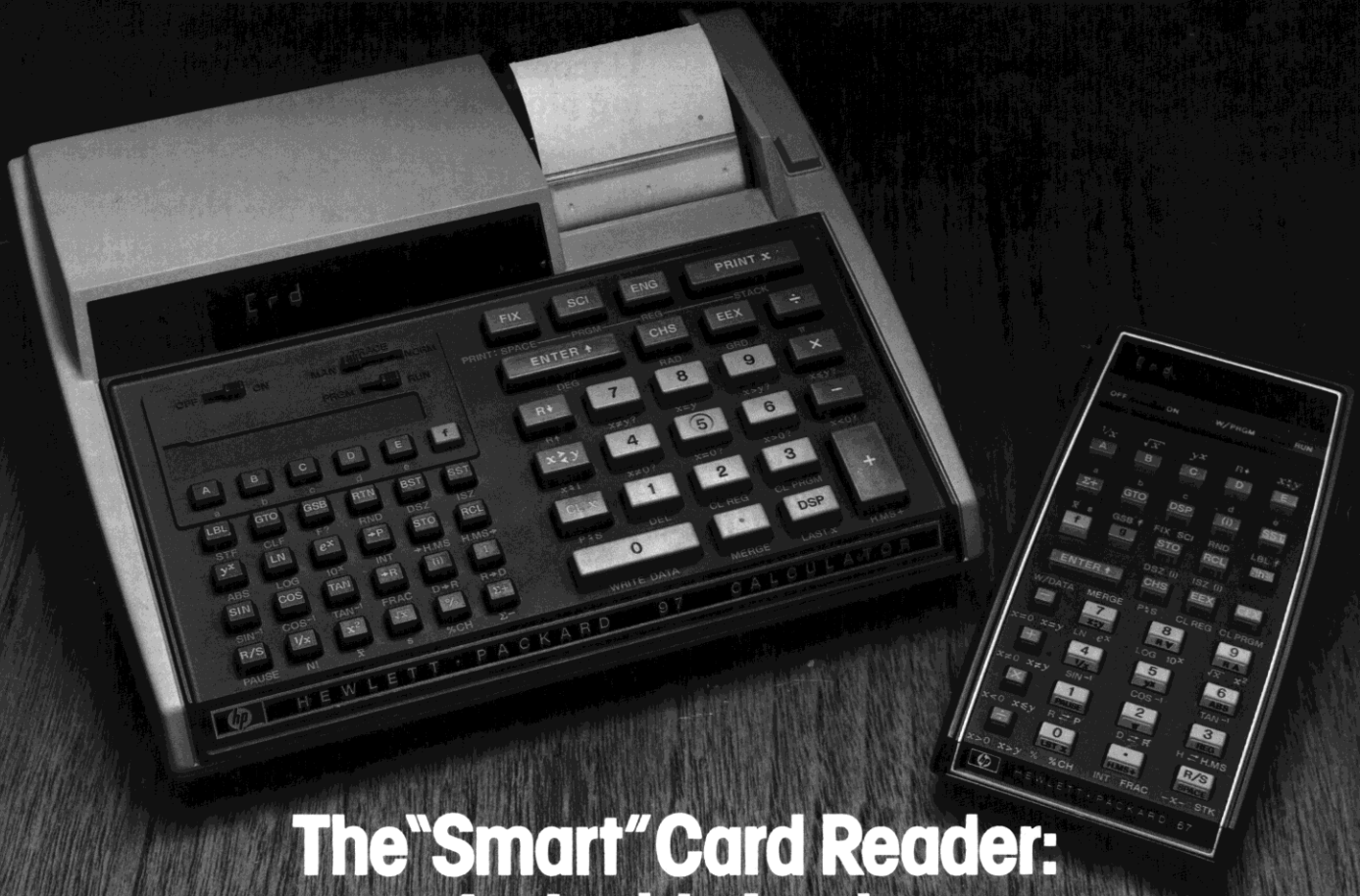


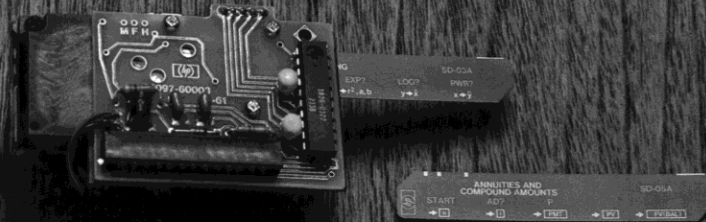
The Hewlett-Packard Personal Calculator DIGEST

The HP Magazine and Product Catalog

Volume Two, 1977



The "Smart" Card Reader: An Inside Look.



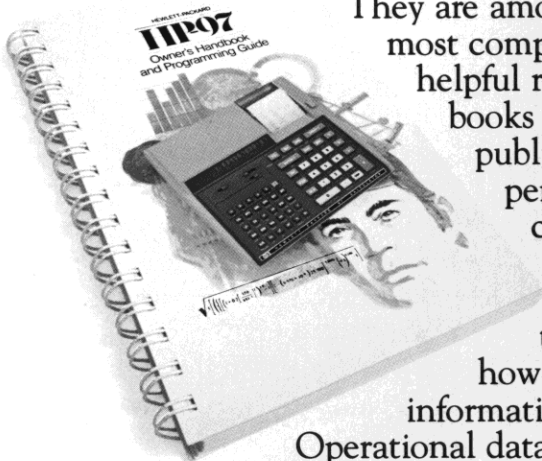
HP CATALOG BEGINS ON PAGE 7!

The hidden values of HP Calculators. They go beyond the price.

When you buy a new calculator by Hewlett-Packard you will quickly discover *four important hidden values.*

Some come in the box. Some do not. All provide significant advantages to you.

Owner's Handbooks that are far more than handbooks.



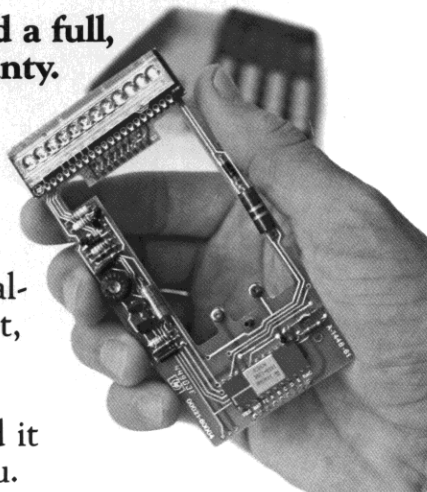
They are among the most complete and helpful reference books ever published for personal calculators, going far beyond the usual how-to-use-it information.

Operational data is given in lavish detail, along with many suggestions for maximum efficiency in use. And there's page after page of practical applications.

Fast service and a full, one-year warranty.

In the unlikely event your calculator fails to operate properly and your HP dealer can't correct it, send it to us.

We'll repair it quickly and send it right back to you.



Uncompromising quality that top professionals rely on.

With an HP calculator, you're in good company. No less than five Nobel Prize winners own and use them. In fact, the first

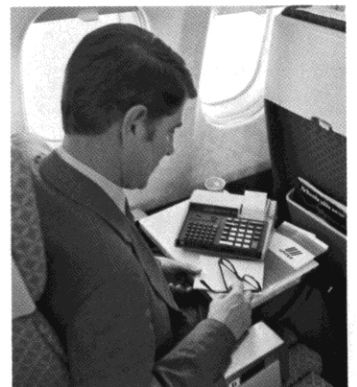


American to climb Mt. Everest packed one in his pocket. And HP calculators have been standard equipment on three manned space flights.

During the USA-USSR link-up in space, they were selected for critical in-flight calculations.

The sheer pleasure of owning an HP Calculator.

Ask the owner of an HP calculator how he likes it and you're apt to detect in his answer a quiet sense of pride. For he has experienced the sheer pleasure of owning an instrument that has been designed—in every detail—to be the finest of its kind in the world.



HEWLETT  PACKARD

Letters

DIGEST Reviews

The last issue of your *Digest* cost me \$472.50 because after reading it there was nothing to do the next morning but wait for the MIT Coop to open and sell me one of their HP-67's.

It's a wonderful instrument and I thought the same about the HP-35 I bought three years ago.

Richard S. Naylor
Associate Professor and
Chairman
Northeastern University
Boston, Massachusetts

I enjoyed your first issue of the *HP Digest*. It was nicely designed, well written, and informative. I particularly enjoyed the articles on C-MOS and RPN.

Marion B. Guerin
Newport Beach, California

Thermal Printing

Thank you very much for sending me a copy of the first volume of the new *Hewlett-Packard Digest*. It is a very interesting edition and one that I enjoyed reading very much. I am quite familiar with the Thermal Printing method which is disclosed on page 4 of the *Digest* publication. I did considerable research work on the synthesis of many of these triphenylmethane lactones and leuco derivatives for use in color duplication schemes. The Crystal Violet Lactone whose structure is pictured on page 5 is generally used today as a colorless carbon paper copy for duplicating purposes. It develops a color on coming in contact with an acidic clay or similar substances.

Walter J. Balon
Woodstown, New Jersey

The Volume One, 1976 issue of the *HP Digest* contains truly impressive information about HP's calculators.

My purpose in writing is really two-fold. I wanted to thank you for including the technical information you did, especially the chemistry of

the thermal printing. I'm constantly looking for practical examples of "chemistry in action," and you've provided one here.

The other reason for writing also concerns the thermal printing chemistry. There is a bit of a mistake in Fig. 2, page 5: Aside from the unfortunate slight upward displacement of the positively charged " $N(CH_3)_2$ " group on the right two structures, the arrows connecting all three structures should indicate resonance, not equilibrium; i.e., instead of showing a pair of oppositely pointing arrows, the figure should have a single double-headed arrow between each pair of structures.

At any rate, thanks for a fine, informative magazine.

John Otto Olson
Associate Professor of
Chemistry
University of Maine
Fort Kent, Maine

EDITOR'S NOTE: Thanks for your help and I'm glad you enjoyed the article.

C-MOS Remembers

I just received my first issue of *HP Digest*. Your format is well done. I especially enjoyed reading the C-MOS Remembers article and would like permission to copy the article for distribution to the members of our Computer Club here at Johnson & Johnson Exploratory Research.

William H. Greenhalgh, M.A.
Dept. of Microbiology
Johnson & Johnson Research
North Brunswick, New Jersey

I have found your first volume of the *Digest* most interesting and helpful. The explanations of thermal printing and the new C-MOS explanations were surprisingly understandable to me, a person without substantial mathematical or scientific background knowledge.

The new HP-25C is an amazing machine at a very modest price, considering its utilitarian value. Is there at this time any intention of developing a "continuous memory" business calculator?

Frederic R. Marschner, CLU
San Francisco, California

EDITOR'S NOTE: If one does come out you'll be the first to hear about it if you continue to read the *Digest*.

That "Backward" Logic System

As I was reading the letters printed in *Digest*, I recalled an interesting experience I had with my calculator.

I am a physics major at California Polytechnic State University. My HP-25 has been a great help to me. One of the students in my dorm, however, has always criticized my HP with its "backward logic." He claimed his scientific calculator with algebraic logic could out-calculate mine. I challenged him to a competition. I found the most difficult problem in the HP-25 Handbook and defied him to do it faster than I could.

We both began pushing buttons madly. After a couple of minutes I completed the problem. A HP-45 owner who was watching asked me if he could do the problem. Five minutes later he had done it. My competitor was lost in his mountain of parentheses. Half an hour later my competitor grumbled something about the problem being irrelevant and stomped out of the room. Needless to say, he hasn't been so critical of HP's "backward logic."

Edward J. McInerney, Jr.
San Luis Obispo, CA

I currently own an HP-25 (and wish I had a 97, but that's another story).

In the great debate over RPN versus algebraic entry, I have never seen it stated that all "algebraic calculators use RPN for log and trig functions." With RPN, you enter a number, then operate; for example 5, log. With algebraic calculators, you don't say log 5; you enter 5, then take the log.

It turns out that "algebraic" scientific calculators are half and half. HP's are the only ones consistent in their method of operation.

J.N. Wooten, McKinney, Texas

Contribute to Digest: The Editors 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, *HP Digest*, Hewlett-Packard Company, Corvallis Division, 1000 N.E. Circle Blvd., Corvallis, OR 97330, U.S.A.

The "Smart" Card Reader: An Inside Look.

Because of the widespread interest in the HP-67 and HP-97 we are re-printing a portion of an article from the November, 1976 Hewlett-Packard Journal entitled "A Pair of Program-Compatible Personal Programmable Calculators."

Among the important features of the HP-67 and HP-97 is the "smart" firmware-controlled card reader. In the HP-65 a program was either recorded on or read from a single side of the card. The HP-67 and HP-97, however, allow both program and data cards to have either one or two sides of meaningful information. The smart card reader allows either side of a two-sided card to be read first and properly stored. If the other side of a card must be read, the display shows CRD to prompt the user. Data and programs from cards are automatically recognized and stored in their proper locations in the calculator. A special merge function allows two programs on separate cards to be merged together in program memory to form a single unit. Either data or program cards can be placed in the reader while a program is running and read automatically under program control. This allows up to 112 additional program steps or selected data registers to be read into the calculator and acted upon without user intervention.

To help reduce programming overhead the status of the calculator is normally initialized automatically when a program card is read. Display format, trigonometric mode, and user flags are set to the state they were in when the card was recorded.

The HP-67 and HP-97 use the card reader developed for the HP-65.

Although one of the more interesting challenges was adapting the card reader to the new desktop package, the basic mechanical design and two-track recording scheme that have previously been described remained unchanged. In the HP-65, however, the control of the card reader was accomplished in an entirely different

fashion. The microprocessor was effectively bypassed during read and write operations and programs were transferred directly between the card reader and the program memory via the interface circuit. The smart card reader in the HP-67 and HP-97 is made possible by the new way that the card reader interacts with the microprocessor under firmware control.

