

The Golden Age of HP Through Some of Its Masterpieces

# Hewlett-Packard Calculators, Computers, HPIB

History, Engineering, and Restoration

• HP-35 • HP-45 • HP-67 • HP-41C • HP-85 •

Giovanni Becattini



# References

The following references are used in this book:

- [TEO] Tektronix Epic Oscilloscopes – Elektor Books
- [7KS] Tektronix 7000 Series – Elektor Books
- [TREG] Tektronix Oscilloscopes Restoration Guide – Elektor Books
- [HP1] Hewlett-Packard and its Voltmeters and Oscilloscopes – Quacktech
- [HP2] Hewlett-Packard Signal Sources – Quacktech
- [HP3] Hewlett-Packard Counters and Spectrum Analyzers – Quacktech
- [HP4] Hewlett-Packard Calculators, Computers and HP-IB – Quacktech
- [VRE] Vintage Radio Equipment – Elektor Book
- [MAC] Apple Macintosh – History, Engineering, and Restoration – Elektor Books
- [QT602] The Good Giant – Tektronix DSA 602A Oscilloscope – Quacktech
- [QT11KP] The Last Plug-ins – Tektronix 11000-Series Plug-ins – Quacktech
- [SCL] Strumentazione Vintage – Edizioni C&C
- [QTCOL] Collins Classics – KWM-2, 30L-1 and 51S-1: History, Engineering, and Restoration – Quacktech Editions
- [QT324] Two Giants and a Shorty – Tektronix 323/324 - Quacktech
- [QTBYP] Become Your Own Publisher – Quacktech
- [QTHPSS] Hewlett-Packard Signal Sources – Quacktech
- [DAB] Digital but Analog – Quacktech
- [TG7] When Machines Learned to Write - Quacktech

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# Preface

*For generations of engineers, Hewlett-Packard—simply “HP”—set the benchmark for electronic instrumentation. Its instruments were not merely tools, but expressions of precision, reliability, and a distinctive engineering culture.*

*Founded in 1939 by Bill Hewlett and David Packard, HP grew from a modest garage in Palo Alto into one of the most respected electronics companies in the world. Along the way, it shaped how measurements were performed, interpreted, and trusted, leaving an enduring mark on engineering practice.*

*This volume is part of the Technical Art Books collection and belongs to the series The Golden Age of HP: Through Some of Its Masterpieces, which explores that remarkable period through a selection of instruments and systems that best represent HP’s engineering philosophy.*

*While other volumes in the series focus mainly on classic measurement instruments, this book moves toward programmable systems and personal engineering computers. Machines such as the HP-85 were not simply computers, but tools designed for engineers and closely integrated with laboratory instrumentation.*

*Like the other books in the series, this volume combines historical notes, technical analysis, personal memories, and practical restoration experience. Its aim is not only to document remarkable machines, but also to preserve the spirit of an era in which electronic engineering achieved a rare balance of rigor, elegance, and human ingenuity.*

*Giovanni “Gianni” Becattini*  
*[giovanni.becattini.books@gmail.com](mailto:giovanni.becattini.books@gmail.com)*

*To my wife  
and my family*

Voltmeters and  
Oscilloscopes

Signal Sources

Counters and  
Spectrum  
Analyzers

Calculators,  
Computers,  
and GPIB



Hewlett-Packard

Voltmeters

Oscilloscopes

Signal Sources

Counters

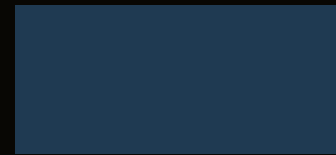
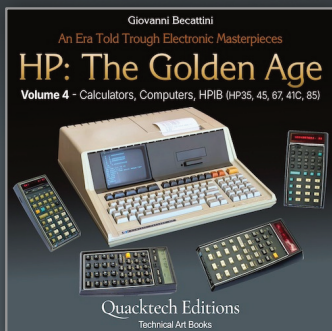
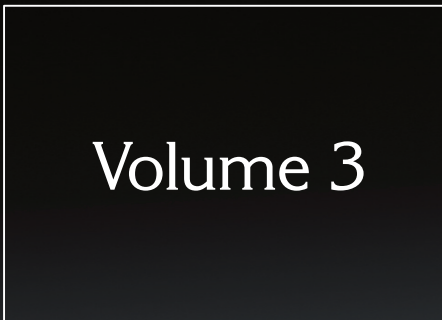
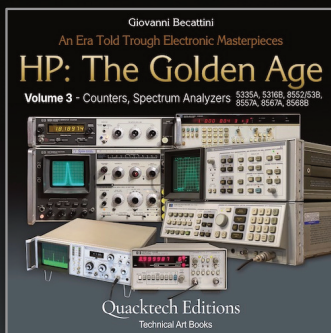
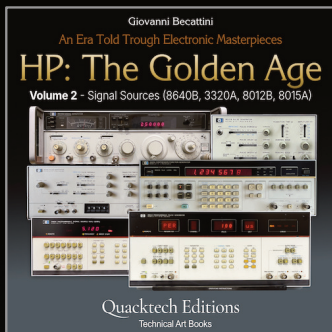
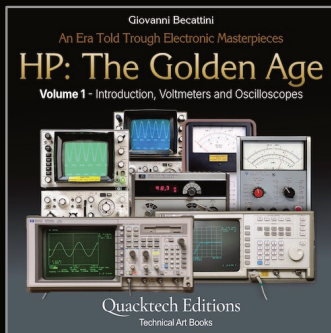
Spectrum Analyzers

Calculators

Computers

HP-IB

# HP: The Golden Age



Hewlett-Packard

Voltmeters

Oscilloscopes

Signal Sources

Counters

Spectrum Analyzers

Calculators

Computers

HP-IB



HP-35 SCIENTIFIC CALCULATOR – HEWLETT, BILL – 1972, OWN WORK

Section

# Calculators

The Information Technology becomes personal and pocket-sized.



Section:

# Calculators

Subsection:

HP-35 Calculator

The first scientific calculator ever







Battery Pack HP 82001A



❶ The HP-45's back label. ❷ The HP-45. ❸ The HP-35. ❹ The HP-41C.

# HP-67 and HP-67 give you exceptional programming power and ease of use for lengthy, repetitive calculations.

## Magnetic card reader every er.

ader in both the HP-97 much more than record ator to card or load to calculator.

entire program memory, either manually or under card reader can read automatically.

ta from all registers onto can also load every or selected registers.

key in data for your reader accepts data run or automatically record.

programs the HP-97 and record the angular mode setting and the status of the previous step of program memory. In PRGM mode, use BST to back up one step at a time in your program.

**Insert and Delete.** You can easily insert operations by positioning the calculator at the step before the intended insertion. Then simply key in the function or functions to be inserted. All subsequent instructions will be "dumped" down one step in program memory for each inserted operation.

**DEL Delete.** When you press f DEL, the displayed instruction is erased from program memory and all subsequent instructions move upward one step.

**Printed tape simplifies checking programs or calculations.** With the HP-97 you have the additional advantage of a printed tape to help you with your editing. You can list your programs, as shown below, and easily check them for mistakes.

card is required, the "Crd."

