

E. Overlay Kit for HP-41C
82152A

F. Module Holders for HP-41C (2)
82151A

Software and Literature

For software and literature in languages other than English please contact the sales office or dealer nearest you. Regional addresses appear on the back cover of the DIGEST.

Owner's Handbooks
- HP-31E
  00031-90001
- HP-32E
  00032-90001
- HP-33E/33C
  00033-90039
- HP-34C
  00034-90001
- HP-37E
  00037-90001
- HP-38E/38C
  00038-90038
- HP-41C
  00041-90001
- 82104A Card Reader
  82104-90001
- 82143A Printer
  82143-90001
- HP-67
  00067-90011
- HP-92
  00092-90001
- HP-97
  00097-90001

Applications Books
- HP-33E/33C Applications Books
  - Mathematics
    00033-90030
  - Statistics
    00033-90031
  - Student Engineering
    00033-90032
  - Surveying
    00033-90033
- HP-34C Applications Books
  - Mathematics
    00034-90032
  - Statistics
    00034-90033
  - Surveying
    00034-90034
  - Student Engineering
    00034-90035
- HP-37E, HP-38E/38C Applications Books
  - Real Estate Applications
    00038-90024
  - R.E. II (Income Property Analysis)
    00038-90051
  - Marketing & Forecasting
    00038-90049
  - Lending, Savings & Leasing
    00038-90025
  - Investment Analysis & Statistics
    00038-90026
  - Personal Finance (HP-38E/38C only)
    00038-90052
- HP-41C Standard Applications Book
  00041-90018
- HP-92 Standard Applications Book
  00092-90011
- HP-92 Real Estate & Investment Analysis
  00092-90042

- HP-67/97 Solutions Books—Refer to page 22 for a complete listing of HP-67/97 Solutions Books.
- HP-67/97 Application Pacs—Refer to page 23 for a complete listing of HP-67/97 Application Pacs.
- HP-41C Solutions Books—Refer to page 12 for a complete listing of HP-41C Solutions Books.
- HP-41C Application Pacs—Refer to page 12 for a complete listing of HP-41C Application Pacs.

Comparison Chart

	Programmable								
	Business			Advanced			Scientific		
Type of Calculator	**HP-92** Page 25	**HP-37E** Page 18	**HP-38E HP-38C** Page 19	**HP-67/97** Page 20-21	**HP-41C** Page 10-11	**HP-34C** Page 15	**HP-33E HP-33C** Page 16	**HP-32E** Page 17	**HP-31E** Page 17
Business/Financial	●	●	●	Ⓜ	Ⓜ Ⓡ	●	●	●	●
Scientific/Engineering	●	●	●	●	●	●	●	●	●
Programmable			●	●	●	●	●		
Features/Functions									
Operating Features									
RPN logic system	●	●	●	●	●	●	●	●	●
Automatic 4-memory stack	●	●	●	●	●	●	●	●	●
Error recovery (Last X)	●	●	●	●	●	●	●	●	●
Stack manipulation (R↓)	●	●	●	●	●	●	●	●	●
Maximum number of digits displayed	10	10	10	10	10	10	10	10	10
Number of digits used in computation	10	10	10	10	10	10	10	10	10
Fixed and scientific notation	●	●	●	●	●	●	●	●	●
Engineering notation			●	●	●	●	●	●	●
Automatic overflow/underflow into scientific	●	●	●	●	●	●	●	●	●
Maximum number of storage registers	30	7	20	26	319	21	8	15	4
Continuous memory			38C		●	●	33C		
Rechargeable batteries/AC recharger	●	●	●	●	●	●	●	●	●
Long-life disposable batteries					●				
Software support									
Application Pacs (with modules)					●				
Application Pacs (with mag cards)				●	●				
Solutions Books				●	●				
Users' Library programs				●	●				
Applications book(s)	●	●	●		●	●	●		
Accessory Support									
Memory modules					●				
Reserve power pack	●	●	●	●	●	●	●	●	●
Security cradle/cable	●			●					
One year limited warranty	●	●	●	●	●	●	●	●	●
Display separates 1,000's		●	●		●	●	●	●	●
Diagnostic self-check		●	●	Ⓜ		●	●	●	●
Error codes/messages		●	●		●	●	●	●	●
Reassignable keyboard					●				
Alpha mode/display					●				
Alpha prompts					●				
Status annunciators					●				
Automatic power off					●				
Catalog of functions, programs and peripheral functions					●				
Audible tones					●				
Decimal-octal conversion					●				
Functions									
GENERAL FUNCTIONS									
+, −, ×, ÷, y^x, $\sqrt{x}$, $^1/x$, CHS	●	●	●	●	●	●	●	●	●
Ln x, e^x	●	●	●		●	●	●	●	●
Log				●	●	●	●	●	●
x^2				●	●	●	●	●	
π				●	●	●	●	●	●
Absolute value				●	●	●	●		
Storage register arithmetic	●	●	●	●	●	●	●	●	●
BUSINESS FUNCTIONS									
Maximum number of financial registers	8	5	5						
Present value	●	●	●	Ⓜ	Ⓜ Ⓡ	Ⓐ	Ⓐ		
Future value	●	●	●	Ⓜ	Ⓜ Ⓡ	Ⓐ	Ⓐ		
Payment	●	●	●	Ⓜ	Ⓜ Ⓡ	Ⓐ	Ⓐ		
Number of periods	●	●	●	Ⓜ	Ⓜ Ⓡ	Ⓐ	Ⓐ		
Compound interest rate	●	●	●	Ⓜ	Ⓜ Ⓡ	Ⓐ	Ⓐ		
Simple interest			●	Ⓜ	Ⓐ				
Accumulated interest/remaining balance (amortization)	●	●	●	Ⓜ	Ⓜ Ⓡ		Ⓐ		
NPV (net present value)			●	Ⓜ	Ⓜ Ⓡ	Ⓐ			
IRR (internal rate of return)			●	Ⓜ	Ⓜ Ⓡ	Ⓐ			
Price		●							

