

HEWLETT  PACKARD

MODEL
20

9820A
CALCULATOR

TECHNICAL DATA DECEMBER 1972



New concepts in programmable calculator design make the Hewlett-Packard Model 9820A (Model 20) both the easiest to use and the most versatile desktop calculator available. With the Model 20 you can design a system to meet your own specific needs in the business, technical, industrial, or scientific fields. This system allows you to write, edit, and use programs to solve your problems with unprecedented time savings and ease.

MAJOR FEATURES

An easy-to-use, natural algebraic language simplifies both keyboard calculations and programming.

Simple programming and editing stem from immediate error detection, the availability of program printouts, and the ability to insert, correct, and delete program segments with *automatic* adjustment of program storage.

Three special function keyblocks are defined by up to three plug-in ROM blocks, tailoring the Model 20 to *your* applications.

Both the large, easy-to-read display and the built-in printer have full alphanumeric capability.

Peripheral and memory expandability; internal memory options, external peripherals, and plug-in blocks are available.

A built-in magnetic card reader facilitates recording programs and data, and permits using prerecorded programs.

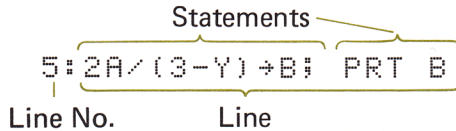
NATURAL ALGEBRAIC LANGUAGE

The Model 20's natural, algebraic language is unique and new to the world of programmable calculators. While achieving programming and operating simplicity, it has some of the best computer language features, including branching and subroutines capability. It also adds many of its own unique features.

Simply key in the mathematical expressions; the Model 20 does the rest. In keyboard calculations, you see the results as numerical answers. The basic calculator can be programmed to include displayed or printed alpha labels and messages.

The Program Line

The structural unit of this language is a *line* composed of one or more statements representing complete activities. The statements are separated by semicolons. For example:



In this line, A and Y are the contents of registers A and Y. The value of the expression $\frac{2A}{3-Y}$ is calculated; the result "goes into" (→) register B. The statement following the semicolon causes the contents of register B to be printed.

The maximum length of a line can be from 35 to 68 keystrokes, depending on its composition.

A line can be either executed or stored.

EXECUTE causes the operations in the line to be performed, and the numerical result, if any, to be displayed. This is keyboard operation.

SIMPLE PROGRAMMING AND EDITING

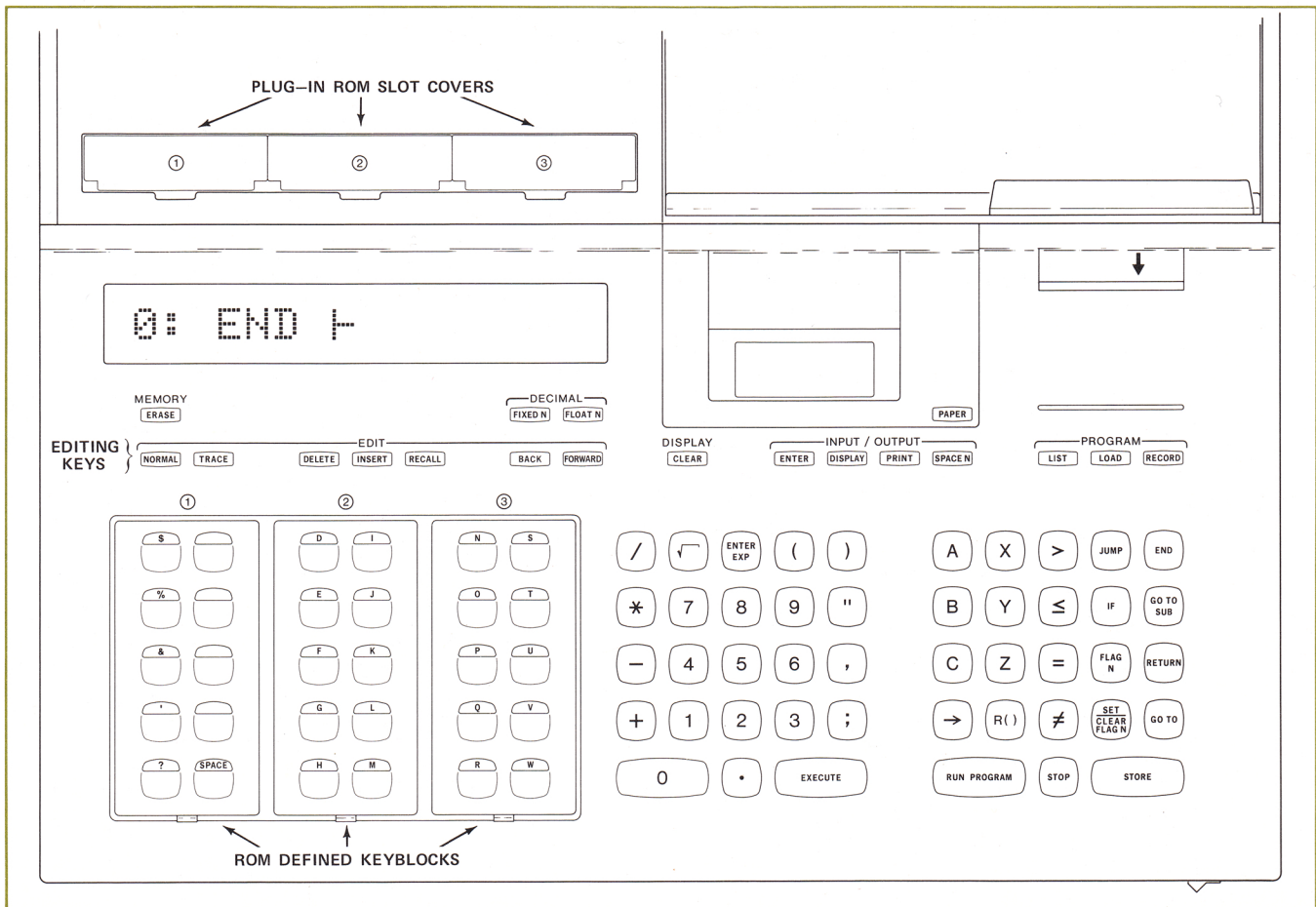
A program is made up of a series of lines.