## Editing is fast and easy

The HP-97 and HP-67 make it easy for you to correct or change your programs.

### Moving to the Right Step.

**GTO** Go To.

In order to correct or change a step in your program, you need to be able to display it quickly and easily. The GTO key followed by the decimal key and a three-digit step number lets you do just that, in either RUN or PRGM mode.

### BST Single Step.

To help you find mistakes in your program, you can execute it one step at a time using the SST key in RUN mode. Or, in PRGM mode, you can use SST to step through each instruction and compare the keycodes with your program listing.

### BST Back Step.

In RUN mode, press BST to display the contents of the previous step of program memory. In PRGM mode, use BST to back up one step at a time in your program.

### Insert and Delete.

You can easily insert operations by positioning the calculator at the step before the intended insertion. Then simply key in the function or functions to be inserted. All subsequent instructions will be "dumped" down one step in program memory for each inserted operation.

### DEL Delete.

When you press f DEL, the displayed instruction is erased from program memory and all subsequent instructions move upward one step.

### Printed tape simplifies checking programs or calculations.

With the HP-97 you have the additional advantage of a printed tape to help you with your editing. You can list your programs, as shown below, and easily check them for mistakes.

826	*LBLA	21	11
827	F8P	16	23 00
828	SFC	16	-11
829	RCL E	36	15
830	I	01	
831	+	-55	
832	F8P	16	23 00
833	PRTY	-14	
834	x <sup>2</sup>	-41	
835	F8P	16	23 00
836	PRTY	-14	

pleted building the number x. Then key in the value for y, and press **f**. The number of data pairs plus one (i + 1) will appear in the display. Repeat the procedure for all data pairs. Try it for this data set:

x <sub>i</sub>	1	3	7
y <sub>i</sub>	2.7	20	1100

The keystrokes you should use are **1** **ENTER** **2.7** **3** **ENTER** **20** **7** **ENTER** **1100** **f**. If you make a mistake, look at the second note at the bottom of the User Instructions. It describes procedures for correcting errors. If the last input pair was in error, you could press **f** **DEL** **f** and eliminate it. Don't do this. Instead eliminate the (3,20) pair and replace it with (4,60). The keystrokes are **3** **ENTER** **20** **4** **ENTER** **60** **f**.

Now that you know how the program works, the mnemonics on the magnetic card will prompt you on data input and data correction.

When all data have been keyed into the calculator, the regression coefficients can be calculated. Step 7 of the User Instructions says press **f** to do this.

Three values will be displayed in the order listed in the comments column of the user instructions. First, the coefficient of determination (R<sup>2</sup> here equal to 1.00) will be displayed. Then the regression coefficients, a (1.02) and b (1.00), will be displayed. Go ahead and press **f**. When execution stops (after all three values have been displayed), you may review the values by pressing **f** again.

If you wish to have more time to observe a value during a pause, press **f** during the pause. This stops program execution leaving the value displayed. To restart the calculator, press **f** again. Try this. Press **f**, then stop the calculator during the first pause by pressing **f**. Press **f** again to restart program execution. Stop the calculator during the second pause and see 1.02. Press **f** again to complete the calculation. Note that during an output pause, the decimal point flashes. This signifies that program execution has not terminated and will resume automatically.

## 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.

### 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.

### PAUSE

If you need to key in data or load a card in the middle of your program or to see an intermediate answer—no problem. The PAUSE function initially interrupts program execution and displays current results for about 1 second. At that time, you can optionally enter data from the keyboard or load magnetic cards. The interruption is extended for as long as necessary. If you want the program stopped indefinitely, you can use the R/S (Run/Stop) function.

### 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.

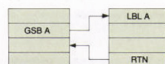
### Subroutines

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 next RTN (Return) instruction when the next RTN instruction is executed (see following illustration.)

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

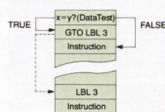


After a GSB instruction, RTN transfers program execution to the program step following the GSB.

### Conditional Branching.

$x \neq y$  |  $x = y$  |  $x < y$  |  $x > y$   
 $x \neq 0$  |  $x = 0$  |  $x < 0$  |  $x > 0$

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  $y$ .

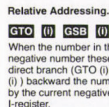
### Flags.

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. Flags F0 and F1 are command-cleared flags. Once they have been set, they remain set until cleared using a CLF (Clear Flag) instruction. Flags F2 and F3 are test-cleared flags. They are cleared automatically.

## Indirect Addressing.

You can perform a direct routine to a label specified by the number in the I-register. **GTO (i)** **GSB (i)**

These operations depend on the I-register. If it is positive, direct branch (GTO (i)) (i) to the label specified.



## Relative Addressing.

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

When the number in the negative number these direct branch (GTO (i)) (i) backward the number by the current negative I-register.

**006 Instruction**  
**007**  
**008 GTO (i)**

**Indirect Control of Data Operations.** You can also use the I-address of a storage register.

**STO (i)**  
**RCL (i)**  
**STO +**  
**STO x (i)** **STO**



## Section 1 Getting Started

Your HP-67 is shipped fully assembled, including a battery. You can begin using your calculator immediately by connecting the cord from the ac adapter/recharger and plugging the charger into an ac outlet. If you want to use your HP-67 on battery power alone, you should charge the battery for 14 hours first. Whether you operate from battery power or from power supplied by the charger, the battery pack must always be in the calculator.

### To begin:

Slide the W/PRGM-RUN switch **WPRGM** **RUN** to RUN.  
 Slide the OFF-ON switch **OFF** **ON** to ON.

### Display

Numbers that you key into the calculator and intermediate and final answers are always seen in the bright red display. When you first turn the calculator ON, the display is set to **0.00** to show you that all zeros are present there.

### Keyboard

Each key on the keyboard can perform as many as four different functions. One function is indicated on the flat plane of the key face, while another is printed in black on the slanted face of the key. A third and a fourth function may be indicated by printed symbols in gold and blue, respectively, below the key.

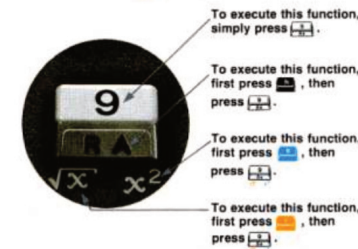
There are three *prefix* keys, **f**, **f**, and **f**. By pressing one of these prefix keys before pressing a function key, you select the function printed on the slanted key face or one of the functions printed in gold or blue below the function key.

To select the function printed on the flat plane of a function key, press the key.

To select the function printed in black on the slanted key face, first press the black **f** prefix key. Then press the function key.

To select the function printed in gold below the function key, first press the gold **f** prefix key. Then press the function key.

To select the function printed in blue below the function key, first press the blue **f** prefix key. Then press the function key.



In this handbook, the selected key function will appear in the appropriate color, outlined by a box, like this: **f**, **f**, **f**.

### Keying In Numbers

Key in numbers by pressing the number keys in sequence, just as though you were writing on a piece of paper. The decimal point must be keyed in if it is part of the number (unless it is to be right of the last digit).