This chart has been designed for your convenience in making direct comparisons of the features and functions of the HP calculators described in the preceding pages. For your convenience, page numbers of catalog listings are indicated for each calculator.

	Business		Programmable						
				Advanced			Scientific		
Features/Functions	**HP-92** Page 25	**HP-37E** Page 18	**HP-38E** **HP-38C** Page 19	**HP-67/97** Page 20-21	**HP-41C** Page 10-11	**HP-34C** Page 15	**HP-33E** **HP-33C** Page 16	**HP-32E** Page 17	**HP-31E** Page 17
Rounding	●	●	●	●	●	●	●	●	●
Beginning/end of period selection	●	●	●	Ⓜ	Ⓡ	Ⓐ			
Calendar functions	●		●	Ⓜ	Ⓡ				
STATISTICAL FUNCTIONS									
Means/standard deviations (1 or 2 variable)	●	●	●	●	●	●	●	●	●
Linear regression/estimate	●	●	●	Ⓜ	Ⓡ	●	●	●	●
Summations (n, Σx, Σx^2, Σy, Σy^2, Σxy)	●	●	●	Ⓜ	●	●	●	●	●
Correlation coefficient	●	●	●	Ⓜ	Ⓡ	●	●	●	●
Percent	●	●	●	●	●	●	●	●	●
Percent change	●	●	●	●	●	●		●	
Percent of total	●	●	●	●				●	
Normal distribution			Ⓐ	Ⓜ	Ⓡ	Ⓐ	Ⓐ	●	
Gamma function				Ⓜ	Ⓜ	●			
Factorial function			●	●	●	●		●	
SCIENTIFIC FUNCTIONS									
Solve (rootfinder)				Ⓜ	Ⓡ	●			
Integrate (numerical integration)				Ⓜ	Ⓡ	●			
Metric conversions				Ⓜ	Ⓡ			●	●
Trigonometric functions:									
Modes (degrees, radians, grads)				●	●	●	●	●	●
Sin, Sin^{-1}, Cos, Cos^{-1}, Tan, Tan^{-1}				●	●	●	●	●	●
Hyperbolics and inverses				Ⓜ	Ⓡ	Ⓐ	Ⓐ	●	
Rectangular coordinates ⟷ Polar coordinates				●	●	●	●	●	●
Decimal angle ⟷ angle in degrees (hrs)/min/sec				●	●	●	●	●	
Degrees ⟷ radians				●	●	●	●	●	●
Programming Features									
Maximum number of program lines			99	224	2000	210	49		
Automatic memory allocation			●			●			
User controllable memory allocation					●				
User definable key positions				10	68	2			
User definable alpha labels					●				
Single character alpha labels				10	56	2			
Numeric labels				10	19	10			
Program review (single step, back step)			●	●	●	●	●		
Insert/delete program lines				●	●	●			
Unconditional branching			●	●	●	●	●		
Conditional tests			2	8	10	8	8		
Pause			●	●	●	●	●		
Flags				4	56	4			
Controlled looping				●	●	●			
Levels of subroutines				3	6	6	3		
Indirect control of:									
Data storage and recall				●	●	●			
Alpha storage and recall					●				
Storage register arithmetic				●	●	●			
Branching, looping, display				●	●	●			
Flags					●				
Integer/fraction truncation			●	●	●	●	●		
Alpha string manipulation					●				
Input Output Devices									
"Smart" card reader				●	Ⓟ				
Program card compatability				Ⓒ	Ⓒ				
Records private programs					Ⓟ				
Whisper-quiet printer	●	●		97	Ⓟ				
Battery operable	●	●		97	Ⓟ				
Manual/trace/normal modes				97	Ⓟ				
Alpha and special characters					Ⓟ				
Plotting capability					Ⓟ				
Optical wand (bar code reader)					Ⓟ				