STORE places the line in the read/write memory as a program line. The lines are automatically assigned sequential numbers (0, 1, 2, ...) as they are stored.

Some unique features which simplify programming and editing are:

Immediate Error Detection

Language syntax errors are detected immediately and a **NOTE (N)** appears in the display, referring to a table identifying the type of error. For example, omitting a closing parenthesis causes **NOTE 03** to appear. The calculator will not accept further entries until the error is corrected.



Quick Program Listing and Tracing

A listing of the program or the part you wish to examine is printed out at a touch of the key. The program listing serves as both an editing aid and a permanent file record.

```

0:
FXD 3:ENT A,B,C:
X:
1:
DSP AA/B+C/XX+Y:
2:
JMP -2:
3:
END :
    
```

Program listing

The TRACE mode is obtained with the **TRACE** key. In this mode, during program execution the printer lists the number of each line and any quantities it stores. This allows you to verify intermediate results and detect logic errors.

```

0:
2→A:          2.000
r3→B:          1.732
-4r7→C:        -10.583
2.011→X:       2.011
1:
2:          -.307
    
```

TRACE mode printout from program above

The TRACE mode is a valuable tool in debugging programs. You can either select it from the keyboard or program it to examine part of a program's activity, then cancel it with a NORMAL statement following the suspected part of the program.

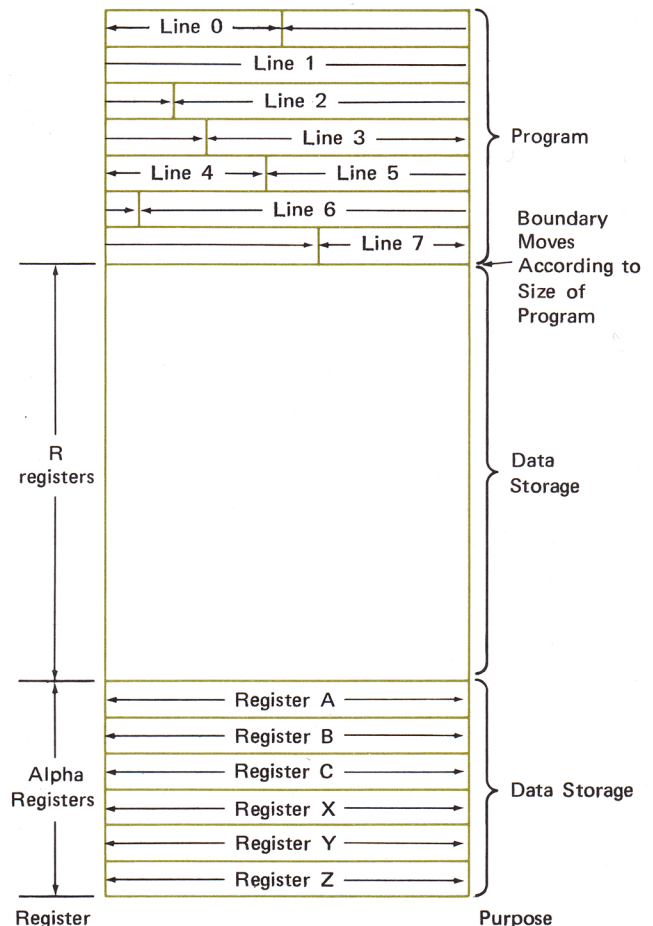
Easy Line Correction, Insertion, or Deletion