### Example:

Key in 148.84 by pressing the keys **1** **4** **8** **.** **8** **4**

**Display**  
**148.84**

The resultant number 148.84 is seen in the display.

At nearly the same time that the second switch is activated, a third switch may or may not be activated depending on whether the corner of the card is cut off. This is the file protect scheme, which prevents the user from writing over a previous program. When the second switch is activated the third switch is interrogated. If the third switch is not activated (the corner being cut off) the machine will not write over that card when the calculator is in the W/PRGM mode.

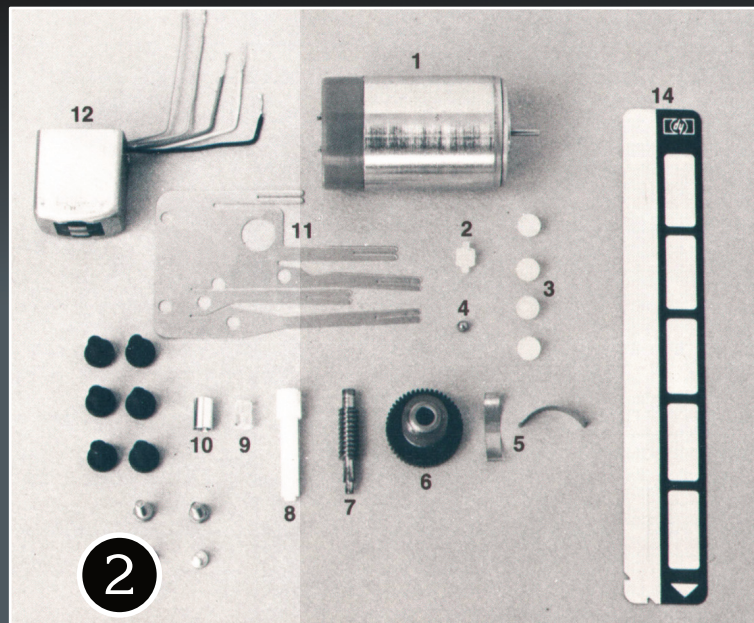
The data is written/read by a two-track recording scheme. As the card proceeds out the left side of the calculator it is held against the side of the card guide by a second side-loading leaf spring. When the trailing edge of the card passes the motor start switch the motor and read/write circuits are shut off. The card may then be removed from the machine. Figure 1 shows the card-reader parts disassembled.

## The Key to Success

The card reader was probably the most important key to the success of the HP-65/67, because it opened the door to this terrible and wonderful thing we call software. Not only could you start creating and selling your own applications, but you could also draw on the extensive HP (or third-party) software collection.

HP Application Pacs allowed users to save a lot of time solving a wide range of problems. They allowed the full power of the HP-67 to be used immediately. A wide variety of programs - in science, engineering, and business - were made available on pre-recorded magnetic cards. Application Pacs contained 19 to 26 pre-printed, pre-recorded program cards, a program card holder, and a manual with complete documentation.

The manual also contained operating instructions, equations, limits and warnings, and sample problems with solutions for each program in the Pac.



Application Pacs contain 19 to 26 pre-printed, pre-recorded program cards, a program card holder, and a manual with complete documentation.

The manual also provides operating instructions, equations, limits and warnings, and sample problems with solutions for each program in the Pac.

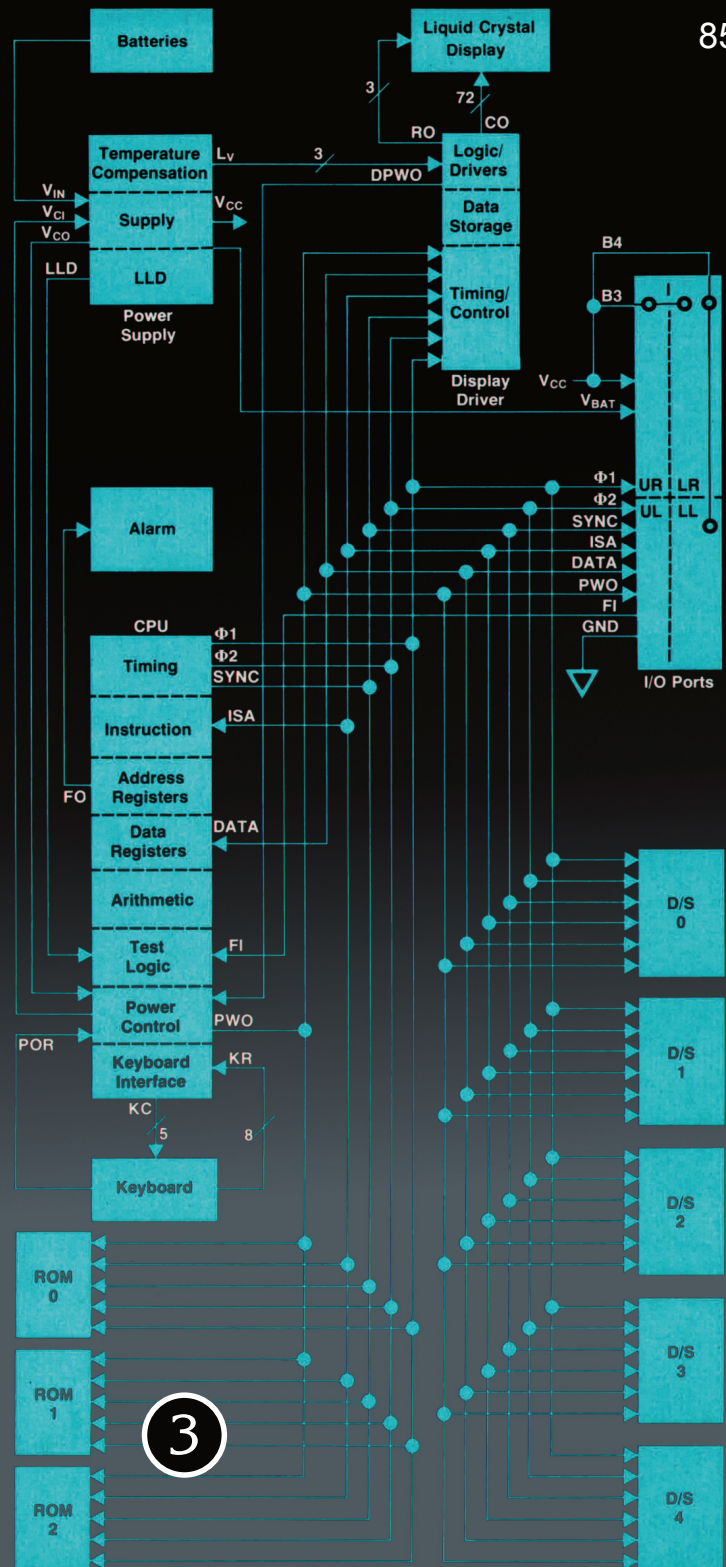
See over page for list of all HP Application Pacs currently available for the HP-67 and HP-97:

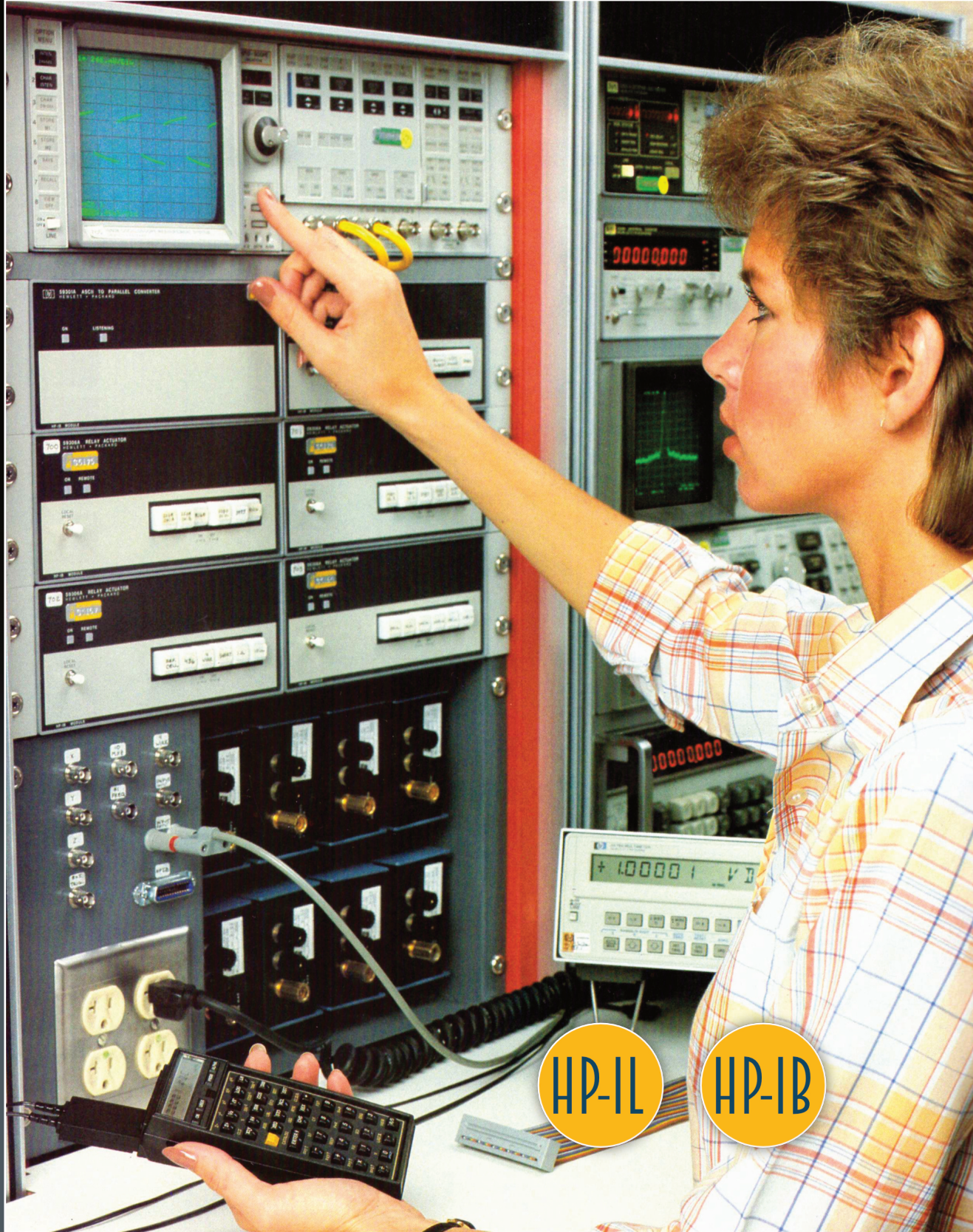
In addition to these addressing and register capabilities, other CPU enhancements include new peripheral instructions to meet I/O demand, software-programmed on-off logic, automatic reset circuitry, and a new instruction to read ROM contents as data. The new instruction, CXISA, is especially useful for reading lookup tables, application ROMs, and ROM checksums. The HP-41C contains 12K words of system ROM (read-only memory), partitioned into three ROM chips with 4K words of 10 bits in length. That is 16 times more ROM than the HP-35 and more than twice that of the HP-67. The system can accommodate four plug-in application ROM modules at the same time, each containing one or two ROM circuits; the ROM operates in the same way in all four ports. The number of possible application ROMs is not limited by the hardware.

## Data Storage

There are five data storage circuits, each containing 16 56-bit registers of RAM (random-access memory). One of these circuits is allocated for internal storage, including the stack, display register, program pointers, and so on. The other four chips provide the user with 64 registers that can be partitioned between data and program memory at a rate of seven bytes of program per register.

❶ The HP -41 alphanumeric display. ❷ The HP-41C logic board (CPU). ❸ The HP-41C block diagram.





HP-IL

HP-IB

# HP-85

## Hey, This Is Not an Instrument!

Yes, I know—but there are many reasons to talk about it. First, it has often been used as a controller for instrument systems via the HP-IB interface. But above all because I like it: it was one of my dreams at the time, although far too expensive to buy just for fun. Moreover, it was one of the “Great HP” products, and therefore fully consistent with the spirit of this book.