Symbols

Ⓜ Available on prerecorded magnetic program card
Ⓡ Available with ROM (read only memory) Application Pac
Ⓐ Available with magnetic card Application Pac
Ⓟ Available with peripheral
Ⓒ 67/97 ⟷ 67/97, 67/97 → 41C, 41C ⟷ 41C

This Business of Financial Calculators

...or How to Stay Afloat!

We may well be in the age of specialization. Or computerization. Or proliferation. Or any number of equally appropriate tag words depending on which cause you espouse. But one thing is certain. As each day passes, we are privy to more information than was available the day before. And increasingly it has become the advantageous use of information that determines the winners and losers in today's competitive business environment.

The casual business style of your friendly corner grocer has all but faded from view—replaced now by sophisticated methods that demand quick sensitivity to changing conditions. Selling of any kind has progressed to the point where an engaging personality accompanied by a "seat-of-the-pants" approach just isn't enough. Consumers are more informed and competition is better equipped.

With these conditions in mind, it is easy to see why the introduction of financial calculators was so instrumental in the evolution of business concepts and practices. For the first time, practitioners could quickly move past an understanding of basic financial concepts to practical applications—and skip the tedious calculations that were before unavoidable stumbling blocks.

In the scientific community a considerable amount of preparatory formal education is in some way devoted or related to mathematics. While in the business community, education has heretofore been more conceptual, with the majority of any mathematical study being spent in accounting rather than quantitative analysis. This may explain the overwhelmingly favorable reception of programmable calculators within the scientific community and the hesitant, almost resistant attitude of many within the business environs. Many business practitioners are unfamiliar with mathematical and statistical methods and therefore come by their trepidation naturally.

But the scenario is almost analogous to taking your first swim of the day. After the initial plunge you realize the water isn't really cold after all. And when the only way to your desired end is via the water—it becomes a case of sink or swim. Especially in light of the growing emphasis placed on financial calculators by business educators today.

The use of calculators in explaining and teaching basic concepts like the time value of money has increased dramatically since 1970. Today's graduates have a much firmer grasp of business and statistical concepts because they can apply these concepts easily to practical problems using financial calculators. And it may be the competitive pressure of youth with its "calculator advantage" that is forcing older professionals to look a little more closely.

The old saying, "Figures can lie and liars figure" appropriately indicates the sentiment of the old style businessman to the importance of accurate financial information. The average leasing officer or risk manager often found statistical methods too difficult and time consuming. But for the successful practitioner they were regarded much like the successful realtor viewed tables and charts—as a necessary evil.

However, slowly but surely major sectors of the business community have begun to realize the advantages and inevitability of calculator usage in their professional circles.