Fig. 1 shows the system organization of the HP-67. When a card is inserted into the card reader the motor switch is activated, setting an input flag on the card reader controller (CRC). The microprocessor, when it is not otherwise busy, interrogates the CRC via the I_S line to see if a card is present. The CRC sends a pulse back to the arithmetic, control, and timing circuit (ACT) on the FLG line, indicating the presence of the card. If the PRGM/RUN switch is in the RUN position and the write data function has not been called for, the firmware sends an instruction to the CRC indicating that a read operation is about to (Cont'd on page 28)

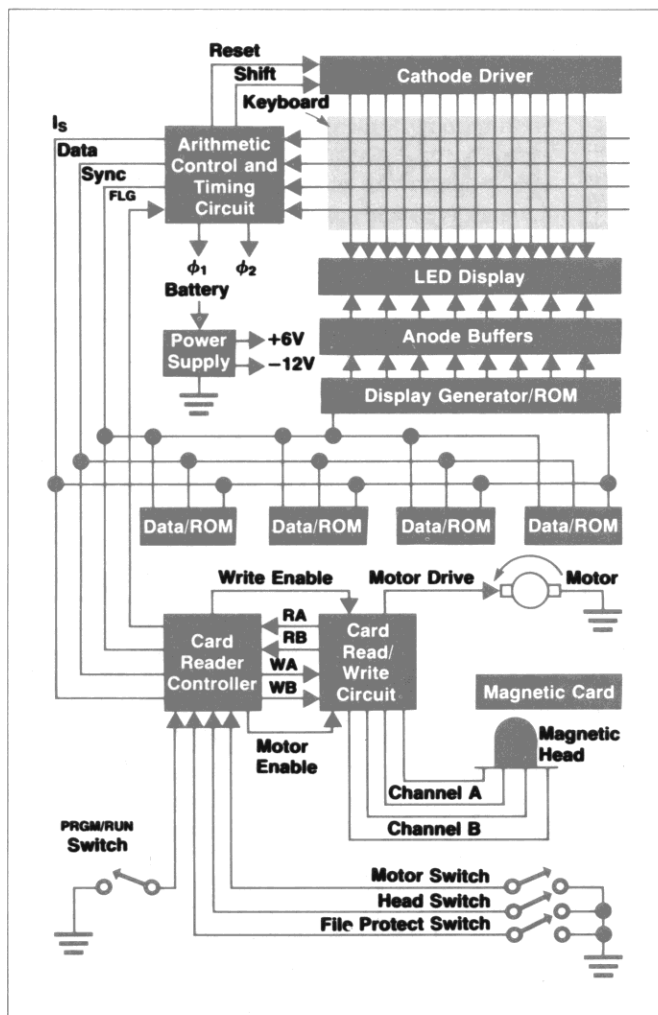
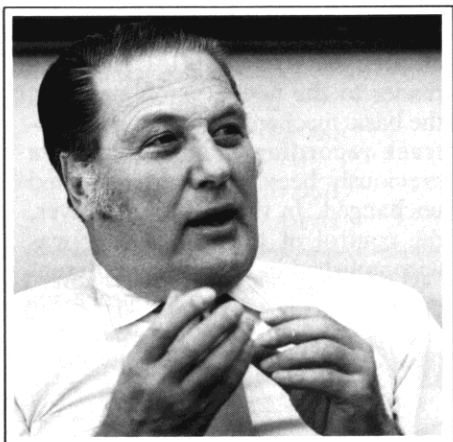


Fig. 1. System organization of the HP-67. The card reader is controlled by the microprocessor so its operation is natural and foolproof

The pocket calculator

By Bernard M. Oliver



BERNARD M. OLIVER. Dr. Oliver is Vice-President of Research and Development at Hewlett-Packard. He received his Ph.D. in Electrical Engineering from the California Institute of Technology. He holds over 50 U.S. patents in the field of electronics and was elected to both the National Academy of Engineering and the National Academy of Science.

No other HP product has had such a profound and widely recognized impact on society and particularly upon the technical segment of society, as the pocket calculator.

It is tempting to describe the pocket calculator as a triumph of modern research and development, but one must be a little careful about making such a statement. It is true that a great deal of research and development preceded the introduction of the first pocket calculators, but most of it had been done for other reasons and for other projects. Integrated circuits had been developed for many applications, both digital and analog, and the large scale integration that made the

Its advent and impact.

M. Oliver

microprocessor possible was a natural extension of the art, driven mainly by the need for cheaper memories and logic circuits. The read-only memory (ROM) that made possible the powerful function-computing capability of the HP-35 and its descendants was developed for computers, and was used in our first desktop calculators. Large scale integration simply enabled us to miniaturize the ROM. Even the LED display had already been developed and needed only to be miniaturized.

In a very real sense the pocket calculator was a natural outgrowth of the general advance in solid state technology. This advance, coupled with the existence in HP labs of several frustrated engineers who had recently mastered the art of designing algorithmic state machines in producing the HP 9100A, made it inevitable that the HP-35 would be conceived and born there.

All this does not mean that there were no engineering problems to be solved. Indeed, there were many. But most were of a more homely and commonplace kind such as: How does one make an inexpensive waterproof keyboard? Or: How does one inexpensively, safely and fully charge nickel-cadmium batteries?

Anything but a "toy."

Because it filled a real need among scientists and engineers, the HP-35 was an instant success. As sales mounted the forewarnings of our market analysts that we were producing a "toy" were quickly forgot-

ten. The overpowering fact was that for the first time in human history a scientist or engineer could carry in his pocket more computing power than was available in any form prior to 1950. In two decades the computer revolution had produced a portable jewel. At a single stroke all the log tables, trig tables and (with the introduction of the HP-80) interest tables that once cluttered the engineer's and financial man's shelves were rendered obsolete. Why bother ever again to tabulate numbers that can be instantly computed?

Students were quick to appreciate the enormous advantage of the HP-35 over the earlier devices such as the slide rule. Greater accuracy, the ability to add, subtract, store results and place the decimal point led to greater speed and accuracy (to coin a phrase).

So great were the advantages offered by the calculator that professors became concerned over the unfairness of a test in which students with calculators competed with others who couldn't afford them. Often calculators were banned. Fortunately the rapidly falling prices made possible by further technological advances and production economics soon placed the calculator within the reach of all students. In real dollars the HP-21 today costs less than the nearest equivalent slide rule did when I was a student.

The four-function revolution.

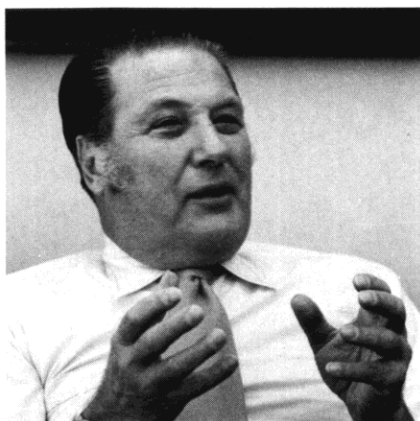
Great as has been the impact of the technical calculator, it is small in our society compared with that of the

simple four-function machine. For every professional calculator sold, dozens of these "four bangers" find their way into the average person's hands. Just as the HP-35 put all the common transcendental functions at the professional's fingertips, so the ordinary calculator makes instant error-free arithmetic available to everyone. Clerks and waiters use them to add bills, housewives use them to compare prices and check the clerks, school children use them to do their homework.

Whenever a new tool of wide utility appears, everyone who grew up with having to do the job the hard way feels relieved. But at the same time he is denied the sadistic pleasure of watching his children endure the same hardships. The use of the pocket calculator by school children is a prime example. Today parents are asking "Is my child really learning arithmetic? In my day we had to practice long division for years. Today all they do is push buttons." I'm sure the same questions were asked when logarithms were invented. Certainly they were when the slide rule came into widespread use.

Something lost; something gained.

Whenever such an innovation occurs something is lost and something is gained. I think we must be prepared to find our children less facile than we at carrying out arithmetic operations in longhand; they will have had less practice. But for the same reason more of their time can have been spent learning the *concepts and principles*, not only of arithmetic, but



"It is not out of the question that portable machines having the ability to do algebraic problems and even symbolic calculus will be available before the end of the century."

of higher mathematics as well. Many young people used to be turned off early by the drudgery of arithmetic or later by the boredom of interpolating in log and trig tables. These youngsters developed emotional blocks that have made them hate math. Today there is no need for this; an arc cosine is as accessible as an integer.

As I look back on my own schooling I think one of the things that motivated me in math was the opportunity I had to play with a rotary calculator in my father's office after school. Although I had to do my homework longhand, this did not bother me much because I knew when I grew up I could have a calculator. Well, I have. Most everybody has. What's more, the calculator's internal program takes square roots the same way I learned to do it on that old rotary machine.

It is my firm belief that the pocket calculator will lead to a more widespread familiarity with mathematics, not just arithmetic, but higher math as well. This in turn could lead to a more common ability to reason quantitatively, and thereby a more widespread understanding of the size and nature of our universe.

A servant, not a master.

An interesting side effect of the calculator is that the fear of the computer has largely disappeared. A few years ago newspaper articles depicted computers running our lives. Today everyone feels he owns a computer—a little one, to be sure—and

it doesn't bite and it's very cooperative. As programmable calculators become more popular this familiarity with and understanding of the computer will increase. The average person will come to understand that computers only do what they are told and they do it more faithfully than any human servant. Further, the discipline of programming is valuable in itself; it leads to orderly habits of thought.

The HP 9100 desktop calculator appeared in 1968. Twenty years earlier its computing power could not be matched by a room full of equipment costing a million dollars. Five years later the HP-65 put the equivalent of the 9100 in your pocket. Will this trend continue and, if so, how far? So far as the heart of the pocket calculator is concerned—the memories and the microprocessor—the computing power of the pocket calculator could be increased an order of magnitude today. The real problem is that this much of an increase cannot be accessed conveniently. In computer jargon, the pocket calculator is severely I/O limited: one cannot enter large amounts of data conveniently nor print or display it in proper format. Further, the pocket calculator handles only numbers. To really make it useful in other areas where larger calculators and computers are used, it should handle alphabetic characters as well.

The pocket computer next?

When our technology allows us to display many numbers and a great

deal of text at one time with lower power drain, and when we learn how to enter the data from a compact, uncluttered keyboard, we will enter a new era: that of the pocket computer.

Large amounts of non-volatile memory would allow complete letters or dissertations to be stored for later viewing and revision or for automatic typing back at the office. In *Imperial Earth**, Arthur Clarke's hero carries a "minisec" into which he enters all his observations, plans and problems. Clarke's minisec was voice operated. That is some time in the future, but the manually operated minisec may not be so far off.

A calculator with alphabetic capability can, in principle, do symbolic mathematics as well as numeric calculations. It is not out of the question, indeed it is probable, that portable machines having the ability to do algebraic problems and even symbolic calculus will be available before the end of the century. When this happens an even more drastic change will occur in the teaching of mathematics. Again, the need will arise to distinguish between the learning and the principles being learned and to emphasize the latter.

Stanley Kubrick, director of 2001, *A Space Odyssey*, was an early purchaser of an HP-35. He wrote me a letter of praise and ended by saying that the HP-35 would do for now, but what he really wanted was a pocket machine that told him what to do next. Even at the present rate of progress, I doubt if Kubrick can ever have that machine.

* *Imperial Earth*, Arthur C. Clarke; Ballantine Books, New York; 1976.

The 1977 Hewlett-Packard Catalog And Buyer's Guide to Personal Calculators.

The Buyer's Guide: Pages 8-9

This guide lists every feature and function found in all HP Personal Calculators. You will find the list extremely useful in determining specific features and functions on any unit and for making fast direct comparisons of two or more units.

The Catalog: Pages 10-25

The catalog provides a description of each HP Personal Calculator with emphasis on its special capabilities and applications in meeting user requirements. Also given are physical specifications and accessories furnished with each unit.

How to order from this Catalog:

You may order any HP Calculator in this catalog by contacting your nearest HP sales office or distributor. For the name of the office nearest you, write Hewlett-Packard Company. Addresses appear on the back cover of this magazine. If, after that time, you are not satisfied with the unit—for any reason—simply return it for a prompt refund in full or for credit toward any other Hewlett-Packard calculator.

Buyer's Guide

Features/Functions

	HP-25/25C PAGE 10	HP-21 PAGE 12	HP-91 PAGE 13	HP-80 PAGE 14	HP-22 PAGE 15	HP-27 PAGE 16	HP-67 PAGE 18	HP-97 PAGE 18
RPN Logic System								
Memory								
Automatic four-memory stack								
Addressable memory	8	1	16	1	10	10	26	26
Financial memory					5	5		
Last x memory								
Program memory	49						224	224
Continuous memory (program and data)	25C only							
Positioning Operations								
Stack roll down								
Stack roll up								
x, y memory exchange								
x, I memory exchange								
Display								
Fixed notation								
Scientific notation								
Engineering notation								
Automatic overflow into scientific								
Automatic underflow into scientific								
Enter exponent								
Change sign								
Improper operating and low battery indicators								
Special Features								
Rounding								
Calendar								
Programming Features								
Program review—back step								
Program review—single step								
Insert/delete								
Overwrite								
Direct branching								
Pause								
Conditional tests	8						8	8
Flags							4	4
DSZ, ISZ (looping)								
3 levels of subroutines								
Smart card reader:								
Stores programs and data								
Merges programs and data								
Automatic prompting								
20 labels								
10 user-definable functions								
Indirect control of:								
Data storage and recall								
Storage arithmetic								
Unconditional branching								
Subroutine branching								
DSZ, ISZ								
Display								
Relative addressing								
Clearing Options								
Clear x								
Clear stack								
Clear all								
Clear addressable registers								
Clear statistical registers								
Clear prefix								
Clear program memory								
Reset financial registers								
Printing Features								
Print x								
List stack registers								
List addressable registers								
List statistical registers								
Paper advance								
Three print modes								
Print space								
List program								

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

Features/Functions	HP-25/25C PAGE 10	HP-21 PAGE 12	HP-91 PAGE 13	HP-80 PAGE 14	HP-22 PAGE 15	HP-27 PAGE 16	HP-67 PAGE 18	HP-97 PAGE 18
Built-in Statistical Functions								
Mean and standard deviation (number of variables)	1	2	2	1	1	2	2	2
Trend line							•	•
Linear regression							•	•
Linear estimate							•	•
Factorial							•	•
Summations								
(n, Σx , Σx^2)								
(n, Σx , Σx^2 , Σy , Σxy)								
(n, Σx , Σx^2 , Σy , Σy^2 , Σxy)								
Correlation coefficient							•	•
Variance							•	•
Normal distribution							•	•
Built-in Financial Functions								
Number of periods							•	•
Interest rate/period							•	•
Payment/period							•	•
Present value							•	•
Future value							•	•
Simple interest							•	•
Accumulated interest							•	•
Remaining balance							•	•
Bond prices, yield							•	•
Rule of 78's interest rebate							•	•
Net present value							•	•
Internal rate of return							•	•
Beginning/ending period switch							•	•
Built-in Scientific Functions/Mathematics								
Trigonometric:								
Decimal degrees mode								
Radians mode								
Grads mode								
Sin x, Sin ⁻¹ x, Cos x, Cos ⁻¹ x, Tan x, Tan ⁻¹ x								
Rectangular coordinates ↔ Polar coordinates								
Decimal angle (time) ↔ Angle (time) in deg (hr.)/min/sec								
Angle in degrees ↔ Angle in radians								
Angle (time) arithmetic								
Logarithmic:								
Log x, 10 ^x								
Ln x, e ^x								
Metric Conversions:								
Inch ↔ Millimeter							•	•
Btu ↔ Joule							•	•
Foot ↔ Meter							•	•
Gallon ↔ Liter							•	•
Pound ↔ Kilogram							•	•
Force in pounds ↔ Newton							•	•
Fahrenheit ↔ Celsius							•	•
Other:								
y ^x								
√x								
1/x								
x ²								
π								
%								
Δ%								
%Σ							•	•
+, -, ×, ÷								
Absolute value								
Integer/fraction truncation								

• Not a built-in function, but available on pre-recorded magnetic program cards.

HP-25C

**Scientific Programmable Pocket Calculator
with Continuous Memory.**

Retains your programs and saves your data—even when you turn it off.

The continuous memory capability of the HP-25C can provide tremendous values in time-saving and convenience to any scientist, engineer or student who uses a few long programs repeatedly—for example, if twenty percent of your programs will solve most of your problems.

The HP-25C retains a program—no matter how often you switch it on and off—by means of sophisticated complementary metal-oxide-semiconductor circuitry (C-MOS). The last program you store is saved, ready for use, until you clear it or enter a new program.

As a result, you can program a frequently-needed calculation once, and then perform it as often as necessary—hour after hour, day after day—without the bother or lost time caused by reentering your program.

**Lets you add special functions
not on the keyboard.**

Continuous memory makes it possible to add specialized functions to those already preprogrammed into the HP-25C.

For example, if you anticipate extensive work with hyperbolics, you can program them into the

HP-25C where they will be retained by the continuous memory for repeated calculations at the touch of a key.

Many specialized functions can be programmed into the HP-25C for fast keystroke calculations, including conversions such as decimal degree/radian, octal/decimal; statistical functions; pricing analysis functions; real estate functions; business functions and many others.

Remembers data collected for later use.

The HP-25C with continuous memory not only retains all information in its 49-step program memory, it also retains all data in the 8 addressable registers and the LAST-X register.

This capability lets you use the HP-25C as a notebook to save data from previous problems for later use or to keep the sum of statistical data entries while taking samples in the field. For example, surveyors doing traverses in the field can keep intermediate results even while the calculator is turned off between readings.