## First of a Lineage

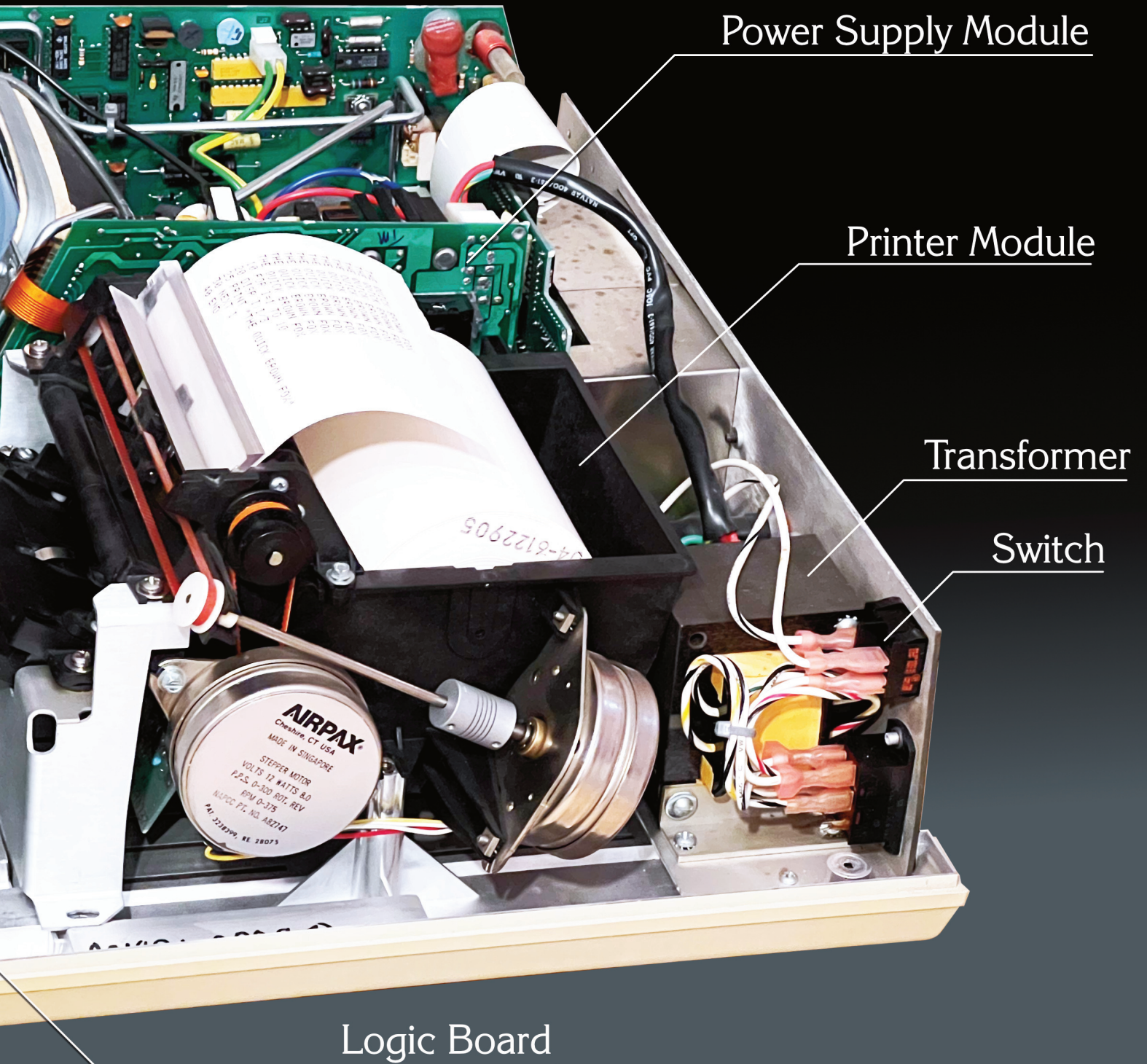
Briefly, the HP-85 was the first member of the HP 80-Series family of microcomputers introduced at the end of 1979. But this alone says very little; to appreciate the HP-85, it is necessary to recall the world in which it appeared—a moment that I remember very well and that I will try to describe here.


## A Long Story

As we saw in the previous chapter, the story began much earlier, with Olivetti’s Programma 101 project and the introduction of the HP 9100 and 9800 series of desktop programmable calculators—machines that offered a kind of “quasi-personal” alternative to minicomputers from companies such as Digital Equipment or Data General.

From this seed came the handheld programmable calculators, such as the HP-67 described in the previous chapter.







A million years ago, I designed the hardware and software of an industrial thermal printer, so the subject is quite interesting to me. As described earlier, the HP-85 printer can print text and graphics. The main goals of the new design were high printing speed and low manufacturing cost. The photo shows the printing mechanism with its companion printed circuit board that contains all of the printer electronics, as well as the power supply shown on the following pages.

All of the required electronics, except for the high current drivers, have been integrated into a single NMOS integrated circuit, the printer controller, which provides internal buffering for up to 32 characters and a 5X7 dot matrix character generator (7x9 is required for good lower case.)

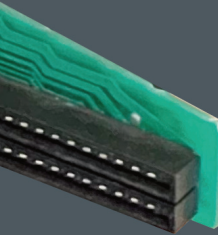
The print head consists of eight thin-film resistors arranged in a vertical column. The entire printhead is moved across the paper so that a character is formed when the correct resistors are activated at specific times.

An eight-position rotary switch is connected to select eight pre-programmed print intensities (7 is the darkest) by varying the pulse duration of the signals applied to the printhead resistors.

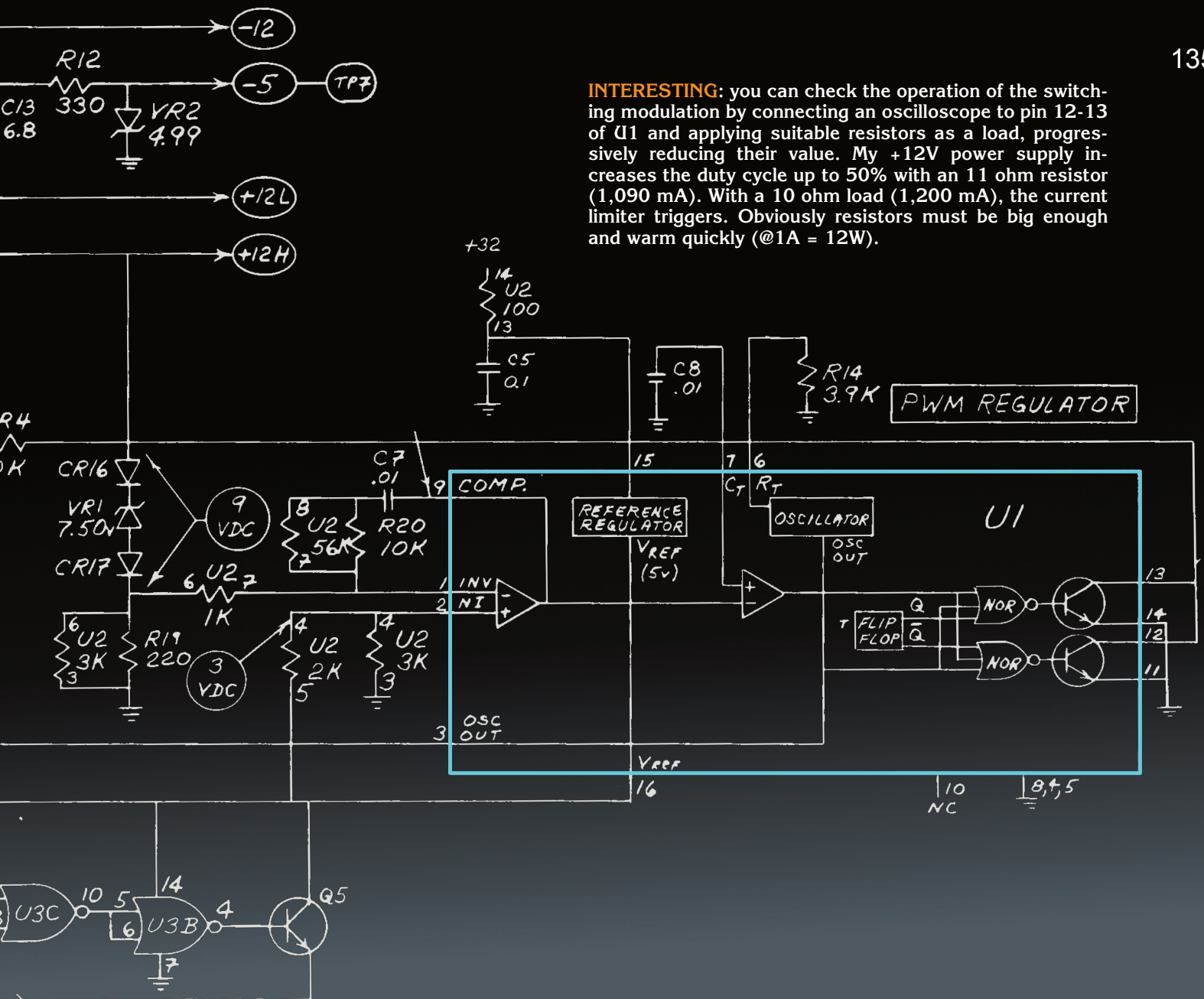
The controller is capable of bidirectional printing for alphanumeric copies; to maximize printing speed, a look-ahead algorithm is built into the chip. The controller decides which direction to print by looking at the current line length and the next line length.