The real estate profession has taken the lead in the education arena with seminars and classes on calculator usage springing up all over the country. These classes are often one or two day sessions that take the business practitioner through the paces with his machine, showing him the calculator's capabilities and then the applications particular to his specific needs and interests.

But acceptance and use of financial calculators is by no means confined to the real estate profession. Commodities traders have found that financial calculators allow them

to construct and test a variety of different models, trading methods, and systems — which in turn provides the opportunity to evaluate more markets. And with a programmable machine the trader is able to maintain moving averages, analyze momentum and complicated spreads, or identify trends. A distinct advantage in today's fast-paced swirl of choices.

Bankers, under increasing governmental pressure to arrive at proper statements of the APR (annual percentage rate) for loans, are finding the accurate, easy-to-use financial calculator a welcome respite.

And investors, long familiar with the tedious calculations required to make "return versus risk" analyses or to estimate the return on an actively traded portfolio are also awakening to calculator convenience.

The gradual acceptance of financial calculators within the business community is probably best summarized in the comments of a middle-aged realtor after a fairly intensive 8-hour calculator usage seminar: "You know, I've been avoiding this for quite a long time — and now for the life of me, I can't understand why!" Certainly a painless way to remain afloat in today's competitive waters! ■

(Special thanks to Mr. Palmer Berge, C.C.I.M., and Mr. Thomas A. Gauldin, C.M.B., for their assistance.)

Preprogrammed vs. Programmable

To better help you decide which type of advanced financial calculator is right for you it is important to understand the difference between **Preprogrammed** and **Programmable.** And to understand that difference it is helpful to know exactly what is meant by the word "program."

A **program** is nothing more than a sequence of keystrokes that is remembered by the calculator — the exact same keystrokes that you would have to manually execute one at a time in order to solve the same problem unaided.

With that in mind, the rest is easy. A **preprogrammed** calculator has certain popular functions like percent and square root permanently placed in the calculator's function library when it is designed by Hewlett-Packard. These functions can then be executed by pressing a single key.

HP **Programmable** calculators offer an extra convenience. They have the most popular functions preprogrammed into the calculator *and* they offer an additional feature which allows the user to enter other programs of his choosing. Then these "custom" functions can likewise be executed at the press of a key. This is especially helpful by eliminating the drudgery of repetitive or iterative calculations.

With a **programmable** calculator the user can enter specialized business programs that have already been written by Hewlett-Packard, or contributed by other professionals to the HP Users' Library, or even design his own for particular needs. In any event, programmability offers an added dimension to problem-solving. And an easy one at that!

Continued from page 5.

the display is readable, shown in Fig. 5 — is determined at the time of manufacture by the light-emitting diodes and by any lenses that may be between the LED segments and the

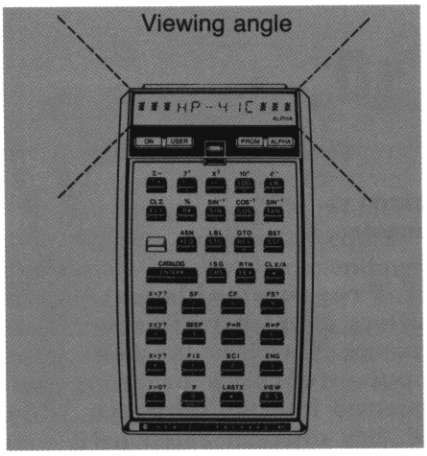


Figure 5

viewer. But the liquid crystals in the LCD are rather temperature-sensitive, and the viewing angle of a liquid-crystal display can actually change with temperature, becoming more narrow as the temperature falls.

Fortunately, the electrical potential — the drive voltage — between the electrodes of a liquid-crystal display also affects its viewing angle, and this can be used to counteract temperature changes. For the HP-41C, Hewlett-Packard engineers designed drive circuitry that also changes with temperature, with the result that the liquid-crystal display in the calculator maintains its full viewing angle over the entire rated temperature range of 0° to 45° C.

Power Requirements

Most of the power in a calculator is usually consumed by the display, and it is here that the liquid-crystal display has an overwhelming advantage over the display made with light-emitting diodes. Since the LCD uses existing light, while the LED must generate its own, the power required to drive an LCD is much less than that used by an equivalent LED display. And while this may not seem significant when operating an instrument from house current, it becomes very important indeed in a portable or battery-operated calculator.