Engineers will find the HP-25C convenient in storing conversion constants until needed later.

Power economy greatly extends battery operating time.

Since the HP-25C may be switched off between calculations without losing programs or data, battery operating time can be significantly extended.

Even when changing batteries, the HP-25C will retain your programs and data. When batteries are removed a capacitor temporarily furnishes power to the continuous memory circuits. Depending on the charge of the battery being replaced, time available for the exchange is between 5 seconds and 2 minutes.

The extended battery operating time made possible by C-MOS circuitry makes the HP-25C ideal for many uses in the field where time between data collections is prolonged; for example, navigation, surveying, and many other applications.

The HP-25C and the HP-25 solve repetitive problems quickly and easily.

Both the HP-25C and the HP-25 have all the advanced features described below.

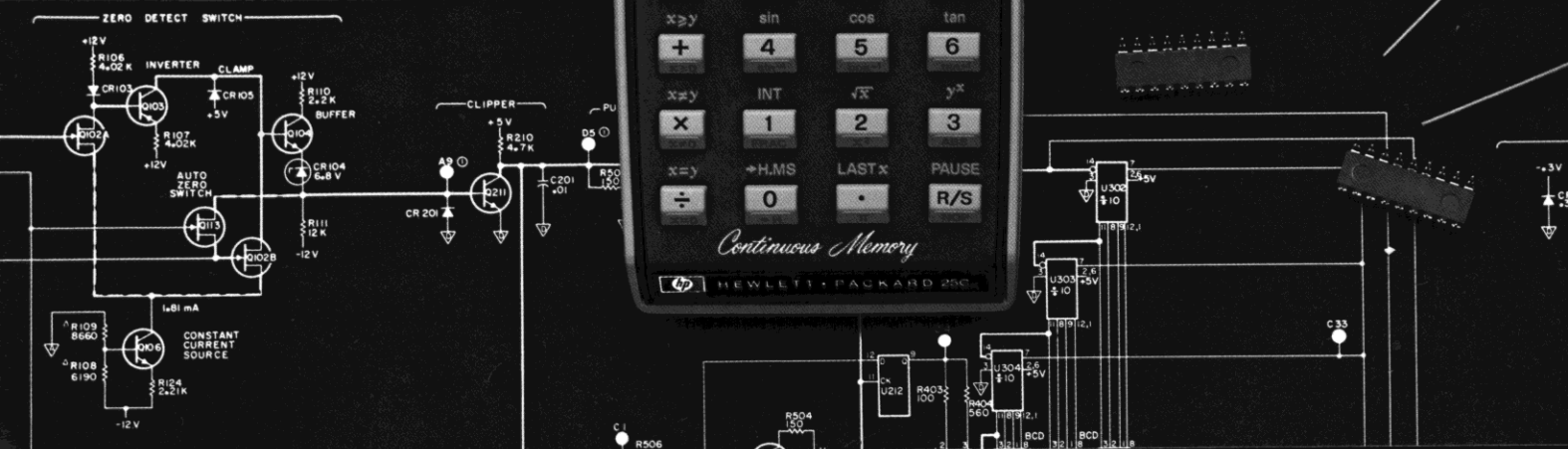
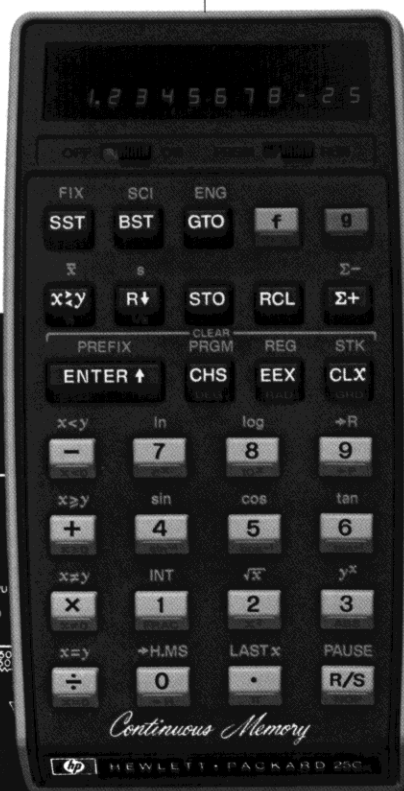
To write a program simply set the HP-25/25C to PRGM mode. Then press the keys you'd normally press to solve the problem. Your program is retained in the HP-25/25C's program memory.

To solve the problem, switch to RUN mode and enter the data. Then press the "Run/Stop" key. Your answer appears on the HP25/25C display. To solve other problems using the same program, just enter the new data and press the "Run/Stop" key again.

Memory review.

The “BackSTep” and “Single-STep” keys let you review the entire memory one step at a time, in either direction.

If you want to change your program, simply stop it at the appropriate step and key in a new entry, which will overwrite the previous one. To test your program a step at a time, switch to RUN and press "SST" repeatedly. You will see its numeric code when you press the key and the intermediate solution when you release the key.

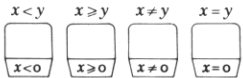


HP-25

Decision branching.

Like a computer, the HP-25/25C can be programmed to make decisions, because they can do conditional branching.

You can program them to test the relationship between two values, by means of these tests:



Depending on the outcome of the tests, the HP-25/25C will automatically skip a step of the program ... or it will continue through the program in sequence.

Or, by means of the "GoTO" key, you can program the HP-25/25C to branch directly to a specified step, and then continue executing the program.

Pause feature.

Another feature of the HP-25/25C is the "PAUSE" key. You can use it to momentarily interrupt (about one second per PAUSE command) the program execution and display the contents of the X register. This gives you the opportunity to review or write down intermediate results.

Absolute and Truncation functions.

The ABSolute value function allows you to take the absolute value of a number within a programmed calculation.

The INTeger/FRAction truncation function allows you to keep only the integer or fractional portion of a number. These functions are especially useful in base conversion, random number generation, or for storing two numbers in one memory.

Extra trigonometric capability.

Rectangular/polar coordinate conversions: you can convert rectangular coordinates to polar coordinates or vice versa, enabling you to do vector arithmetic quickly, easily and accurately. Angle (time) conversions: You can convert angles (times) in decimal degrees (hours) to angles (times) in degrees (hours)/minutes/seconds ... or vice versa.

Of course the HP-25/25C also provide the six basic trig functions—sin x, arc sin x, cos x, arc cos x, tan x, arc tan x.

Logarithmic functions.

The HP-25/25C compute both natural and common logarithms as well as their inverse functions (antilogarithms).

Extra statistical capability.

Summations: The " Σ +" key automatically calculates n , Σx , Σx^2 , Σy , Σxy for statistical and vector calculations. Data may be deleted via the " Σ -" key.

Mean and standard deviations: The HP-25/25C also calculate the mean and standard deviation of a group of data.

You can display decimal, scientific or engineering notation.

The HP-25/25C will display in fixed decimal and scientific notation, common in many scientific calculators. It will also display values in engineering notation with exponents that are multiples of 3. This is useful in working with many units of measure, such as kilograms (10^3), nanoseconds (10^{-9}), etc.

Superior HP memory power.

In addition to the four operational stack memories and a last-x memory, the HP25/25C provide 8 addressable memories for data storage. The memories may also be used for register arithmetic.

A free applications book.

The Applications Programs Book contains 54 programs drawn from the varied areas of number theory, trigonometry and analytical geometry, statistics, finance, surveying, and navigation. Thus, whether your interest lies in solving a particular problem, or in learning more about the programming power of your calculator, this free book will help you get the most from your HP-25/25C.

HP-25/25C Physical Specifications

- Calculator length: 130.2 mm (5-1/8")
- Calculator width: 68.3 mm (2-11/16")
- Calculator height: 30.2 mm (1-3/16")
- Calculator weight: 170.1 g (6 oz.)
- Recharger weight: 141.8 g (5 oz.)
- Shipping weight: 680 g (1-1/2 lb.)
- Operating temperature range: 0°C to 45°C (32°F to 113°F)
- Charging temperature range: 15°C to 40°C (59°F to 104°F)
- Storage temperature range: -40°C to 55°C (-40°F to 131°F)
- Power requirements: AC: 115V or 230V $\pm 10\%$, 50 to 60 Hz
- Battery: 2.5 Vdc nickel-cadmium rechargeable battery pack

For a complete list of features and functions, see the Buyer's Guide on Page 8.

The HP-25 Scientific Programmable Pocket Calculator

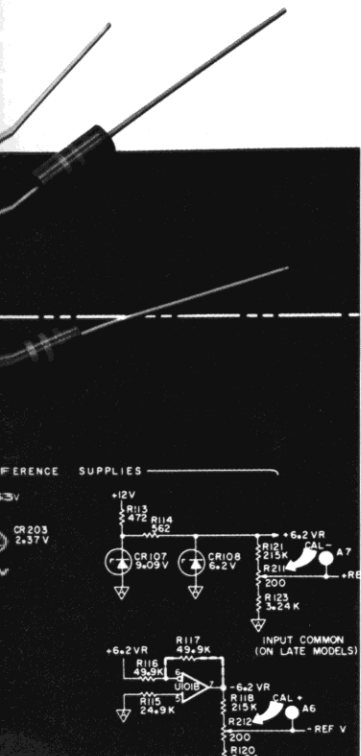
The HP-25 is identical in every respect to the HP-25C except for continuous memory. It is the logical choice for scientists, engineers or students who do not frequently use a few long programs in their work.

The HP-25 Scientific Programmable Pocket Calculator comes complete with:

- Rechargeable battery pack
- Recharger/AC adaptor
- Soft carrying case
- Illustrated Owner's Handbook
- Application Programs Book
- Quick Reference Guide

The HP-25C Scientific Programmable Pocket Calculator comes complete with:

- Rechargeable battery pack
- Recharger/AC adaptor
- Soft carrying case
- Illustrated Owner's Handbook
- Applications Programs Book
- Quick Reference Guide
- Continuous Memory Booklet



HP-21

Scientific Pocket Calculator.

Extraordinary problem-solving power plus HP quality at an economical price.

The HP-21 is the lowest-priced scientific pocket calculator HP offers, yet it has all the functions and features you'd expect to find in a scientific pocket calculator.

More trigonometric capabilities.

Coordinate conversions—Convert polar coordinates to rectangular coordinates, or vice versa. This lets you do vector arithmetic quickly and easily.



Angular mode selection—Just flip a switch to perform trig operations in either of two angular modes: degrees or radians. You can also convert angles from one mode to the other, push-button fast.

Standard trig functions—The HP-21 gives you all of the standard trig functions: Sin x, Arc sin x, Cos x, Arc cos x, Tan x and Arc tan x.



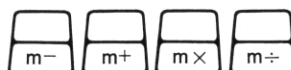
Logarithmic capabilities.

Standard log functions—The HP-21 also gives you all of the standard log and exponential functions: log x, ln x, e^x and 10^x.



Full register arithmetic.

Register arithmetic—The HP-21 has an addressable memory for storing constants or other data, for use later on in a calculation. Any of the four arithmetic operations may be performed directly upon this stored data.



The 120-page HP-21 Application Book. \$10.

Contains major sections on statistics, mathematics, finance, navigation, surveying, conversions. Provides 50 valuable applications to help you get the most from your HP-21 Scientific Calculator.

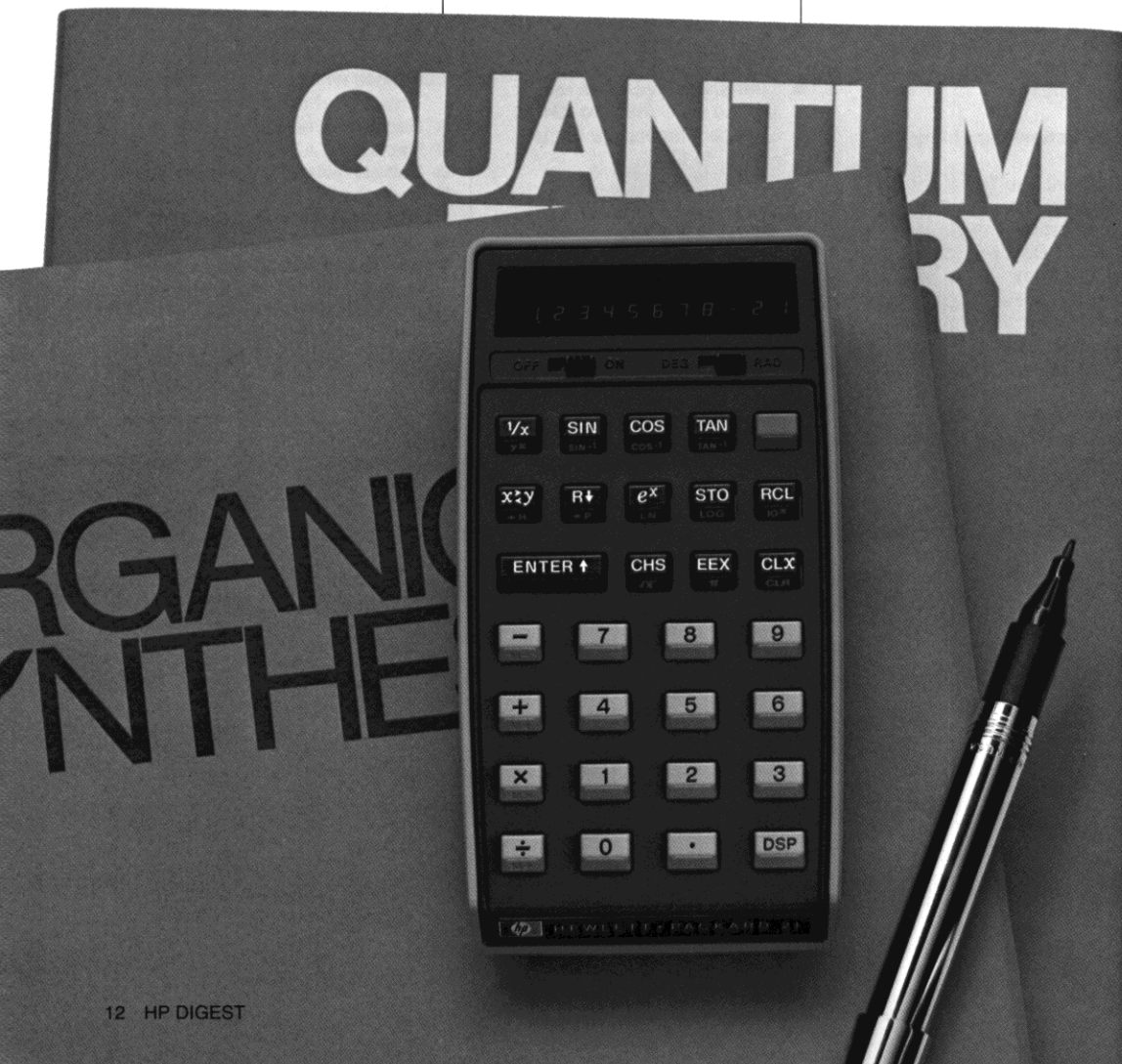
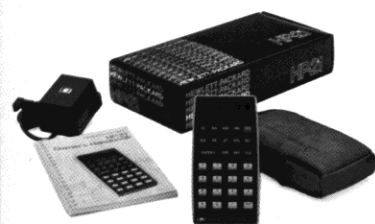
Physical Specifications:

- Calculator length: 130.2 mm (5-1/8")
- Calculator width: 68.3 mm (2-11/16")
- Calculator height: 30.2 mm (1-3/16")
- Calculator weight: 170.1 g (6 oz.)
- Recharger weight: 141.8 g (5 oz.)
- Shipping weight: 680 g (1-1/2 lb.)
- Operating temperature range: 0°C to 45°C (32°F to 113°F)
- Charging temperature range: 15°C to 40°C (59°F to 104°F)
- Storage temperature range: -40°C to 55°C (-40°F to 131°F)
- Power requirements: AC: 115 V or 230 V, ± 10%, 50 to 60 Hz
- Battery: 2.5 Vdc nickel-cadmium rechargeable battery pack.