**Details:** the printhead assembly is moved across the paper by the head drive motor. This motion uses a 7.5° (48 steps) step motor that drives the printhead assembly with a toothed belt. The resolution of the motor is doubled by driving it in a half-step mode (3.75% step). Each step corresponds to one dot column of printout. The motor is driven at 448 steps per second, which is equivalent to a print speed of sixty-four characters per second. Paper feed is accomplished by use of an additional step motor. It operates in a full-step mode (7.5% step) and steps at one-third the rate of the head drive motor. Each step corresponds to one dot row of paper advanced. When the controller finishes printing a line, it automatically advances the paper. For alphanumeric copy, the paper advances ten dot rows, spacing three dots between lines. For graphics copy, it advances only eight dot rows; thus it is possible to print a continuous vertical line for graphics plots.

There is no home switch designed into the printer. At the first PRINT command after system power-on, the system firmware will send a home command to the printer controller. Knowing that this is the first home command received since power-on, the controller drives the printhead assembly all the way to the left. The assembly moves toward and eventually contacts the left wall of the frame. After the motor has been given 256 pulses, the controller then reverses the direction of the motor and moves the head assembly four steps to the right. Then it turns off the power applied to the motor and resets all internal position keeping logic. In this manner, a home position is established.



❶ A typical electronic board from the seventies; the HP-85A had a socket for most ICs; in this 85B, only one for the printer controller is retained. Most boards have only two layers and SMD is still far away (better for us!). After many years, the most critical parts are definitely the ribbon cables and their connectors. Use a thin transparent plastic sheet as an extractor, as described in the text.



range. If the twelve-volt supply shorts, the input power drops, and the short acts as a finite current with zero output voltage.

A + 12V over-voltage sensor crowbars the unregulated 32-volt supply if Q1 is shorted. The other supplies do not have an over-voltage failure mode.

- ❶ A HP98200 cassette with the damaged tape; note the transparent sections. ❷ The driving belt (in red) that moves the tape, driven by the capstan. ❸ The hole in the tape used to signal the approaching end of the tape. ❹ The two holes used to signal the end of the tape.

To use them, you need to

- a) raise the capstan about 2 mm (see next);
- b) add a 1K8 resistor in parallel to R1 to increase the write current (the DC2000 tape has a higher magnetic coercivity);
- c) slightly widen the hole in the PCB, as shown on the previous page.

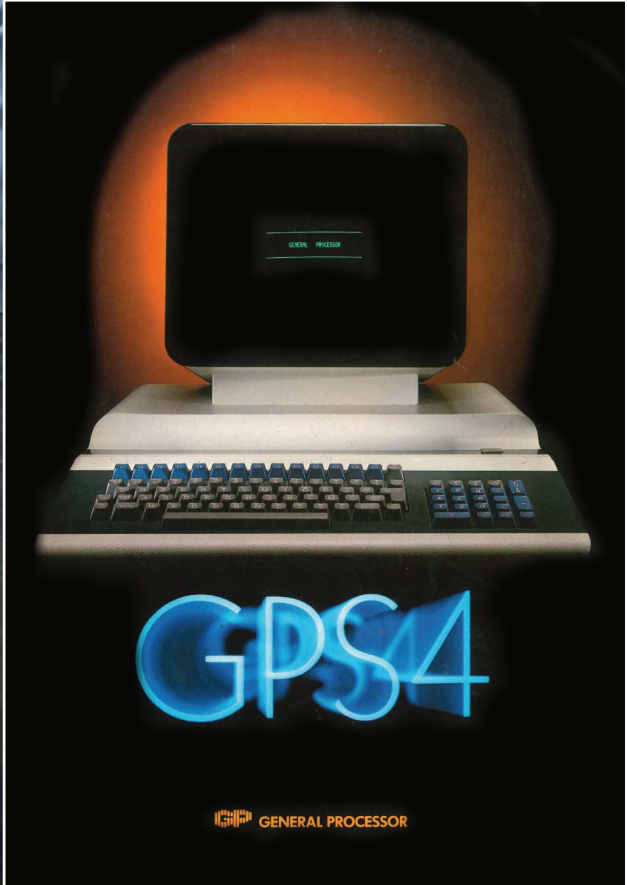


# OS Extensions

One of the strengths of HP calculators was the availability of many software add-ons, either at the system or application level. The HP-85 could also accept ROM cards in its I/O slots. Each ROM card (82936A) could accept up to six ROM plug-ins; each ROM plug-in was a matchbox-sized plastic package that snapped into one of the sockets on the ROM card. Since each ROM was "bank-switched" (the CPU turned them on or off as needed), a user could plug in as many ROM cards as needed (up to four, anyway).

These ROMs enhanced the capabilities of the BASIC interpreter. The most important were (marked with an asterisk those included as default in the HP-85B):

- 00085-15001 **MASS-STORAGE ROM**: provides the capability to interface the HP-85 with the HP 8290X-series Flexible Disc Drives or the HP 9134A/9135A Winchester Disc Drive.
- 00085-15002 **PLOTTER/PRINTER ROM\***: gives the ability to control plotters and external printers. Allows data to be transferred to an HP plotter. Also provides single commands to dump CRT graphics and alpha screens to any HP dot matrix printer.
- 00085-15003 **I/O ROM**: gives the extended functions needed to control its optional I/O interfaces. Provides straightforward input/output commands that enhance the BASIC language capability.
- 00085-15004 **MATRIX ROM\***: gives a powerful set of statements and functions for working with arrays. Both matrices (2-dimensional arrays) and vectors (1-dimensional arrays) are supported. Ideal for those who need matrix computation.
- 00085-15005 **ADVANCED PROGRAMMING ROM\***: gives the user extended functions for the BASIC interpreter. Extends your control over data, programs and system operations. I find it very interesting, and dedicated an extra page to it (see below).
- 00085-15007 **ASSEMBLER ROM\***: provides the capability to write customized assembly language programs that can be executed from the user memory or burned into EPROMs. Used often with the HP 82928A (System Monitor ROM) and HP 82929A (Programmable ROM Drawer). More in the following.
- 00085-15012 **ELECTRONIC DISK (EDISC) ROM**. The HP-85 may accept up to 4 HP-82908A 64 Kbytes, or HP-82909A 128 Kbyte RAM cards. The EDISC ROM allows some of this memory to be used as a high-speed RAM disc speeding access to programs and data.