The LCD device in the HP-41C calculator, for example, consumes only about 5 to 10 microwatts of power, while a similar display manufactured using LED devices would gobble up many, many milliwatts. The liquid-crystal display is the most important reason behind this calculator's long battery life—as much as several months of daily operation from a single set of the throwaway power cells.

Alphanumeric Display

It is in the combined alphabetic and numeric display that the use of an LCD device is most effective. The HP-41C calculator display could have been constructed using light-emitting diodes, however there are some 17 elements in this "starburst" pattern, along with an annunciator element and each element would have required a separate LED, driving up manufacturing costs and consuming more power in operation.

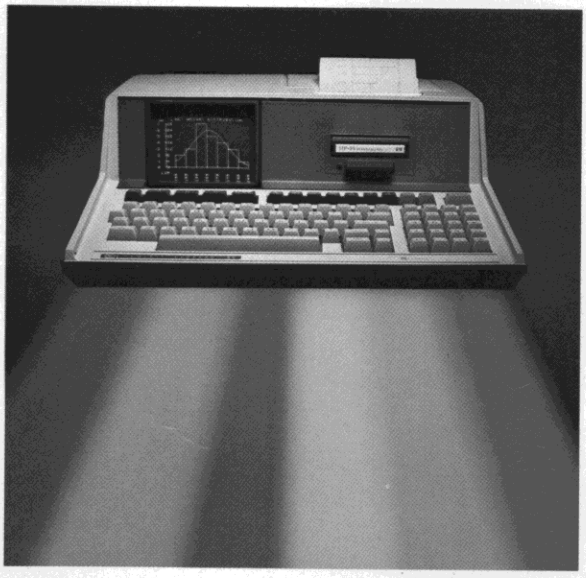
Manufacturing the liquid-crystal display is much simpler. A pattern containing all the elements of the display, including the annunciators, is etched by means of a photographic process onto the two glass plates; these patterns are the electrodes between which the liquid crystal material is activated. The manufacturing process is the same whether the characters are made up of three segments or thirty, so as the number of segments goes up, the cost of the display manufacture remains about the same. In fact, the level of detail of the LCD is limited primarily by the size of the desired segments and by the complexity of the drive signals, not by worries about power consumption or manufacturing expense.

The light-emitting diode is here to stay; in devices with numerical or relatively simple readouts, it remains a reliable, cost-effective display technology. But as calculators progress further along the seemingly countervailing paths of display complexity and longer battery life, you'll be getting more and more information from those gossamerlike films of liquid crystals. ■

THE HP-85: A PERSONAL COMPUTER FOR PROFESSIONALS

In case you haven't heard, Hewlett-Packard now makes a personal computer for professionals. It's the HP-85, a completely integrated computer system designed for personal use. In the lab, on your desk, or in your study, the HP-85 provides professional computing power when and where it's needed. That means no more waiting for data to be processed and returned. A big plus for the professional.

Comparable in size to a portable typewriter, the HP-85 boasts a completely integrated keyboard, CRT display, thermal printer, magnetic tape unit and operating system. And at 20 pounds, it offers the added convenience of portability—true portability.



The HP-85 contains many features not ordinarily found in a personal computing tool. The HP-85's extended BASIC language is easy to use, yet with more than 150 commands and statements, it provides an extremely powerful problem-solving ability.

In addition to a typewriter-like keyset, the keyboard has a numeric keypad, system control and editing keys, and eight "soft" keys that may be defined by the user to select optional courses for program execution.

A highly detailed graphics system is a standard part of the HP-85. And because the 16 graphics statements are integrated into the HP-85's BASIC language, you can draw graphs, label axes, plot data, and control the graphics display either from the keyboard or in programs.

The HP-85 gives you sophisticated computer power at your fingertips. The bidirectional printer is built-in and whisper-quiet. Yet with a single command it will transform display contents into printed copy.