You can easily insert an additional line into a program by indexing the line counter, entering the extra line, and pressing **INSERT**, **STORE**. Deleting an extra line is performed by indexing the line counter to the number of the unwanted line, then pressing **RECALL**, **DELETE**.

When an insertion or deletion occurs, the rest of the program moves to occupy the minimum required memory without voids, and program line numbers automatically adjust to remain sequential.

Easy Character and Statement Correction, Insertion, or Deletion

With the editing keys, you can quickly correct, insert, or delete individual characters and program statements within a line. You simply store the modified line in place of the original one. Again, the rest of the program moves automatically to adjust for line length, and the program occupies the minimum required memory. You have no bookkeeping to do.



The Model 20 Memory

EXAMPLES OF BRANCHING

Type of Branch	Statement	Action
Unconditional, fixed address	GTO 10	Branches to line 10.
Unconditional, relative address	GTO +5 GTO -4	Branches ahead 5 lines. Branches back 4 lines.
Conditional, label address	IF X=7; GTO "DIVE"	If X=7, branches to line labeled "DIVE"; otherwise proceeds to next numbered line.
Conditional, computed relative address	IF FLG 2; JMP (A+B)	If Flag 2 is set, jumps ahead or back the computed number of lines; otherwise proceeds to next line.

Other Programming Features

Versatile branching ability gives the Model 20 much of its power. This ability includes conditional and unconditional branching as shown in the above table.

Boolean Capability: logical statements such as $X=5$ will be assigned a value of 1 or 0 depending on the truth or falsity of the statement. For example, a step function can be specified over the range:

$$Y=3 \text{ for } X \leq 10$$

$$Y=7 \text{ for } X > 10$$

in one expression by $(X \leq 10)3 + (X > 10)7 \div Y$.

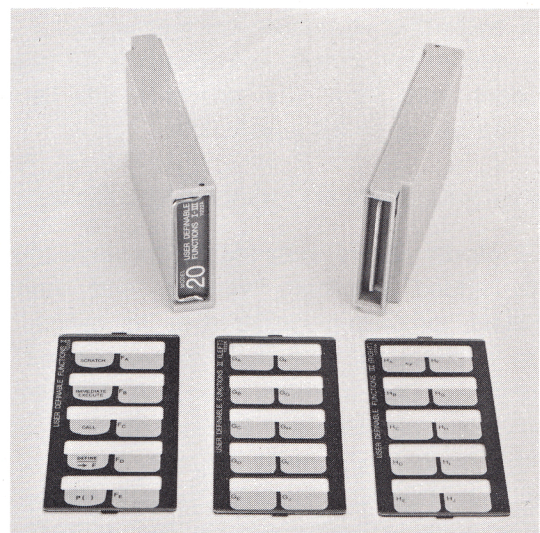
Subroutines can be nested up to 30 deep.

16 flags are available for greater operating and programming versatility. Each flag can be set or cleared either by a program statement or from the keyboard.

Computed R() Register Addresses: the location of data storage, other than in the alpha registers, is in the R() registers (R0, R1, ...). The address can be computed, such as $R(3 + 2Y)$, or nested: $R(R(R12))$, for indirect addressing. Nesting can be to any depth within the allowable program line length.

THREE SPECIAL FUNCTION KEYBLOCKS

Up to three powerful plug-in read-only-memory (ROM) blocks can be used with the Model 20 at one time. Any plug-in ROM can be placed in any



of the three slots provided, to assign special functions to the corresponding keyblock.