5¼-inch floppy disks were a novelty in 1976, when I bought a Shugart SA-400 with controller for about 1,200 million Liras; the same money could buy a Honda 400 motorcycle. 175

By the end of the 1980s, 5¼-inch disks had been superseded by 3½-inch disks, and during this time, PCs frequently came equipped with drives of both sizes. The advantages of the 3½-inch disk were its higher capacity, its smaller physical size, and its rigid case which provided better protection from dirt and other environmental risks.

The HP 3½-inch Flexible Disc was a Sony random-access drive, available in both single-and dual-head configurations. The single-head version was used in the HP 9121D/S and HP 9133 A/B/V/XV products. The dual-head drive was used in the HP 9133D/H, HP 9122D/S, HP 9114A and HP 9153A.

The first appearance of a 3½-inch floppy was 1983 HP catalog, with the 9121, which, in addition to low-cost, reliability, and speed of random access, offered the possibility to use the new smaller and more compact discs. The 3½-inch single-sided drives provided the same amount of storage capacity of the 5¼-inch (270 Kbytes), thanks to the increased track density: 135 tracks per inch, compared to 48 tracks per inch of older ones.

The media was finally totally enclosed in a shirt-pocket-sized, hard plastic envelope to protect it from contamination. A built-in hub reduced centering problems of the media.

The unit weight of 650 grams is enormous today but incredibly low at the time; the rotational speed was of 600 RPM, with one second of start time.

❶ The 3½-inch HP drive was produced by Sony.

❷ The first floppies used only one side, but later they passed to two. The hole on the left identified the high-density floppies.

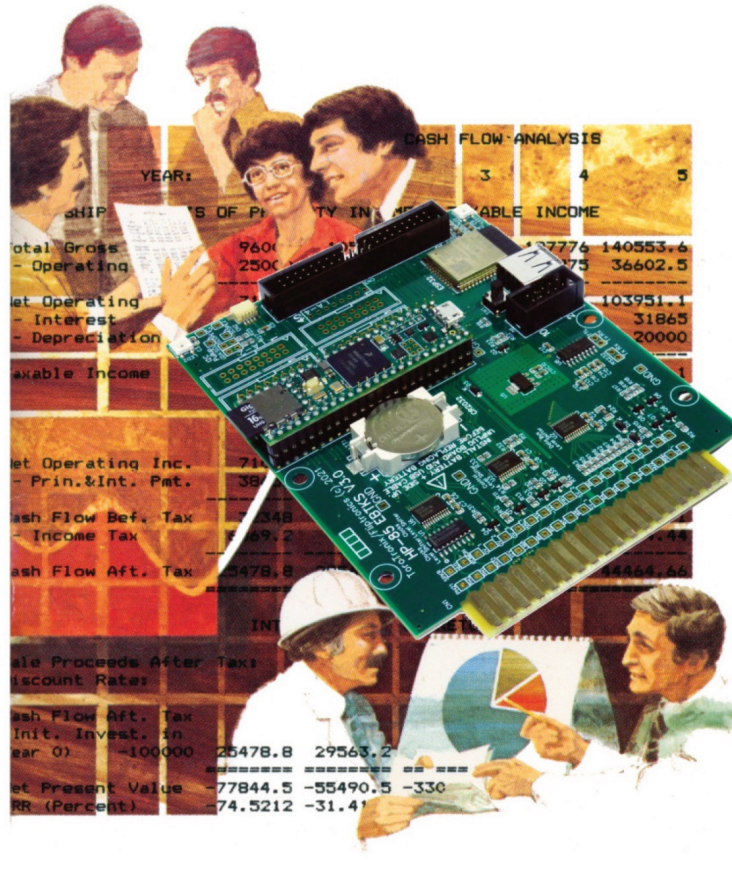
❸ The other hole could be closed by a sliding tab. When left open, it signaled a write-protected disc.



FLIPTRONICS / TOROTRONICS / KASER SOFTWARE

# EBTKS

Plug-In Module  
Pocket Guide



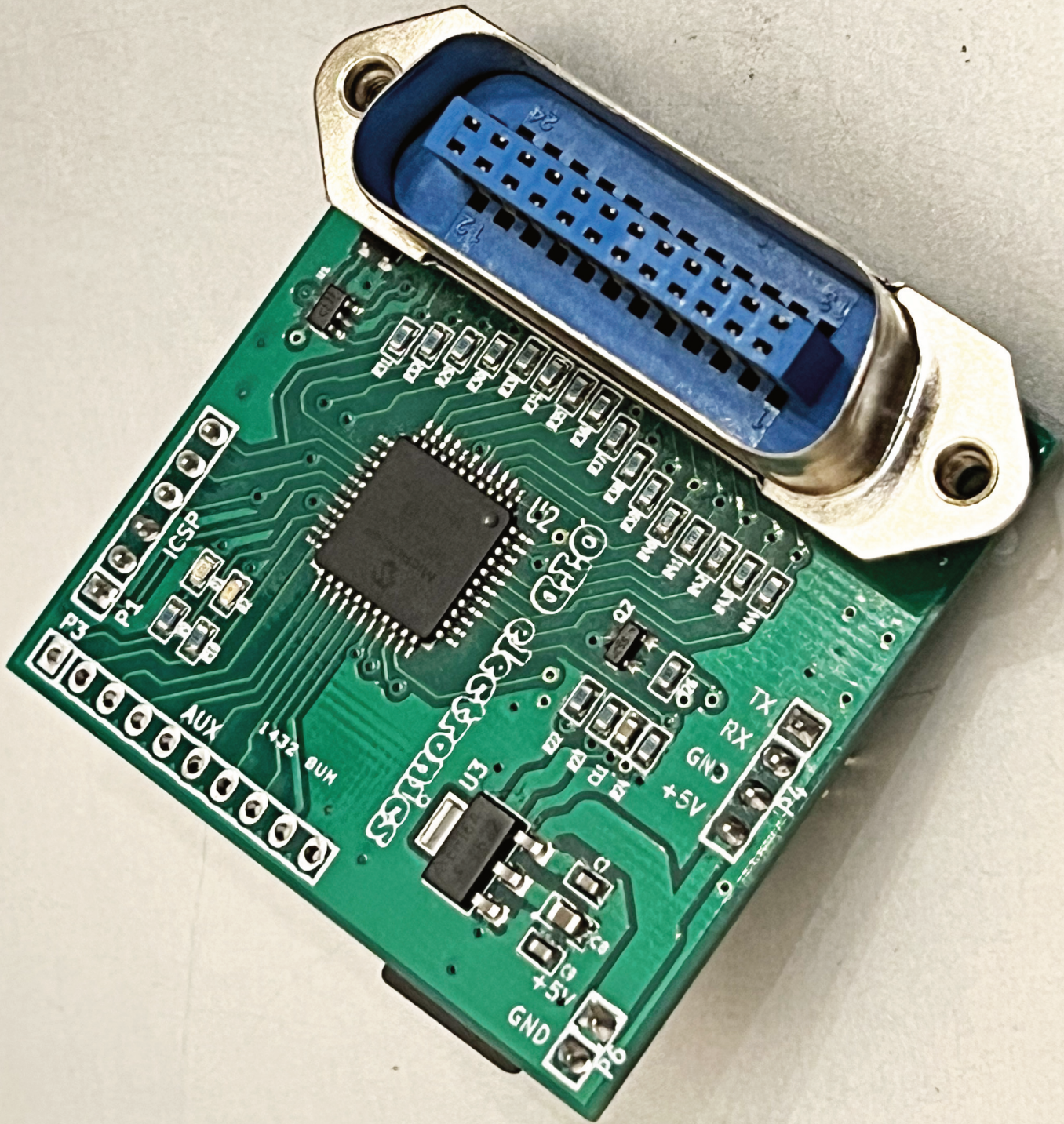
## A Small Great Sign

The above is the EBTKS Pocket Guide. It is only a small part of the huge EBTKS project, but it shows the great attention of the authors to the needs of the users. Even the cover graphic is designed in HP style!