For a complete list of features and functions, see the Buyer's Guide on page 8.

The HP-21 Scientific Pocket Calculator comes complete with:

- Rechargeable battery pack
- Recharger/AC adapter
- Soft carrying case
- Illustrated Owner's Handbook



HP-91

Scientific Printing Calculator.

The first battery-operated scientific calculator that delivers a printed record of all your calculations—wherever you go.

The HP-91 Scientific Printing Calculator provides you with a full range of scientific and arithmetic functions—complete with a printed record—all in one compact calculator. And because the HP-91 prints and operates on AC or its own built-in batteries, you can use it anywhere—in the office or the remotest field locations.

Quiet thermal printer provides a complete record of your calculations.

The thermal printing system of the HP-91 records and labels your calculations on heat sensitive paper. Because the HP-91 can print all your calculations, you can print—with labels—statistical summations, contents of the operational stack, or the contents of all sixteen addressable memories.

You select from three printing modes.

With switch set to ALL, the printer will show all entered data, functions, intermediate and final answers. With the switch set to NORMAL, the printer will record entered data and functions only. With switch set to MANUAL, the printer will operate only when you press the Print X key or a list function.

You may operate on battery or AC.

The HP-91 thermal printing system allows you to operate on batteries alone for between 3 and 7 hours, depending on extent of printer use. The AC adapter/recharger lets you operate from electrical outlets while batteries are being recharged.

You can display and print in decimal, scientific or engineering notation.

The HP-91 will print and display in fixed decimal and scientific notation, common in many scientific calculators. It will also print and display in engineering notation, an exclusive HP feature that displays values with exponents that

are multiples of 3. This is useful in working with many units of measure, such as kilograms (10^3), nanoseconds (10^{-9}), etc.

Compact design and light weight for easy portability.

Total weight of the HP-91 without AC adapter/recharger is only 2½ pounds. It will fit into a standard briefcase so you can operate it while you travel in airplanes, taxis, anywhere. A built-in metal tab lets you secure it to your desk easily with a cable or bolt. (A special cable and lock is available as an optional accessory.)

All the most-needed scientific functions—preprogrammed for speed and accuracy.

The HP-91 provides about the same preprogrammed functions found on the widely-used HP-45 pocket calculator—with the added advantage, of course, of a printed record of all your calculations. Its math capabilities include log and trig functions (the latter in degrees, radians or grads), rectangular/polar conversions and three separate percentage functions. Its statistical capabilities include summations, mean and standard deviation,

linear regression, linear estimates (all for two variables) and factorial. All this, plus sixteen addressable registers, an automatic four-register stack, a Last-x register for easy error recovery and four clearing options.

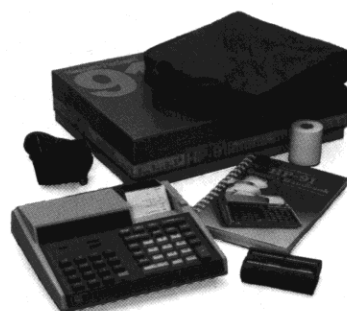
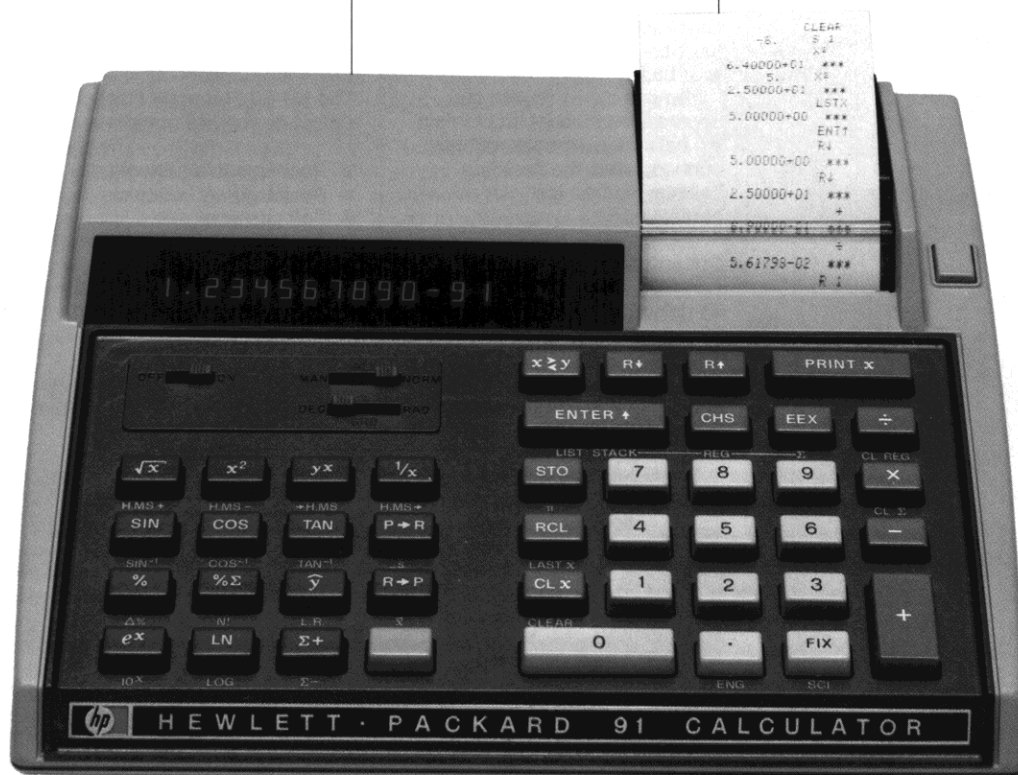
Physical Specifications:

- Width: 228.6 mm (9")
- Depth: 203.2 mm (8")
- Height: 63.5 mm (2.5")
- Weight: 1.13 kg (2.5 lb)
- Recharger weight: 268 g (9.5 oz)
- Shipping weight: 3.16 kg (7 lb)
- Operating temperature range: 0°C to 45°C (32°F to 113°F)
- Charging temperature range: 15°C to 40°C (60°F to 104°F)
- Storage temperature range: -40°C to 55°C (-40°F to 131°F)
- Paper temperature range (operating & storage): 10°C to 30°C (50°F to 86°F)
- AC Power Requirements: 90-127V or 200-254V 50-60 Hz
- Battery: 5.0 Vdc nickel-cadmium rechargeable battery pack

For a complete list of features and functions, see the Buyer's Guide on page 8.

The HP-91 Scientific Printing Calculator comes complete with:

- Battery pack that under normal use provides 3 to 7 hours of continuous operation and fully charges in under 10 hours.
- Recharger/AC adapter that lets you operate the calculator on AC while the battery pack is recharging.
- Soft carrying case with handle.
- Illustrated Owner's Handbook with instructions and applications section.
- Thermal paper (2 rolls).



HP-80

Financial Pocket Calculator.

Specialized features, including bond prices & yields, depreciation, a 200-year calendar, and a comprehensive application book.

The HP-80 Financial Pocket Calculator lets you solve business math or time-and-money problems quickly and easily.

All the interest equations and tables have been built-in. So has a 200-year calendar, used in solving for bond price and yield, or short-term interest.

It's designed to handle general business math problems.

Percentages.

The “%” and “Δ%” keys allow you to easily handle problems concerned with: percentages; net amounts (markups, discounts, chained discounts, dealer discount ratios, anticipation discounts, etc.); and percent difference.

Just press the keys to solve time-and-money problems in seconds.

At the top of the HP-80's keyboard are five keys for solving all types of business problems.

These financial keys save you time and effort when calculating: Amortized (direct reduction) loans (ordinary annuity); Sinking funds (ordinary annuity); Consumer loans; Savings functions (annuity due); Lease and rent functions (annuity due).

Discounted cash flow analysis.

You can quickly and easily perform a discounted cash flow analysis, and calculate the net present value of even, uneven or deferred payment streams.

The HP-80 can also be used to calculate the discounted or internal rate of return.

Equity investment analysis for income property.

You can use the calculator to solve for: equity yield rate; equity investment value and present value; and future value and overall appreciation/depreciation rate.

Bond functions.

The HP-80 has built-in function keys for bond calculations: “Yield-To-Maturity,” “INTeRest” and “BOND”. You can calculate bond price, yield and after-tax yield, accrued interest (between coupons) and bond amortization. You can also calculate a callable bond price and yield-to-call.

Commercial loans (short term notes).

The HP-80's “INTeRest” key lets you calculate the accrued interest amount or the discount amount and annual yield for a discounted note (for either a 360- or 365-day year).

Calendar functions.

This key puts a 200-year calendar (1900 to 2099) at your fingertips. You can find: the number of calendar days between two dates; the day of the week a date falls on; a future date, or a past date, given the number of days from a known date.

Depreciation functions.

The HP-80 incorporates a unique key labeled “SOD” for calculating sum-of-the-years'-digits depreciation—amount and remaining balance—on a full-year or partial year basis.

You can also calculate the depreciation amount and remaining balance via the straight-line method, or via the declining-balance method (full year or partial year).

Statistical functions.

By using the “Trend Line” key, you can easily calculate: a trend line (time series linear regression) giving you the y-intercept (value at point 0); the number of time periods; the slope; and automatic projections.

The HP-80 can also calculate: the mean and the standard deviation, with the ability to change data points after a calculation and recalculate. The “Σ+” key provides running totals and computes the sum of the squares and the number of entries.

Memory power.

In addition to the four-memory stack, the HP-80 has an addressable memory for storing constants or other numbers to be used later on in a calculation.

The financial application book.

With the HP-80 you get a 101-page book offering dozens of keystroke sequences—including Annual Percentage Rate calculations with balloon payments—that benefit brokers, investors, appraisers, assessors, mortgage bankers, analysts and other decision makers in investment analysis.

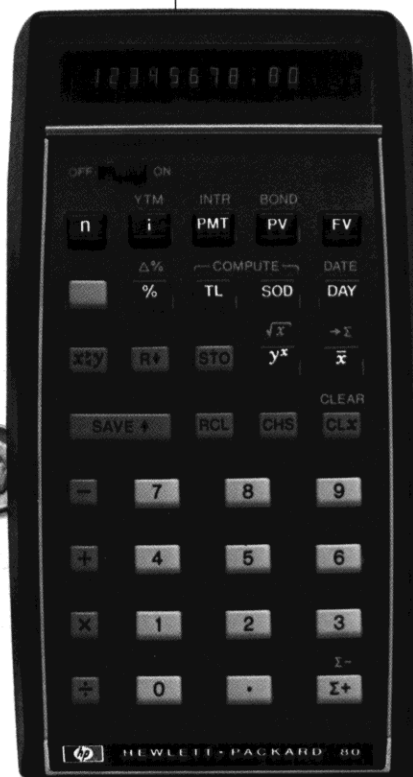
Specifications:

- Length: 147 mm (5.8 in)
- Width: 81 mm (3.2 in)
- Height: 18 to 33 mm (0.7 to 1.3 in)
- Weight: 255 g (9 oz.) with battery pack
- Recharger: 142 g (5 oz.)
- Shipping weight: 900 g (2 lb)
- AC: 86-127V or 172-254V, 50-60 Hz
- Battery: 3.75 Vdc nickel-cadmium rechargeable battery pack
- Operating temperature range: 0°C to 50°C (32°F to 122°F)

For a complete list of features and functions, see the Buyer's Guide on page 8.

The HP-80 Financial Pocket Calculator comes complete with:

- Rechargeable battery pack
- Recharger/AC adapter
- Soft carrying case
- Illustrated Owner's Handbook
- Quick Reference Guide
- A Guide to Profitable Investment Analysis.



HP-22

Business Management Pocket Calculator.

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

With the HP-22 pocket calculator you can handle everything from simple arithmetic to complex time-value-of-money computations including interest rates; present value/future value; ordinary and due annuities; balloon mortgage balances; long term projections; equity yields; net present value and internal rate of return; and extended percent calculations. You can even handle planning, forecasting and decision analysis.

Built-in functions for ease of use.

Financial and investment equations and statistical formulas are built into the HP-22. All you have to do is key in your data, press the appropriate keys, and see your answers displayed—in seconds.

The financial capabilities.

The five keys in the top row of the HP-22 are the basic financial keys that replace equations and interest tables. To use any of the additional functions, press the gold key first. When you enter three known values with the financial keys, you can solve for another unknown value. For example: enter amount of present value [PV]; enter number of periods involved [n]; enter future value [FV]. Then, push [i] and get interest displayed automatically.

Expanded percentages capability.

Percentage is the common standard of measurement in the business and financial world. For this reason, the HP-22 provides three separate percentage function keys. The [%] key is used to calculate a percentage. The [$\Delta\%$] key is used to compute the percentage difference (ratio of increase or decrease) between two numbers. The [$\Sigma\%$] key is used to find what percentage one number is of another number or of a total sum. The HP-22 saves

the base number for multiple percentage calculations of the same base number.

The statistical capabilities.

In addition to the financial capabilities, the HP-22 gives you advanced statistical capabilities for planning, forecasting and analysis. Using the [$\Sigma+$] key, you can enter statistical data into five of the ten addressable memories, where it remains unaffected by most other calculations. What's more, using the [$\Sigma-$] key you can adjust or correct input data without having to repeat the entire calculation. To project sales, key in past performance data with the [$\Sigma+$] key. Then key in the number of the forecast period and press the [$\hat{y}$] key to obtain sales at that future point in time. To obtain an average, key in all data, then press the [$\bar{x}$] key. To find standard deviation (a measure of statistical validity), key in your data, then press the [s] key for the answer.

The mathematical capabilities.

The HP-22 gives you virtually all the math capabilities you need in business, such as logs, anti-logs, exponentiation and root extraction so you may work out your own solutions to unusual individual problems.

Expanded memory capacity.

In addition to the 5 financial memories and the 4 operational stack memories, the HP-22 provides 10 addressable memories you can use to store data. For example, to store a displayed value in the first addressable memory, press [STO] [0] and the value will be automatically stored in that memory. To recall the value, press the [RCL] recall key and the [0] key and the value will again be displayed. For added convenience, register arithmetic can be performed with all 10 memories.

The remarkable HP-22 Owner's Handbook.

Even if you lack special training in mathematics, statistics or advanced financial planning, the 148-page Owner's Handbook will make it easy for you to take full advantage of the capabilities of the HP-22. The book is a valuable survey course in modern

management problem-solving, analysis and planning. It provides formulas and procedures for solving more than 50 different financial, mathematical and statistical functions on the HP-22.

Physical Specifications:

- Length: 130.2 mm (5-1/8")
- Width: 68.3 mm (2-11/16")
- Height: 30.2 mm (1-3/16")
- Weight: 170.1 g (6 oz.)
- Recharger weight: 141.8 g (5 oz.)
- Shipping weight: 680 g (1-1/2 lb.)
- Operating temperature range: 0°C to 45°C (32°F to 113°F)
- Charging temperature range: 15°C to 40°C (59°F to 104°F)
- Storage temperature range: -40°C to 55°C (-40°F to 131°F)
- Power Requirements:
AC: 115V or 230V
±10%, 50 to 60 Hz
- Battery: 2.5 Vdc nickel-cadmium rechargeable battery pack.

For a complete list of features and functions, see the Buyer's Guide on page 8.

The HP-22 Business Management Pocket Calculator comes complete with:

- Rechargeable battery pack
- Recharger/AC adapter
- Soft carrying case
- Illustrated Owner's Handbook



HP-27

Financial/Statistical/Scientific Pocket Calculator.