Magnetic tape cartridges supply the HP-85 with high quality digital storage. High search speed and data access rates coupled with automatic tape directories give the HP-85 superior storage capabilities. Each magnetic tape cartridge can hold up to 217K bytes in up to 42 separate files, plus a "catalog" command tells you exactly what is on any tape.

Whether you're in science, engineering, industry or business, the HP-85 you need today can easily be expanded or customized to meet your needs tomorrow. You can double RAM capacity to 32K or expand ROM firmware to 80K with optional modules that plug right into the HP-85.

It's easy to enhance the system's capability by adding powerful HP peripherals like a high speed, full width line printer, full size plotter, or floppy disc drive. You can also streamline your problem-solving with HP Application Pacs which offer preprogrammed solutions in a wide variety of disciplines on prerecorded magnetic tape cartridges.

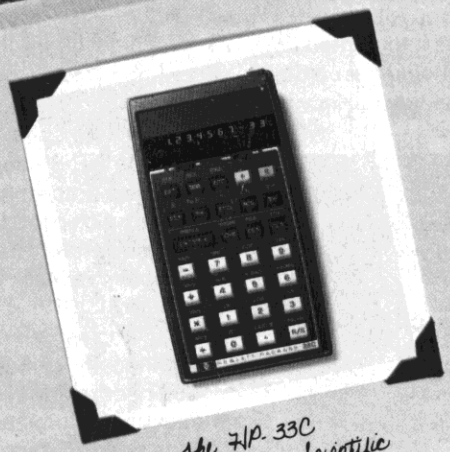
The HP-85's versatility, expandability and sophisticated simplicity all grew out of Hewlett-Packard's underlying principle of *excellence by design.* Excellence that includes rigid quality control and testing as well as a worldwide maintenance support network to ensure continued customer satisfaction.

Want to experience the HP-85 for yourself? Call 800-547-3400 (in Oregon call 758-1010) for the HP-85 Dealer nearest you. Please note: **The HP-85 is not available by mail-order from Hewlett-Packard.** Outside of the U.S. please contact the sales office or dealer nearest you. Regional addresses appear on the back cover of the DIGEST.

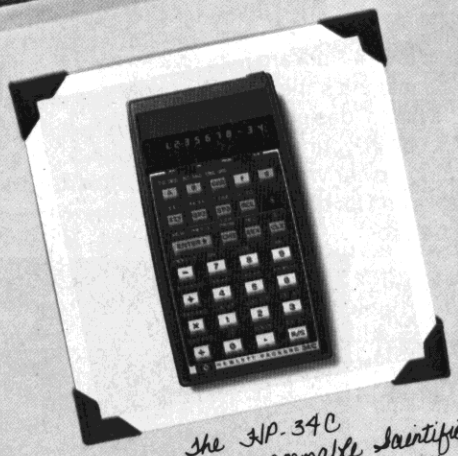
The New "C's" in Our Series E Family!

There are now three new programmable models with Continuous Memory in our Series E family. Each is built with the same excellence by design that is standard in Series E. And each offers the traditional affordability of Series E. But there's one big difference. The difference of Continuous Memory. That's the unique feature pioneered by Hewlett-Packard back in 1975 that retains your programs and data even when the calculator is turned off. A big help for those who frequently use a favorite program.

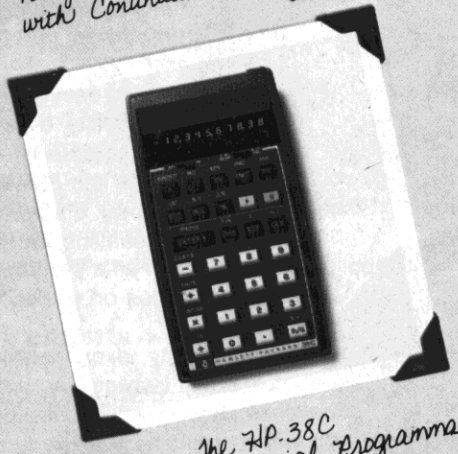
With more members in our family there's certain to be one just right for you. Look inside on pages 14-19 to find the Series E that meets your needs.



The HP-33C
Programmable Scientific
with Continuous Memory



The HP-34C
Advanced Programmable Scientific
with Continuous Memory



The HP-38C
Advanced Financial Programmable
with Continuous Memory

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