**SOME ASSEMBLY  
REQUIRED**



**SOME ASSEMBLY  
REQUIRED**



# Thank You All!

Unlike other topics, the HP-85 is an endless chapter. Every time I think I have finished, I discover that there are still oceans of things to study and describe.

My first draft of this document was significantly improved thanks to the friends of `hpseries80@Groups.io`, who patiently reviewed it and, through their suggestions, helped me reduce the number of silly or incomplete things I had written.

In particular, I would like to mention (in alphabetical order):

- **Piero Andreini**, my personal friend, who made possible the repair of the HP-IB interface and supplied the 9121 and 9130 drives, together with the necessary knowledge;
- **Philip Freidin**, one of the creators and the driving force behind the mythical EBTKS board, who also reviewed most of the content of this chapter;
- **Gastone Garziera**, one of the members of the Olivetti Programma 101 team;
- **Everett Kaser**, the man who deserves an equestrian monument;
- **Randy Kindig**, from Floppy Days;
- **Darryl Ramm**, who—among many corrections—suggested the orange color and the new Korinna font. I liked it so much that I adopted it for my other books as well.

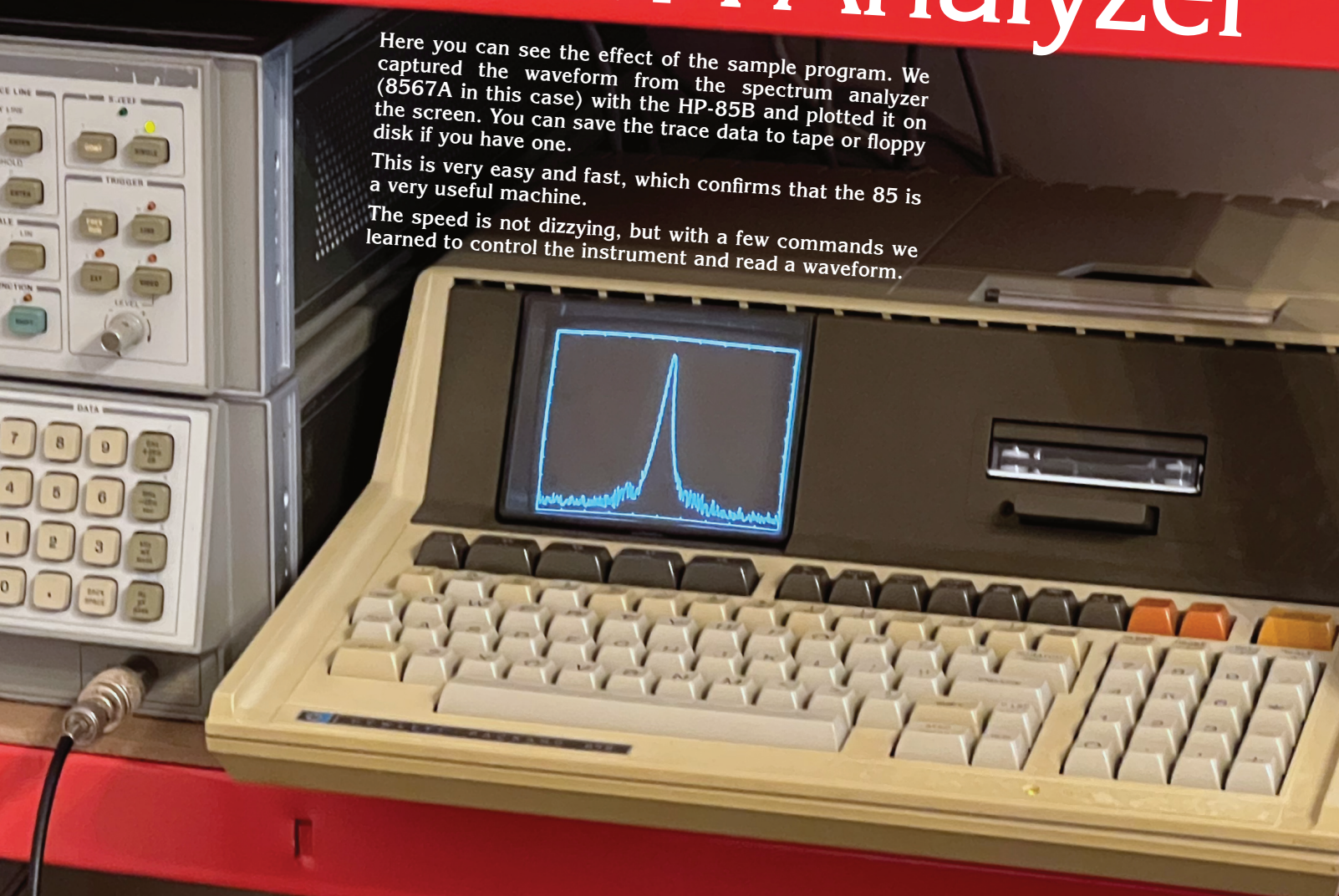
Thank you, guys!

# an 8567A Analyzer

Here you can see the effect of the sample program. We captured the waveform from the spectrum analyzer (8567A in this case) with the HP-85B and plotted it on the screen. You can save the trace data to tape or floppy disk if you have one.

This is very easy and fast, which confirms that the 85 is a very useful machine.

The speed is not dizzying, but with a few commands we learned to control the instrument and read a waveform.



At first sight, this program is very similar to the other examples that we saw before, but the `FUNCDF` command in line 10 specifies that the command must be stored, not executed. By the way, line 30 says also that `Q` will be used to close the function, i.e., to close the store mode. This closing is performed by statement 40. Line 50 associates this function to the 6 key.

❶ Let's use the `Z_ZOOM` function to zoom on the highest peak on the CRT. Simply press `SHIFT`, then the assigned key (the key `6` in this case). ❷ Here we have pressed `SHIFT`, `6`, `Hz`: the highest peak is centered and reported to the reference level. In this photo, you can see the `SHIFT`, the `6`, and the `Hz` keys. Note that every key has a letter associated. In theory you could use them to write your program directly on the analyzer, but that seems more a punishment than a possible job.