Gives you everything from internal rate of return for 10 uneven cash flows to advanced statistical functions.

The HP-27 Financial/Statistical/Scientific Calculator is the most powerful preprogrammed pocket calculator Hewlett-Packard has ever built.

Its highly sophisticated design effectively integrates financial, statistical, and scientific functions—and thus eliminates the need for separate calculators.

The extraordinary versatility of the HP-27 will be extremely valuable to any businessman or engineer whose responsibilities extend into such areas as: targeting, budgets, cost analysis, financial and forecasting considerations, technical calculations...

New financial and statistical functions greatly expand your calculating power.

The HP-27 gives you all the most-used financial and statistical functions, including five new functions never before made available on an HP pocket calculator—net present value, internal rate of return for uneven cash flows, variance, correlation coefficient, and normal distribution.

All these functions are preprogrammed and permanently stored in the HP-27. All you have to do is key in your data, press the appropriate function keys and see your answer displayed in seconds.

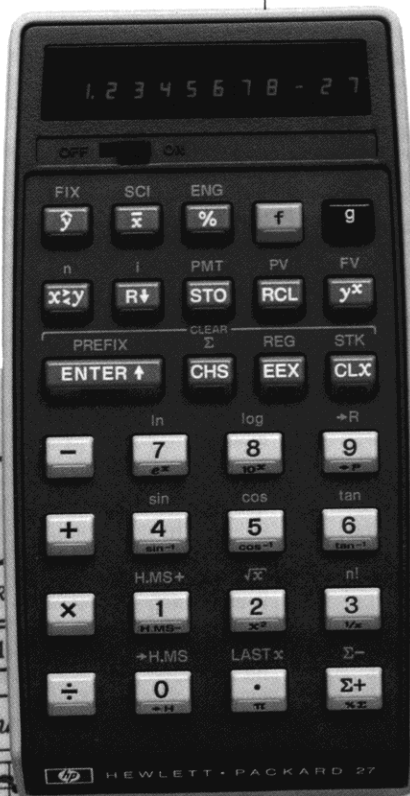
And for added convenience, the HP-27 provides an exceptionally large memory capacity, flexible display controls and selective clearing options.

10 valuable financial functions—all preprogrammed.

For convenience in solving both personal and job related business problems—such as mortgages, compound interests and sinking funds—all fundamental financial functions are preprogrammed into the HP-27 to eliminate the need for bulky books of equations and interest tables. Two new preprogrammed functions—net present value and internal rate of return with uneven cash flows—facilitate capital budgeting and resource allocation. In addition, the HP-27 provides three separate percentage functions for ease in calculating margins, markups, discounts, percents of totals, etc.

15 important statistical functions—all preprogrammed.

Many statistical functions useful in both science and business are provided by the HP-27. These include three new functions: variance, correlation coefficient and normal distribution. Summations of data points are stored for easy access. What's more, you can adjust or correct input data without having to repeat an entire calculation. Once your data is keyed in, you can calculate the means, standard deviations and variances for two variables. You can also calculate linear regression, linear estimates and the correlation coefficient for two variables. In addition, you can calculate the density function and upper-tail area under a normal distribution curve.



THE WALL STREET JOURNAL

© 1977 Dow Jones & Company, Inc. All Rights Reserved.

TUESDAY, JANUARY 11, 1977

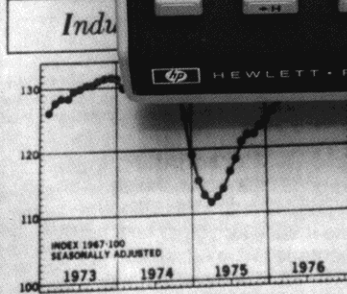
What's News—

Business and Finance

World-Wide

FISCAL 1978'S BUDGET of \$440 billion was sent to Congress by President Ford; it would shrink the deficit to \$47 billion from a projected \$57.2 billion. Democratic leaders criticized the budget for offering too little economic stimulus and the wrong priorities, but Carter's changes

THEODORE SORENSEN withdrew as Carter's nominee to head the CIA. After defending himself against allegations that he misused classified information gained while an aide to President Kennedy, Sorensen told the Senate Intelligence Committee he no longer wished to be considered for Director of Central Intelligence. His nomination was in trouble, partly because he used secret data to write a book but also



INDUSTRIAL PRODUCTION in December rose to 132.8% of the 1967 average, after seasonal adjustment, from 131.9% in November, the Federal Reserve Board reports. (See story on page 2.)

Letter

Report on People
Jobs in Office
Fields and Factories

TAX PREPARERS face extra demands due to the new tax law. Exactax Inc., a Chicago company, stretches its training days from 90 and boosts hiring with the complex new rules progress. The 8,000 preparers with Angeles-based Tax Corp. of with a new manual, special tra class time. "Even the don't know what the new yet," gripes a California In New York, Tax C

28 exponential, log and trig functions—all preprogrammed.

The HP-27 gives you all the most-used exponential, log and trig functions—including sines, cosines, tangents and their inverses in three angular modes; natural and common logs and anti-logs; pi; related arithmetic functions; coordinate conversions; angle conversion, addition and subtraction.

20 memories help simplify your most difficult calculations.

In addition to the 5 financial memories, the 4 operational stack memories and a last-x memory, the HP-27 provides 10 addressable memories for data storage. This large memory capacity lets you make highly complex and lengthy calculations with ease and assurance. Displayed values may be stored in any addressable memory and later recalled to the display. In addition, register arithmetic can be performed on all ten addressable memories.

6 clearing options give you flexible use of memories.

With the CLX key, you can clear the display only. You can clear all four memories of the operational stack with the STK key. The last six addressable memories, which are used for statistics, are cleared with the Σ key. The REG key clears all ten addressable memories, all five financial memories and the last-x memory. Or you can clear the status of the financial memories with the RESET key. In addition, you can clear the prefix keys with the key labeled PREFIX.

You can display fixed decimal, scientific or engineering notation.

In fixed decimal, the most commonly used notation, you can display between 0-9 places to the right of the decimal point. Whenever the value is too large or too small to be displayed in fixed notation, the display automatically changes to scientific notation. In scientific notation, useful when working with very large or small numbers, values are displayed with a single digit to the left of the decimal point followed by up to seven digits to the right, and a two digit exponent. In engineering notation, values are displayed with exponents that are multiples of 3 (useful in working with many units of measure such as kilograms (10^3), nanoseconds (10^{-9}), etc.)

The 216-page Owner's Handbook.

The Owner's Handbook for the HP-27 Calculator is one of the most extensive and detailed texts ever published for a pocket calculator. It covers every aspect of operation—including a clear description of the RPN Logic System—with valuable suggestions for maximum efficiency in use. Nearly half the book is devoted to practical applications of the HP-27 in mathematics, statistics, navigation, surveying and finance. Formulas for each of the preprogrammed functions in the HP-27 are provided for easy reference.

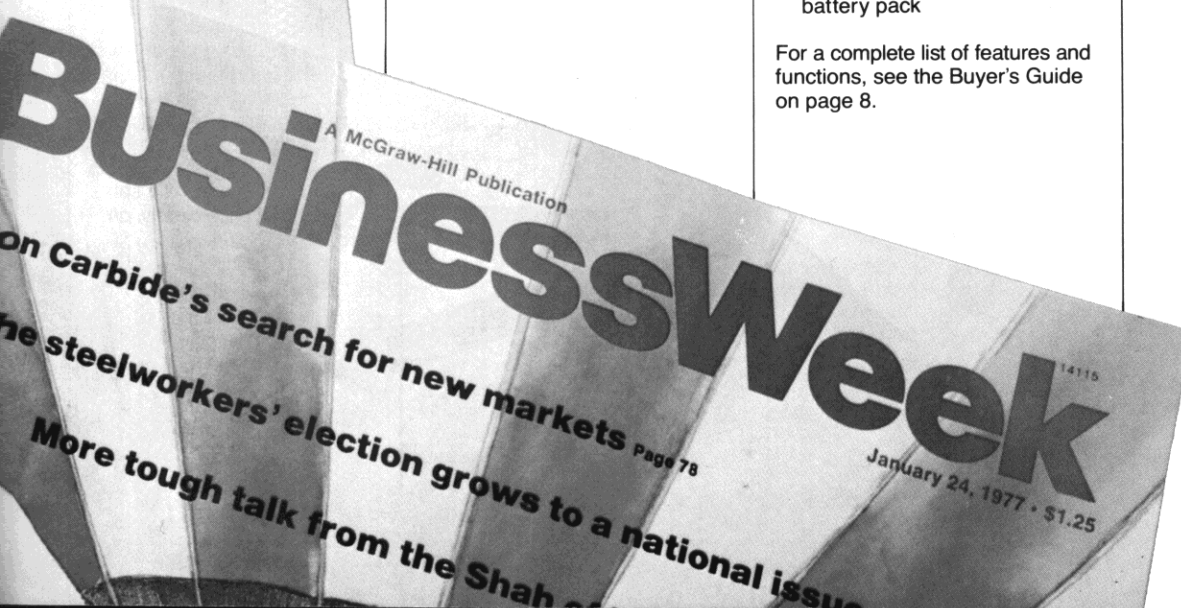
Physical Specifications:

- Calculator length: 130.2 mm (5-1/8")
- Calculator width: 68.3 mm (2-11/16")
- Calculator height: 30.2 mm (1-3/16")
- Calculator weight: 170.1 g (6 oz.)
- Recharger weight: 141.8 g (5 oz.)
- Shipping weight: 680 g (1-1/2 lb.)
- Operating temperature range: 0°C to 45°C (32°F to 113°F)
- Charging temperature range: 15°C to 40°C (59°F to 104°F)
- Storage temperature range: -40°C to 55°C (-40°F to 131°F)
- Power requirements: AC: 115V or 230V, $\pm 10\%$, 50 to 60 Hz
- Battery: 2.5 Vdc nickel-cadmium rechargeable battery pack

For a complete list of features and functions, see the Buyer's Guide on page 8.

The HP-27 Financial/Statistical/Scientific Pocket Calculator comes complete with:

- Battery pack that under normal use provides 3 hours of operation and fully charges in under 6 hours.
- Recharger/AC adapter that lets you operate the calculator on AC while the battery pack is recharging.
- Soft carrying case with belt loop.
- Illustrated Owner's Handbook with instructions and sample problems.



HP-97

The HP-97 Fully-Programmable Printing Calculator.

A major leap forward in fully-programmable personal calculators.

These are the most powerful personal calculators Hewlett-Packard has ever made. The HP-97 combines exceptional programming power—plus a battery-operated printer—all in one self-contained unit. The HP-67 provides the identical power of the HP-97 in the classic pocket size.

Exceptional power easily handles your lengthy, repetitive problems.

The HP-97/67 lets you write programs of up to 224 steps. Every function (one, two or three keystrokes) is merged to take only one step 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-97/67 can handle either job. All this, plus these other powerful programming features:

- 3 Levels of Subroutines
- 10 User-Definable Keys
- 10 Conditional/Decision Functions
- 4 Flags
- 3 Types of Addressing:
 - Direct Addressing to labels
 - Relative Addressing
 - Indirect Addressing

You don't have to wait to get on a computer to handle those extremely difficult calculations you face daily.

The preprogrammed power of the HP-97/67 is equally versatile. Choose from trigonometric functions, exponentials, logs, statistical functions, angular conversions. Round your inputs and answers, display them in three different formats, truncate their fractional or integer parts.

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

Keystroke programming makes programming the HP-97/67 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.

A "smart" card reader frees your mind by automatically recording the display mode setting, angular mode setting, and the status of the four flags when you record your program.

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 step in the program, and to easily insert steps 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.

An unparalleled program of owner support.

The highly-detailed HP-97 and HP-67 Owner's Handbooks teach you how to write programs quickly and easily. They are incomparable instructional guides—with step-by-step explanations of every powerful feature and with a wealth of sample problems.

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. The handbook for this pac is full of additional programming tips and techniques.

Also available in many disciplines are HP Application Pacs, where a professionally programmed and documented solution may already exist to solve a problem. These pacs—which put the full power of the HP-97 or HP-67 at your disposal—quickly transform your calculator into a special-purpose machine designed to solve complex problems in your field at the touch of a few keys.

A one-year subscription to the Users' Library and a Newsletter to keep you abreast of current information is also available. The library contains programs contributed by other owners as well as HP Application Pac programs.

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

The new 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. And to back it all up, there's one of the most comprehensive support programs ever developed for the owners of HP personal calculators.

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

With the HP-97, you can list a program, (stepnumber, 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. With the printer switch set to MANUAL, the printer will operate only when the Print X key or a list function is executed from the keyboard or from within a program. With the switch set to NORMAL, the printer will record all entered data and functions. With the switch set to TRACE, the printer will list the stepnumber, function and result of each step of an executing program or the operation and results of a manual calculation.

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.

The HP-67 Fully-Programmable Pocket Calculator.

HP-67

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, it will easily fit into lockable desk drawers or the glove compartment of your car. A built-in metal tab lets you secure it to your desk easily with a cable or bolt. (A special cable and lock is available as an optional accessory.)

Desktop keyboard and display adds extra convenience.

The HP-97 features large, conventionally-spaced keys that make it easy to key in data or programs. The keyboard also employs a seven-character buffer so skilled operators may use keys at high speed without danger of losing data.

The brilliant, large-size display of the HP-97 shows up to ten significant digits, plus two-digit exponent and appropriate signs. And the display is at a 45° angle that makes it easy to read while seated at your desk or standing at your workbench or drafting board.

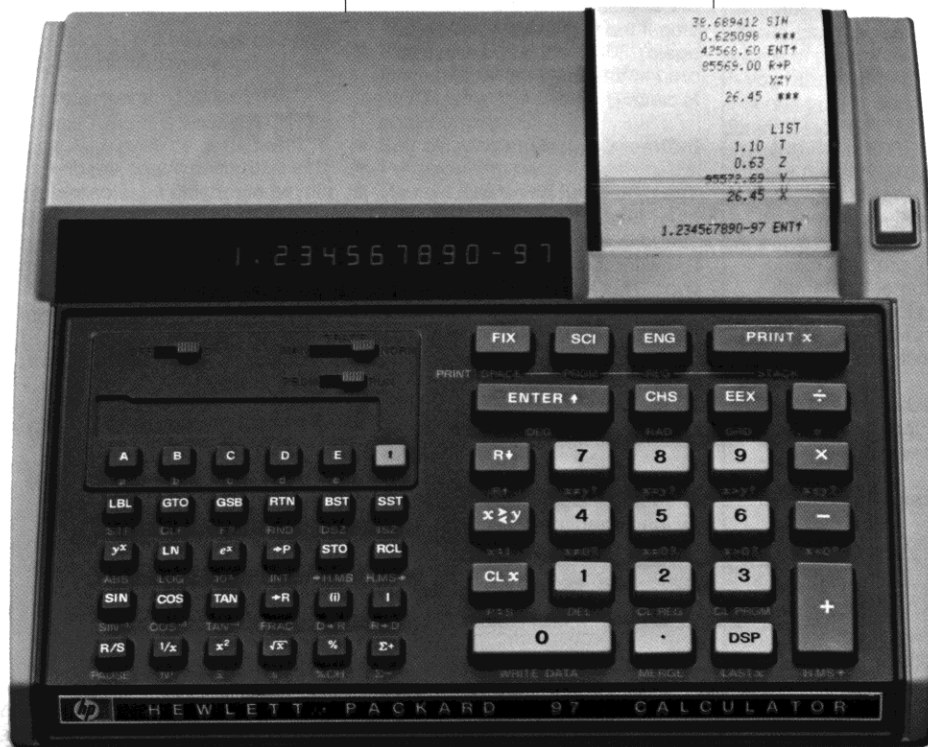
You can operate it on batteries or AC.

The power requirement of the HP-97 thermal printing system is so low that it may be operated solely on batteries for 3 to 5 hours, depending on how much you use the printer. The AC adapter/recharger permits you to operate from electrical outlets while batteries are being recharged. You can use it in the office or in the field.

The HP-67 Fully-Programmable Pocket Calculator provides the identical power of the HP-97.

The HP-67 is ideal for those who want the powerful features of the HP-97, but do not require a printing capability. The HP-67 is completely compatible with the HP-97. Programs recorded on one unit may be loaded and executed on the other—even the print commands (e.g., when the HP-67 executes a Print X command, it pauses, and displays the current results).

Used separately—or together—these compatible fully-programmable calculators do the job faster and with less chance for error.



HP-97 and HP-67 — Continued

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

As your needs increase, you can be confident of your capacity to handle them—because the HP-97 and the HP-67 give you the power you need to solve the most lengthy and repetitive problems you are ever likely to encounter.

New "Smart" magnetic card reader makes every problem easier.

The magnetic card reader in both the HP-97 and the HP-67 does much more than record programs from calculator to card or load programs from card to calculator.

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-97 and HP-67 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. They may be executed from the keyboard or from within a program. In addition, there are ten numerical labels (LBL 0 thru LBL 9). These user-definable keys and labels may be executed from the keyboard or from within a program.

Direct Branching

Though program steps are executed sequentially in many programs, you have the power to transfer (branch) program execution to any part of program memory you desire.

GTO Go To.

When followed by a label designator (A through E, f A through f E, or 0 through 9) GTO directly branches program execution to the specified label.

Subroutines

When a series of instructions is executed several times in a program, you can save program memory by executing that series as a subroutine.

GSB Go Subroutine.

A GSB instruction followed by a label designator (A through E, f A through f E, 0 through 9) branches program execution to the label specified just as a GTO instruction does. But, using the GSB instruction, program execution is then "returned" automatically to the step following the GSB instruction when the next RTN (Return) instruction is executed.

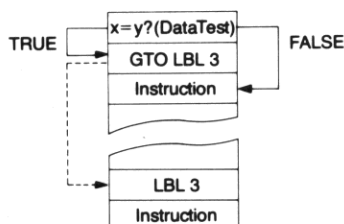
A GSB instruction can also be used within a subroutine to a depth of three levels.

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. If the data test is true, the calculator will "do" the next instruction in program memory. (Remember "Do If True.") If the data test is false, program execution branches around the next instruction.



The next step is executed if $x = y$. Program execution branches around one step if x does not equal y .

Flags.

You can use the four flags in the calculator for tests in your programs. They can be set, cleared, or tested. When a flag is tested, the calculator executes the next step if the flag is set ("Do If True" again). The calculator branches around the next step if the flag is clear.

Indirect Control.

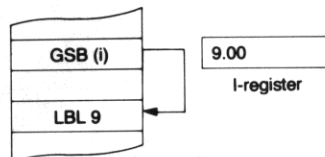
The (i) key combined with certain other functions uses the number stored in the specially-defined I-register to control those functions. This indirect control gives you the power and versatility you need to complement the extra large program capacity and data capacity.

Indirect Addressing.

You can perform a direct branch or subroutine to a label specified by the current number in the I-register.

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

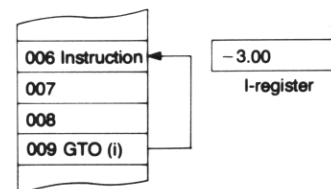
These operations depend on the number in the I-register. If it is positive they perform a direct branch (GTO (i)) or a subroutine (GSB (i)) to the label specified.



Relative Addressing.

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

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 steps specified by the current negative number in the I-register.



Indirect Control of Data Register Operations.

You can also use the I-register to specify the address of a storage register.

STO (i)

This instruction stores the displayed number in the storage register specified by the value in the I-register.

RCL (i)

This instruction recalls the contents of the storage register specified by the value in the I-register.

STO + (i), **STO - (i)**

STO x (i), **STO ÷ (i)**

These four instructions perform storage register arithmetic upon the contents of the storage register specified by the value in the I-register.

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. If the contents equal zero, program execution branches around the next step in program memory.

HP-97 Specifications:

- Calculator width: 228.6 mm (9")
- Calculator depth: 203.2 mm (8")
- Calculator height: 63.5 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)
- Operating temperature range: 10°C to 40°C (50°F to 104°F)
- Charging temperature range: 10°C to 40°C (50°F to 104°F)
- Storage temperature range: -40°C to 55°C (-40°F to 131°F)
- Paper temperature range (operating & storage): 10°C to 40°C (50°F to 104°F)
- AC Power Requirement: 90-127V or 200-254V, 50 to 60 Hz
- Battery Power Requirement: 5.0 Vdc nickel cadmium rechargeable battery pack

HP-67 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: 342 g (11 oz)
- Recharger weight: 142 g (5 oz)
- Shipping weight: 2.5 kg (5.5 lb)
- Operating temperature range: 10°C to 40°C (50°F to 104°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 172-254V, 50 to 60 Hz
- Battery Power Requirement: 3.75 Vdc nickel cadmium rechargeable battery pack.

For a complete list of features and functions, see the Buyer's Guide on Page 8.

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).

The HP-67/HP-97 Users' Library.

Administered by Hewlett-Packard as a customer service, the HP-67/HP-97 Users' Library is dedicated to making programs contributed by HP-67 and HP-97 users available to others. In addition, all programs in the HP-67/HP-97 Application Pacs are included in the Library and are available on an individual basis.

With the many programs available in a wide variety of application areas, the program solutions you require may have already been developed. You won't have to research the application, program the solution, debug the program, or complete the documentation. Programs from the Library can also serve as a source of programming techniques in your application area.

A one year subscription to the library costs U.S. \$20.00. You will receive the Catalog of Contributed Programs, updates to the Catalog, and coupons entitling you to three free programs of your choice.

158 prerecorded programs already available for the HP-97 and HP-67.

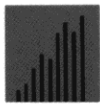
With HP Application Pacs, the solutions you require may already exist. They let you put the full power of the HP-97 and HP-67 to work instantly. You save significant time because no researching, programming, debugging or documenting is needed.

A wide variety of programs—in science, engineering and business—is available on prerecorded magnetic cards that program the calculator for you in less than 2 seconds. Each program is fully documented with helpful comments on each program listing. Using these valuable programming hints, you can adapt programming techniques you find useful in each application area.

Application Pacs contain 19 to 26 preprinted prerecorded program cards, a program card holder and a manual of complete documentation. The manual also provides operating instructions, equations, limits and warnings, and sample problems with solutions for each program in the Pac.

The Application Pacs for the HP-97 and HP-67 are listed on the following two pages.





Stat Pac (00097-13111)

21 programs on 24 magnetic cards

General Statistics

- Basic Statistics for Two Variables
Basic statistics for two variables, grouped or ungrouped.
- Factorial, Permutation, and Combination
Calculate factorial (extended range), permutation, and combination.
- Moments, Skewness, and Kurtosis (For Grouped or Ungrouped Data)
Moments, Skewness, and Kurtosis are calculated for general (geometrical) description of a distribution; symmetry, relative peakness or flatness, etc.
- Random Number Generator
Generate up to 500000 different numbers.
- Histogram
A histogram program for 24 intervals of equal width between specified upper and lower limits.

Analysis of Variance

- Analysis of Variance (One Way)
This program is used to test the observed differences among sample means.
- Analysis of Variance (Two Way)
The row effects and the column effects are tested independently in the analysis of the total variability of a set of data.
- Analysis of Covariance (One Way)
This program tests the effect of one variable separately from the effect of the second variable.

Distribution Functions

- Normal and Inverse Normal Distribution
Polynomial approximation is used to calculate normal and inverse normal distribution.
- Chi-Square Distribution
This program evaluates the chi-square density. A series approximation is used to evaluate the cumulative distribution.
- t Distribution
This program evaluates the t density function and the cumulative distribution for a given x and degree of freedom ν .
- F Distribution
This program evaluates the integral of the F distribution for given values of $x(>0)$, degrees of freedom ν_1, ν_2 , provided either ν_1 or ν_2 is even.

Curve Fitting

- Multiple Linear Regression
Linear regression for two independent variables, using least squares method.
- Polynomial Approximation
This program approximates in the least square sense the function $f(x)$ by a polynomial of degree m , where $2 \leq m \leq 4$. Data from equally spaced points are required.

Test Statistics

- t Statistics
Paired t statistic tests the null hypothesis $H_0: \mu_1 = \mu_2$ for two observations.
t statistic for two means tests the null hypothesis $H_0: \mu_1 - \mu_2 = d$ for two independent random samples.
- Chi-Square Evaluation
This program calculates the value of χ^2 statistic for the goodness of fit test.
- Contingency Table
2 x k and 3 x k contingency tables test the null hypothesis that two variables are independent.

- Spearman's Rank Correlation Coefficient
This program tests whether 2 rankings are substantially in agreement with one another.

Quality Control

- $\bar{x}$ and R Control Chart
 $\bar{x}$ (mean) and R (range) are used to decide periodically whether a process is in statistical control.
- Operating Characteristic Curves
This program evaluates the probability of P_a of acceptance for a single sampling plan with finite or infinite lot size.

Queueing Theory

- Single- and Multi-Server Queues
Queueing theory for infinite customers and finite customers.

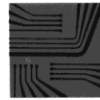


Math Pac (00097-13121)

19 programs on 20 magnetic cards

- Factors and primes
Finds prime factors of an integer; finds all primes between two numbers.
- GCD, LCM, decimal to fraction
Finds greatest common divisor and least common multiple of two integers; finds nearest fractional approximation for a decimal number.
- Base conversions
Converts a number in base b to its equivalent in base B ($b, B < 100$).
- Optimal scale for a graph; plotting
Finds a "nice" scale for graphing a function; generates ordered pairs for a graph.
- Complex operations
Arithmetic and several functions for complex numbers.
- Polynomial solutions
Solves polynomial equations up to 5th degree.
- 4 x 4 matrix operations (2 cards)
Computes determinant and inverse of 4 x 4 matrix, solves 4 simultaneous equations in 4 unknowns, by Gaussian elimination.
- Solution to $f(x) = 0$ on an interval
Uses combination of bisection and secant method to guarantee rapid convergence to a root.
- Numerical integration
Trapezoidal rule and Simpson's rule for discrete case; Simpson's rule for functions known explicitly.
- Gaussian quadrature
Uses the six-point Gauss-Legendre quadrature method to find integrals over finite or infinite intervals.
- Differential equations
Solves first- and second-order differential equations by the fourth-order Runge-Kutta method.
- Interpolations
Linear, Lagrangian, and finite difference.
- Coordinate transformations
Two- and three-dimensional translation and rotation of axes.
- Intersections
Line-line, line-circle, circle-circle.
- Circles
Circle determined by three points; equally spaced points on a circle.
- Spherical triangles
Solutions to six cases of spherical triangles.
- Gamma function
Computes $\Gamma(x)$ for $1 \leq x \leq 70$.

- Bessel functions, error function
Computes the value of the Bessel functions $J_n(x)$ and $I_n(x)$; computes error function and complementary error function.
- Hyperbolics
Finds hyperbolic functions and their inverses.



EE Pac (00097-13131)

18 programs on 20 magnetic cards

- Network Transfer Functions
This program computes various transfer functions of a ladder network composed of any number of standard elements.
- Reactive L-Network Impedance Matching
This program computes networks which will match any two complex impedances.
- Class A Transistor Amplifier Bias Optimization
This program simplifies the design of a class A transistor amplifier.
- Transistor Amplifier Performance
This program computes the small-signal properties of a transistor amplifier given the h-parameter matrix and the source and load impedances.
- Transistor Configuration Conversion
This program permits conversion among h-parameter matrices for CB, CE, or CC transistor configurations.
- Parameter Conversion: $S \leftrightarrow Y, Z, G, H$
This program allows conversion among various commonly used parameter sets.
- Fourier Series
This program computes Fourier coefficients from samples of a periodic function.
- Active Filter Design
This program computes element values for a standard filter circuit.
- Butterworth or Chebyshev Filter Design
This program computes component values for Butterworth or Chebyshev filters between equal terminations. The user may select various filter characteristics.
- Bode Plot of Butterworth and Chebyshev Filters
This program provides gain, phase, and group delay information for Bode plots of n-pole Butterworth or Chebyshev filters.
- Resistive Attenuator Design
This program computes values for the resistors which yield an attenuator having any desired loss.
- Smith Chart Conversions
This program converts among various radially scaled parameters ($\sigma, \rho, \text{SWR}, R_L, \dots$) and also interconverts impedance and reflection coefficient.
- Transmission Line Impedance
This program computes high frequency characteristic impedance for five types of transmission lines.
- Microstrip Transmission Line Calculations
This program computes relative phase velocity and characteristic impedance for lossless microstrip. It also computes copper loss and resistance per unit length.
- Transmission Line Calculations
This program computes the input impedance of lossy transmission line terminated in Z_L .
- Unilateral Design: Figure of Merit, Maximum Unilateral Gain, Gain Circles
This program computes $u, G_u, G_{\min}, G_{\max}, G_0, G_{1\max},$ and $G_{2\max}$ from a transistor's s-parameters. It also computes r_{01} and ρ_{01} from $G_1 \leq G_{\max}$ ($i = 1, 2$).

- Bilateral Design: Stability Factor, Maximum Gain, Optimum Matching
This program computes the maximum gain available and the load and source reflection coefficients which yield the maximum gain.
- Bilateral Design: Gain and Stability Circles, Load and Source Mapping
This program computes the location and radius of stability circles. It also computes the source or load reflection coefficient corresponding to a given load or source termination.



Business Decisions Pac (00097-13144)

22 programs and 22 magnetic cards

- Internal Rate of Return
Yield of a sequence of uneven cash flows.
- Internal Rate of Return—Groups of Cash Flows
Yield of groups of uneven cash flows.
- Discounted Cash Flow Analysis—Net Present Value
Finds the net present value of future cash flows.
- Direct Reduction Loans—Sinking Fund
Solves problems when payments are made at the end of the compounding periods (ordinary annuity).
- Accumulated Interest/Remaining Balance
Calculates accumulated interest and remaining balance, and generates an amortization schedule(s).
- Wrap-Around Mortgage
Calculates yield of wrap-around mortgage.
- Constant Payment to Principal Loan
Generates schedule for constant payment to principal loan.
- Add-on Rate Installment Loan/Rule of 78's
Calculations involving add-on loans and loans using the rule of 78's.
- Savings Plan - Leases
Solves problems involving payments at the beginning of the compounding periods (annuity due), and compounded amounts.
- Advance Payments
Payment and yield calculations when additional payments are made in advance.
- Savings—Compounding Periods Different from Payment Periods
Calculations when deposits and compounding periods differ.
- Simple Interest/Interest Conversions
Simple interest calculations and nominal to effective interest rate conversions.
- Depreciation Schedules
Straight line, SOYD, declining balance, and crossover between straight line and declining balance.
- Days Between Dates
Calendar routine.
- Bond Price and Yield
Calculates price and yield of semi-annual coupon bonds.
- Interest at Maturity/Discounted Securities
Price or yield of interest at maturity or discounted securities.
- Linear Regression—Exponential Curve Fit
Fits a set of data points x, y to a straight line and a curve. Determines goodness of fit.

- **Multiple Linear Regression**
Fits a set of data points x , y , z to a straight line. Also determines goodness of fit.
- **Break-Even Analysis**
Calculates all values for linear break-even chart.
- **Invoicing**
Maintains net line totals, subtotal and grand total for invoicing.
- **Payroll**
Guide for writing a payroll program.
- **Inventory**
Guide for establishing an inventory program.



Clinical Lab and Nuclear Medicine (00097-13165)

19 programs on 19 magnetic cards available late 1976

Clinical Chemistry

- **Beer's Law**
Converts between absorbance and %T; solves for an unknown concentration given a standard concentration and the absorbance or %T of the standard and unknown.
- **Protein Electrophoresis**
Given integration counts of a number of protein fractions, finds percentage of each. Calculation of weights optional.
- **LDH Isoenzymes**
Given values for the five LDH isoenzymes, finds activity of each as a percent of total. Compares results against normal values.
- **Body Surface Area**
Calculates an estimated BSA by method of Dubois or Boyd. Accepts either English or metric units.
- **Urea Clearance**
Calculates urea clearance with option of correcting for BSA.
- **Creatinine Clearance**
Calculates creatinine clearance with option of correcting for BSA.
- **Amniotic Fluid Assay**
Performs calculations for the spectrophotometric estimation of bile pigments in amniotic fluid.
- **Blood Acid-Base Status**
Finds total plasma CO_2 and base excess from PCO_2 , pH, and Hgb concentration.
- **Oxygen Saturation and Content**
Finds oxygen saturation and content in blood given PO_2 , PCO_2 , pH, and body temperature.
- **Red Cell Indices**
Given hematocrit percent, red cell count, and hemoglobin, finds mean corpuscular volume, mean corpuscular hemoglobin, and mean corpuscular hemoglobin concentration.

Nuclear Medicine

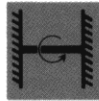
- **Total Blood Volume**
Computes total blood volume by the radioisotope dilution method.
- **Schilling Test**
The radioisotope determination of vitamin B_{12} absorption.
- **Thyroid Uptake**
The radioisotope determination of thyroid uptake.
- **Radioactive Decay Corrections**
Finds the activity of a radioisotope corrected for decay over time.

Radioimmunoassay

- **Radioimmunoassay**
Computes least-squares regression line of logit of net counts vs. log concentration, including regression constants, correlation coefficient, and concentration for a given count.

Statistics

- **Basic statistics**
Computes mean, standard deviation, standard error, and coefficient of variation for grouped or ungrouped data.
- **Chi-square evaluation and distribution**
Computes the chi-square statistic for goodness of fit. For given $x \geq 0$, finds the chi-square density function $f(x)$ and the cumulative distribution $P(x)$.
- **t Statistics**
Computes the paired t statistic and the unpaired t statistic.
- **t Distribution**
For a given $x > 0$, evaluates the t density function and cumulative distribution.



ME Pac (00097-13155)

23 programs on 26 magnetic cards available late 1976

- **Vector Statics**
Performs basic vector operations of addition, cross product, and dot product, and finds angles between vectors.
- **Section Properties (2 cards)**
The area, centroid, and moments of an arbitrarily complex polygon may be calculated using this program.
- **Stress on an Element**
Reduces data from rosette strain gage measurement and performs Mohr circle analysis.
- **Soderberg's Equation for Fatigue**
Solves for any one of the seven variables of Soderberg's equation for fatigue.
- **Cantilever Beams**
Calculates deflection, slope, moment and shear for point, distributed, and moment loads applied to cantilever beams.
- **Simply Supported Beams**
Calculates deflection, slope, moment and shear for point, distributed, and moment loads applied to simply supported beams.
- **Beams Fixed at Both Ends**
Calculates deflection, slope, moment, and shear for point, distributed, and moment loads applied to beams fixed at both ends.
- **Propped Cantilever Beams**
Calculates deflection, slope, moment, and shear for point, distributed, and moment loads applied to propped cantilever beams.
- **Helical Spring Design**
Performs one or two point design for helical compression springs.
- **Four Bar Function Generator (2 cards)**
Program designs four bar systems which will approximate an arbitrary function of one variable.
- **Progression of Four Bar System**
Calculates angular displacement, velocity, and acceleration for the output link of a four bar system.
- **Progression of Slider Crank**
Calculates displacement, velocity, and acceleration of the slider and angular velocity and acceleration of the connecting rod for the progression of a slider crank system.
- **Circular Cams**
Computes parameters necessary for design of harmonic or cycloidal, circular cams with roller, flat or point followers.
- **Linear Cams**
Computes the parameters necessary for design of harmonic, cycloidal, or parabolic profiles for linear cams with roller followers.

Gear Forces

- **Gear Forces**
Computes the reaction forces resulting from torque applied to helical, bevel, and worm gears.
- **Standard External Involute Spur Gears**
Calculates parameters necessary in design manufacture, and testing of standard, external, involute, spur gears.
- **Belt Length**
Computes belt length around an arbitrary set of pulleys.
- **Free Vibrations**
Calculates an exact solution to the differential equation for a damped oscillator vibrating freely.
- **Vibration Forced by $F_0 \cos \omega t$**
Finds the steady-state solution for a damped oscillator forced by $F_0 \cos \omega t$.
- **Equations of State**
Ideal gas relation plus Redlich-Kwong model of real gas behavior.
- **Isentropic Flow for Ideal Gases**
Replaces isentropic flow tables for ideal gases in converging-diverging passages.
- **Conduit Flow**
Calculate velocity or pressure drop for incompressible viscous flow in conduits.
- **Heat Exchangers (2 cards)**
Performs analysis of counter-flow, parallel-flow, parallel-counter-flow and crossflow (fluids unmixed) heat exchangers.



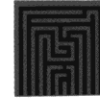
Surveying (00097-13175)

19 programs on 26 magnetic cards available late 1976

- **Traverse, Inverse and Sideshots**
Reduction of field traverse data with closure and area calculation.
- **Traverse Adjustment**
Adjustment of traverses by compass rule or Crandall's rule.
- **Intersections**
Bearing-bearing, bearing-distance and distance-distance intersections and offset from a point to a line.
- **Curve Solutions**
Calculation of parameters of circular curves.
- **Horizontal Curve Layout**
Calculation of field data for layout of horizontal circular curves.
- **Spiral Curve Layout**
Calculation of field data for layout of spiral transition curves.
- **Vertical Curves and Grades**
Station and elevation calculations for vertical curves and grades.
- **Resection**
Solution of the "three point problem."
- **Two Instrument Radial Survey**
Location of a point using a distance meter and theodolite.
- **EDM Slope Reduction**
Reduction of slope distances measured with an Electronic Distance Meter.
- **Stadia Reduction/3-Wire Leveling**
 - a. Reduction of stadia-observations to distance and elevation.
 - b. Calculation of elevations for a line of wire levels.
- **Taping Reduction/Field Angle Check**
 - a. Correction and reduction of taped distances.
 - b. Reduction of field angle data.
- **Azimuth of the Sun**
Calculation of the sun's azimuth from a solar observation.
- **Predetermined Area**
Location of one side of a land parcel to enclose a specified area.
- **Earthwork**
Calculation of volume by average end area and volume of a borrow pit.

Coordinate Transformation

- **Scaling, rotation and translation of coordinates from one system to a second.**
- **State Plane Coordinates—Lambert**
Conversion of geographic coordinates to and from state plane coordinates on Lambert projections.
- **State Plane Coordinates—Transverse Mercator**
Conversion of geographic coordinates to and from state plane coordinates on transverse Mercator projections.
- **State Plane Coordinates—Alaska Zones 2-9**
Conversion of geographic coordinates to and from state plane coordinates for Alaska zones 2-9.



Games (00097-13185)

19 programs on 20 magnetic cards

- **Game of 21**
Also known as blackjack.
- **Dice**
Includes the game of "Craps" as well as a dice roller.
- **Slot machine**
The familiar one armed bandit.
- **Submarine Hunt**
Find and then sink the moving submarine with your depth charges.
- **Artillery**
Locate and destroy the moving target before it destroys you.
- **Space War**
Search out and annihilate the 3 evil Algols before time and energy are gone.
- **Super Bagels**
Based on "Mastermind."
- **Nim**
Who will pick the last object from the last pile, you or the calculator?
- **Queen Board**
You and the calculator take turns moving a chess queen to its target.
- **Hexapawn**
You and the calculator command armies of 3 chess pawns each.
- **Tic-Tac-Toe**
Your best hope is to play to a draw.
- **Wari**
Also known as Man-Kalah.
- **Racetrack**
Up to 5 players can race.
- **Teaser**
Changing from one pattern to the other looks easy, but...
- **Golf**
The Country Club course is challenging.
- **The Dealer**
Shuffles and deals a deck of cards to 4 people; also calls Bingo.
- **Bowling Scorekeeper**
Keeps score for up to 10 bowlers.
- **Biorhythms**
Calculates cycle values for any date, and tells which of the next 33 days are critical, maximum or minimum days.
- **Timer**
Offers 2 visible timers, a count-up and count-down timer, and allows splits to be taken.

Accessories

Optional Accessories.

DC Adapter/Recharger

Now available is a new accessory most often asked for by our existing customers: a recharger that operates from a 12 volt DC battery.

HP-21, HP-22, HP-25/25C,
HP-27/82055A
HP-80 and HP-67/
82054A*

Reserve power pack.

You'll always have a fully-charged spare battery pack on hand when you use this reserve power pack, especially designed for Hewlett-Packard pocket calculators. It comes complete with a spare battery pack.

Simply slip the battery pack into the holder, then plug the holder into the recharger/AC adapter that comes with your calculator. A built-in light-emitting diode tells you that the battery pack is recharging. In six to eight hours, you'll have a fully-charged battery pack to exchange for the one in your calculator.†

Temperature range: 0°C to 40°C
(32°F to 104°F)
Dimensions: 8x8x3cm (3x3x1")
Weight with battery pack: 110g
(4oz.)

Battery pack and holder for models HP-80 and HP-67/
82004A

Battery pack and holder for models HP-21, HP-22, HP-25/25C,
and HP-27/
82028A

Battery pack and holder for models HP-91 and HP-97/
82037A

†For models HP-67 and HP-80 the recharging time is between 14 and 17 hours.

Security cradle helps reduce pilferage.

When leaving your HP calculator unattended in the office or lab, you can help guard it against "mysterious disappearance" by means of this ruggedly-constructed security cradle.

A key is used to lock and unlock the cradle holding your calculator. And while your calculator is in place you have complete access to the keyboard and display, with battery pack or AC operation.

The security cradle may be attached to your desk via: (1) four corner screws, (2) center screw attachment, allowing 360° rotation, (3) removable six-foot steel cable, or (4) extremely hard-to-remove adhesive tape. (All are supplied.)

Security cradle for model HP-80/82007A***

Security cradle for model HP-67/82015A**

Security cradle for models HP-21, HP-22, HP-25/25C and HP-27 (shown), has built-in prism to provide better viewing angle when on flat surface/82029A
Security cable for models HP-91, and HP-97/
82044A

Hard leather case helps protect your calculator outdoors.

Using your HP calculator outdoors? Help protect it by carrying it in this hard leather field case. It snaps onto your belt and 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.

Field case for model HP-80/
82006A***

Field case for model HP-67/
82016A**



Designed to protect and increase the ver- satility of Hewlett- Packard Calculators.

Replacement Accessories.

Accessories to replace or replenish those received with your pocket calculator.

Owner's Handbook

HP-21/00021-90001
HP-22/00022-90001
HP-25/25C/00025-90001
HP-27/00027-90001
HP-80/00080-90001
HP-91/00091-90001
HP-97/00097-90001
HP-67/00067-90001

Quick Reference Guide.

HP-25/25C/00025-90021
HP-80/00080-90003
HP-67/00067-90011

Soft Case

HP-21, HP-22, HP-25/25C, and
HP-27/82027A
HP-80/82021A***
HP-67/82053A**
HP-91 and HP-97/
82035A

Battery Pack

HP-21, HP-22, HP-25/25C,
HP-27/82019A
HP-80 and HP-67/
82001A*
HP-91 and HP-97/
82033A

Recharger/AC adapter

HP-21, HP-22, HP-25/25C and
HP-27/82041A(110Vac)
82026A (110/220 Vac)
HP-80 and HP-67/
82002A*
HP-91 and HP-97/
82040A

Calculator Supplies

Thermal Printing Paper for
models HP-91 and HP-97/
82045A (6 rolls)
3 Program Card Holders
for models HP-67 and HP-97/
00097-13142**
Program Pads for models HP-
25/25C, HP-67 and HP-97/
00097-13154**
Blank Program Cards for models
HP-67 and HP-97 40 card pac/
00097-13141**
120-card pac/
00097-13143**

Application Books and Pacs.

Application Books

HP-21 Applications Book/
00021-90016
HP-25/25C Application
Programs/00025-90011
35 Math Pac/00035-
66001
45 Math Pac/00045-
66001
55 Math Programs/00055-
66001
55 Statistics Programs/
00055-66002
HP-80 Real Estate Appli-
cations/00880-66006

HP-65 Application Pacs

Finance Pac I/00065-
67044
Math Pac I/00065-67001
Math Pac II/00065-67002
Stat Pac I/00065-67005
Stat Pac II/00065-67053
EE Pac I/00065-67007
EE Pac II/00065-67056
Chemical Engineering Pac I/
00065-67050

Stress Analysis Pac I/ 00065-
67051
Surveying Pac I/00065-
67003
Machine Design Pac I/ 00065-
67052
Medical Pac I/00065-
67004
Aviation Pac I/00065-
67042
Navigation Pac I/00065-
67045

HP-67/97 Application Pacs

Math Pac/00097-13121
Stat Pac/00097-13111
Business Decisions Pac/00097-
13144
EE Pac/00097-13131
Surveying Pac/00097-
13175
Clinical Lab and Nuclear
Medicine Pac/00097-
13165
M.E. Pac/00097-13155
Games Pac/00097-13185

*Also usable on HP-35, HP-45,
HP-55, HP-65, and HP-70.

**Also usable on HP-65.

***Also usable on HP-35, HP-45,
HP-55 and HP-70.



Homo programmus: a new breed.



I had a dream not long ago that all the programmable calculators in the world disappeared forever. I woke up in a cold sweat."

The man chuckled as he told the story—but he was dead serious. He is one of thousands of a new and special breed who find themselves in a synergistic relationship with their programmable calculators.

Man and machine have had tenuous links in the past, but certainly the relationship has never been stronger. These people use their calculators to extend their minds and in a like manner use their minds to extend the capabilities of their calculators. The result: they solve problems they would never before have even tackled.

It began with the introduction of the HP-65 some 3 years ago and the relationship continues with increased strength with the HP-67 and HP-97 and their fantastically increased powers. To the people who use them, these calculators have proved to be more than buttons and batteries. They have been captured by the mystique of a device that has incredible power and versatility—and by the logic system that can control that power.

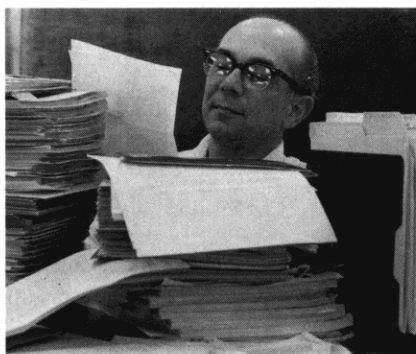
These people want to share their excitement in finding features of which others—even Hewlett-Packard—are unaware. They have, as an average, IQ's as high as any similarly-sized group of people ever collected. Hewlett-Packard recognized this group from the beginning and began to communicate with them on a regular basis. The result was *Key Notes**, a newsletter dedicated to Homo programmus**.

The first issue of *Key Notes* came out in August of 1974, just seven months after the introduction of the HP-65. In it were such features as: "Inside the HP-65;" "Most Popular Programs;" "Questions and Answers;" "Do's and Don't's of Magnetic Cards;" "How Fast Is the HP-65?" and "Programming Tips." The readers of *Key Notes* are also regularly informed of new application pacs, of particular programs from the User's Library that have a special appeal, and of new prod-

ucts as they are announced.

The task of producing *Key Notes* falls—sometimes heavily—on the shoulders of Henry Horn, the editor. A Homo programmus himself, Henry is also a nut about cameras (he owns 11), and cars (believe it or not, he has owned over 40). His interest in calculators reaches far back to the early mechanical devices that could only add.

But, of course, it takes more than an interest in calculators to produce a newsletter capable of fascinating the large and varied group of HP-65, HP-67, and HP-97 owners. To the task, Henry brings eighteen years of professional writing experience. And to keep abreast of the world of technology, Henry reads or skims 60-100 periodicals a month.



Henry Horn with a typical(?) week's mail.

Henry collects material from a variety of sources. The Hewlett-Packard application engineers often contribute information they have uncovered in researching and writing the latest application pac. He also taps the User's Library for interesting programs that have not been included in an application pac. And, of course, there is the voluminous amount of letters Henry receives each week.

Henry's main job is to judiciously select material he feels is of general interest and then organize it in such a way so that everyone can benefit from it. Choosing what to publish for this group isn't easy. Henry's philosophy is: "If an article or letter interests me after reading thousands of them, then I figure it will interest everyone else."

The widespread acclamation for *Key Notes* demonstrates the success of that philosophy. Each issue provides a careful balance of programming tips, interesting letters, personality profiles, and calculator news.

All in all, though, it is the letters that are most important. As Henry puts it: "Without the letters, there would be no *Key Notes*. Hewlett-Packard—or any other company—could not continually come up with material as interesting as that supplied by Homo programmus. The plain fact of the matter is they're not interested in us as much as they're interested in each other."

An incredible fact is that the readers of *Key Notes* write not only to Hewlett-Packard but also to each other. Hewlett-Packard is a clearinghouse for these people.

The types of letters are as interesting as the people themselves. One person wrote in telling how he used his calculator in a helicopter to help him with traffic control. Another sent in a picture of his birthday cake, which his fiancée and sister had ordered from a bakery in the form of a calculator—exact in every detail.

Many letters offer new ideas for calculators of the future. Some are impractical and some have limited appeal but all reflect a genuine interest in the next generation of handheld electronic brains. Hewlett-Packard reviews these suggestions carefully.

The majority of the letters are applications for the calculators. One might wonder why these people are interested in what other people do with their calculators. After all, they had their own reasons for purchasing a calculator and their own applications. Mainly they love interesting applications whether or not they can find uses for them personally. Fodder for creative thinking? Probably. But also a sincere appreciation for someone else's handiwork.

Key Notes reached another milestone this January, 1977, when it was distributed worldwide for the first time. For Henry it's a personal triumph, although he faces the additional continuing task now of eliminating U.S. idioms and buzz words so that everyone can understand the material. For the readers of *Key Notes*, it is an opening of communication long awaited because the species Homo programmus can be found 'round the world. And the increased sharing of applications and anecdotes can only make this service to HP-65, HP-67 and HP-97 users that much more rewarding.

**Key Notes* is available only to owners of the HP-65, HP-67 and HP-97.

***Homo programmus*: It isn't in the dictionary—yet.

(Cont. from page 3) take place and then instructs the CRC to set an output flag that turns on the motor by enabling the motor drive circuit on the read/write chip. As the motor drives the card over the head, flux reversals in the magnetic medium are sensed by the head, amplified and converted to logic levels by the read/write chip, and passed on to the CRC.

The CRC loads the bits into a pair of 28-bit buffers. When one buffer is filled the CRC switches over to the other buffer and signals the ACT that data is ready to be transferred to it via the DATA line. There are 952 bits on each side of the card, and the card cannot stop and wait for the microprocessor to be ready. Therefore, once the bits start coming in, the ACT must receive, process, and store the contents of one 28-bit buffer in not more than the time it takes to load the other 28-bit buffer, so that no bits are lost.

The card passes through the card reader at a nominal 6 centimeters per second. Since the recorded density is slightly greater than 160 bits per cm, the bits must be accepted at approximately a 1-kHz rate. But the microprocessor is capable of executing only approximately three microinstructions in the one millisecond between bits. With the CRC buffering the incoming bit stream, however, the microprocessor need only concern itself with the card reader every 28 milliseconds, on the average. It therefore has approximately $3 \times 28 = 84$ instruction times to process each 28-bit record.

The requirement that cards recorded on any HP-67 or HP-97 be readable on any other HP-67 or HP-97 made for additional considerations. First, the card reader speed can vary $\pm 5\%$ of nominal from one calculator to another. Second, the clock rate controlling the microinstruction execution rate can vary $\pm 5\%$ of nominal from one calculator to another. The firmware had to be designed taking worst-case values into account, so a card recorded on a calculator with a slow card reader and a fast clock can be read on a calculator with a fast card reader and a slow clock without any bits being lost. This meant that the microprogrammer had to assure that each record could be processed in something less than 84 instruction times.

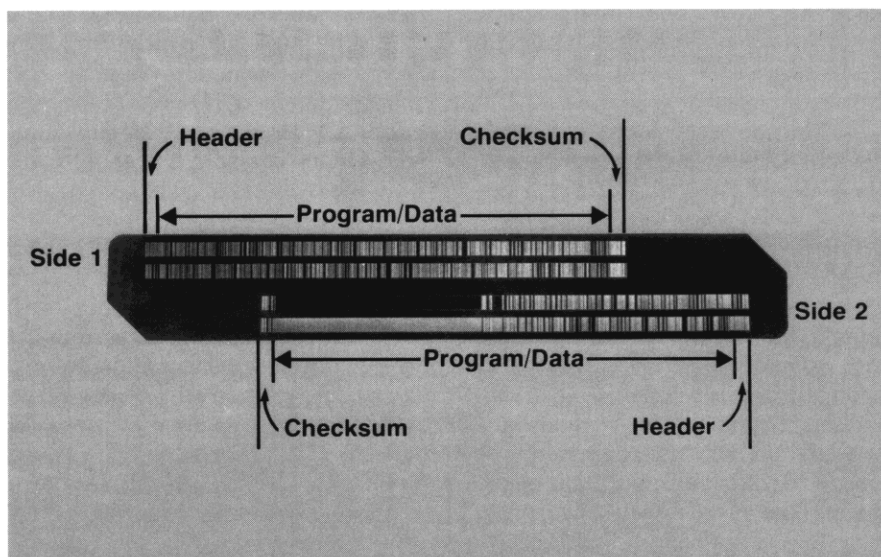


Fig. 2. A typical two-sided program card with the magnetic information made visible. The header tells the firmware what kind of card it is and carries machine status information. Following the header are either 112 program steps or 16 data registers. The last record on the card is a checksum.

Card format.

FIGURE 2 IS A PHOTOGRAPH of a magnetic program card with the recorded information made visible. The first 28-bit record on the card is the header, which carries machine status information if the card is a program card. It must be decoded for one of six card types:

- One-sided program
- First side of two-sided program
- Second side of two-sided program
- One-sided data file
- First side of two-sided data file
- Second side of two-sided data file.

The decoding of the header determines where the remainder of the information on the card should be stored and whether or not the user should be prompted to turn the card around and read it again by displaying the message CRD.

The next thirty-two 28-bit records are either 112 program steps ($3\frac{1}{2}$ program steps per record) or 16 data registers ($\frac{1}{2}$ data register per record). Since the program and data storage memories are actually identical groups of 56-bit shift registers, records must be packed, two per register, prior to storing. The process of storing each record also includes

adding it to a running sum of all the previously read records to form a checksum. This computed checksum is compared to the recorded checksum, which is the last record on the card, to see whether any errors occurred in the reading process. If an error did occur the firmware clears memory and notifies the user by displaying ERROR.

Writing a card is fundamentally the same process in reverse. Writing is attempted if a card is inserted into the card reader with the PRGM/RUN switch in the PRGM position or if a write data command has been issued either from the keyboard or by the program in the RUN mode. When the card reaches the head, the head switch is activated. If the corner of the card has not been clipped to protect the card, the write protect switch will also be activated and writing will commence. The firmware generates and transfers to the CRC the 28-bit header record for clocking out onto the card via the read/write chip. Then the appropriate program or data registers are retrieved, unpacked, and transmitted to the CRC. Each record, as it is processed, is added to the checksum, which is then recorded as the last record. If an attempt is made to write on a file-protected card, an error flag is sent from the CRC to the ACT, the firmware generates an ERROR display, and the card is passed without modification.

Questions & Answers.

Here are a few questions that often pop up in our mail, along with the answers.

Do HP-65 program cards work in the HP-67 and HP-97?

No. The extra power in the HP-67 and HP-97 required subtle changes in the programming language. For instance, conditionals in these new calculators only skip one step on false tests since all functions take only one step of program memory. You'll find that in most cases, converting your HP-65 programs is not difficult. (However, blank cards can be used interchangeably.)

I've lost my calculator. Can you help?

The first thing you should do when you purchase your calculator is to record the serial number yourself. We keep a record of lost calculators by serial number and should the lost unit come in to our service department, we will notify you.

Is there a user's library for the HP-25 and HP-25C?

Hewlett-Packard does not maintain a library of programs for these calculators. However, we are informed that a library does exist.* You can get details by contacting:

Curtis G. Adams
Route 2, Box 965
Estacada, Oregon 97023

*NOTE: This club is not sponsored by nor in any way officially sanctioned by Hewlett-Packard.

At last: a dc recharger.

Now available is a new accessory most often asked for by our existing customers.

Hewlett-Packard's new dc recharger can charge your calculator in your car, boat or motor home—any place where there is a 12-volt supply. Now you can charge your calculator on the way to work or to the field.

Beyond the Call of Duty.

Here is another case where an HP calculator has survived unusual treatment.

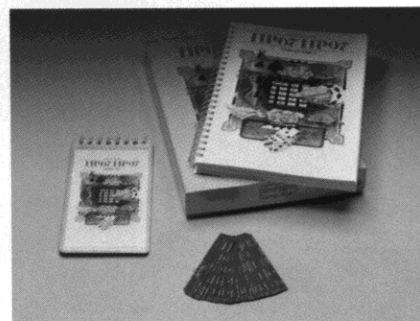
Last winter, while traveling to work at Bemidji State University, in the "Ice Box of the Nation," my car became stuck in a snowbank. While shoveling out the car my HP-65 fell from my pocket, but I didn't miss it for two hours. Anxiously hurrying back in sub-zero weather I saw that a snowplow had been through. I was relieved to see the HP-65 atop the 6 foot snowbank, (about 15 feet from the highway). A chip on one end of the case showed that the calculator had been struck sharply by the blade of the snowplow, so I was amazed to find that the HP-65 still worked. It has been working beautifully ever since!

Gordon E. Lindgren
Bemidji, Minnesota

A 67/97 pac full of games.

Play golf at the Country Club where a hacker with a high handicap can beat a pro. Annihilate alglogs in outer space before time and energy run out. Lose your shirt or win a fortune at blackjack or craps. Or try any of 15 other game programs in the new HP-67/97 Games Pac I.

The games are designed primarily to provide fun but they are also helpful in teaching principles of math, physics and logic.



We've moved and changed our name.

If you're feeling funny about sending in your calculator order to the Corvallis Division in Corvallis, Oregon, relax. This is simply the new name for the Advanced Products Division, now that it has moved to Oregon.

Many of the same people will be answering your questions, building your calculator, and processing your order. So although our name and address have changed, our consistently high quality remains the same. Officially, our new address is:

Hewlett-Packard Company, Corvallis Division, 1000 N.E. Circle Blvd., Corvallis, Oregon 97330

To return a calculator by mail (not U.P.S., etc.) use this new address: Hewlett-Packard Company, P.O. Box 999, Corvallis, Oregon 97330

Our 7-day 24-hour toll-free number has also changed. To locate your nearest dealer or place an order call: 800-648-4711 Extension 1000 (In Nevada dial 1-702-323-2704 collect.)



A pocket calculator specifically designed for complete business management.

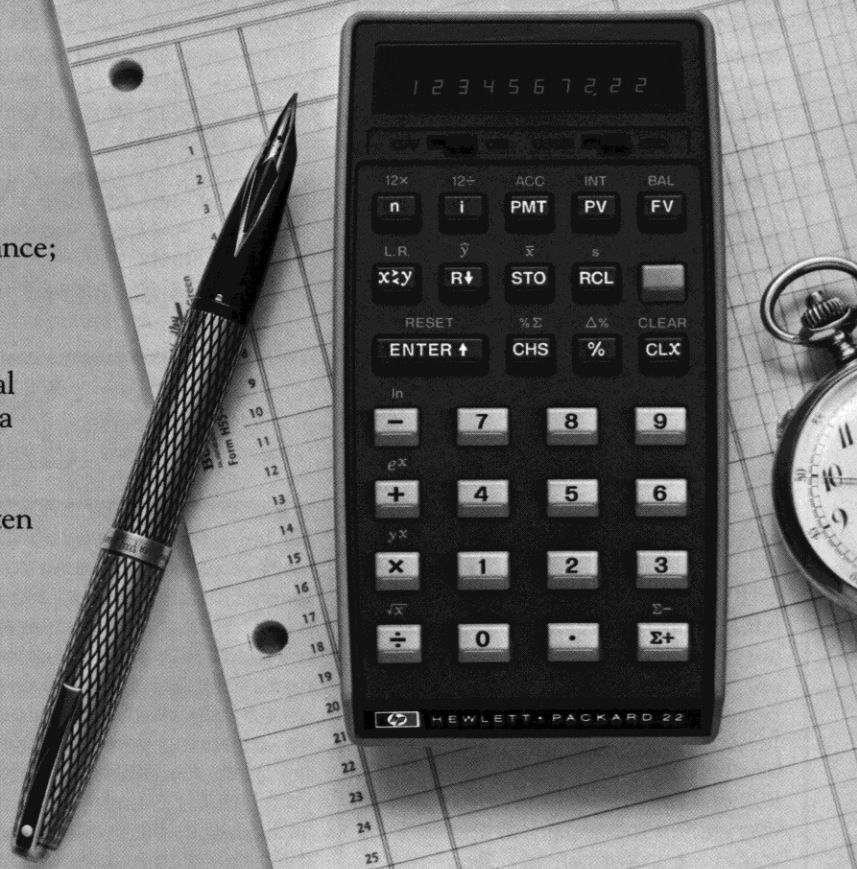
Hewlett-Packard's HP-22 puts an ideal combination of financial, mathematical and statistical functions right at your fingertips.

The HP-22 is an indispensable management tool that lets you perform—easily, quickly and dependably—virtually every computation you need in modern business management from simple arithmetic to complex time-value-of-money problems to planning, forecasting and decision analysis.

- Automatically computes discounted cash flow; percentages; compound interest; remaining balance; annuities; depreciation; statistics; rate of return; amortization and more.
- Expanded percentages capability.
- 19 memories: 5 financial memories, 4 operational memories, plus 10 addressable memories for data storage and register arithmetic.
- Full decimal display control.
- Remarkable Owner's Handbook. A clearly-written survey course in modern management problem-solving, analysis and planning.

See and try the new HP-22 today.

For more details, see page 15.



HEWLETT *hp* PACKARD

Corvallis Division, 1000 N.E. Circle Blvd.,
Corvallis, Oregon 97330, U.S.A.

International Offices

3200 Hillview Ave., Palo Alto, CA 94304, U.S.A.
7 rue de Bois-du-Lan, P.O. Box 349, CH 1217,
Meyrin 2, Geneva, Switzerland
Hewlett-Packard LTD, 6877 Goreway Drive,
Mississauga, Ontario L4V-1M8, Canada

Scan Copyright ©
The Museum of HP Calculators
www.hpmuseum.org

Original content used with permission.

Thank you for supporting the Museum of HP
Calculators by purchasing this Scan!

Please to not make copies of this scan or
make it available on file sharing services.