More plug-in ROM's will be added to the three now available. The following blocks are described more fully in their individual technical data sheets:

The Model 11220A *Peripheral Control I Block* provides general purpose control of most peripherals, and features an especially powerful control of the Model 9862A Plotter and 9861A Typewriter.

The Model 11221A *Mathematics Block* provides mathematical functions such as sine, cosine, tangent, log, natural log, and their inverses.

The Model 11222A *User Definable Functions Block* allows you to write your own mathematical functions, defining up to 25 of the left-hand keys, and use them by name.

ALPHANUMERIC DISPLAY

Light-emitting diodes provide a bright, 16-character display, which is easy to read over a wide range of angles and distances. Each of the 9/32 inch (.714 cm) high characters uses a 7 x 5 dot matrix to provide naturally-shaped numbers, letters, and symbols in this size:



ALPHANUMERIC PRINTER

A quiet thermal printer is built into the basic Model 20 Calculator. It can print the same numbers, symbols, and letters that are displayed, as well as user instructions, alpha labels for program results, and other alphanumeric messages.

The maximum *printer* line length is 16 spaces. This does not limit the *program* line length, which can be up to 68 keystrokes.

PERIPHERAL AND MEMORY EXPANDABILITY

The Model 20 is expandable through plug-in ROM's, added internal memory, and external peripherals, providing capabilities to match any type of application. The basic calculator has 173 R() registers (see memory map). A 429-register memory can be supplied in lieu of this, either with the original shipment (Option 001), or installed later (Model 11228A) by any HP service personnel. As an example of the Model 20's power, the basic memory is sufficient to solve 17 simultaneous linear equations in 17 unknowns, and the 429-register memory can solve up to 36 equations in 36 unknowns.

The Model 20 accepts up to four peripherals at one time, allowing you to assemble a personalized system for your particular applications. An input/output expander to be introduced soon will allow the use of up to 13 peripherals simultaneously. The peripherals now available are:

- Model 9860A Marked Card Reader
- Model 9861A Typewriter Output
- Model 9862A Plotter
- Model 9863A Paper Tape Reader
- Model 9864A Digitizer
- Model 9865A Tape Cassette
- Model 2570A Coupler/Controller
- Model 2575A Coupler/Controller

BUILT-IN MAGNETIC CARD READER

The magnetic card reader built into the basic Model 20 allows you to make and reuse permanent recordings of programs and data. Two sizes of cards, 6 inches (15,2 cm) long and 10-1/2 inches (26,7 cm) long, are available.

Recorded programs are easily protected against accidental rerecording by removing a perforated tab at the end of the card.

OTHER FEATURES

Numerical format to be displayed and printed can be specified as either fixed point or floating point, with the desired number of digits. The commands are given either in a program or from the keyboard. For example, 1356.4255 may appear in the following formats:

FIXED (3)	1356.426
FLOAT (9)	1.356425500E 03
FLOAT (3)	1.356E 03

Dynamic range: $-9.99999999999 \times 10^{99}$ to -10^{-99} , 0, and $+10^{-99}$ to $+9.99999999999 \times 10^{99}$ with 12 significant digits, 10 of which are displayed.

6 dedicated data registers are built into the Model 20 in addition to the 173 or 429 R() registers. These six registers, A, B, C, X, Y, and Z, have their own keys.

The Model 20 keyboard is human engineered, with fingertip-fitting, color-coded, functionally-grouped keys. Often-used keys are made oversized for convenience. Half-size keys in the three left-hand keyblocks allow room for overlays to label their special functions assigned by the plug-in ROM's. Powerful individual keys are included, such as the **ERASE** key, which clears the entire memory and all flags.

MATHEMATICS PROGRAM LIBRARY

A powerful mathematics program library (Model 20 MATH PAC) is supplied with each Model 9820A Calculator. This contains 26 programs which will solve about 60 types of mathematics problems.

PURCHASE PLANS

Check with one of the Hewlett-Packard world-wide sales and service offices for specific prices and plans in your area.

Service Contracts Available

GENERAL SPECIFICATIONS

Temperature:	0° C - 45° C
Power:	100V +5%, -10% 120V +5%, -10% 220V +5%, -10% 240V +5%, -10%
	} selected by switch settings
	50-60 Hz, 150VA maximum
Weight:	36 lbs (16,4 kg).
Shipping Weight:	51 lbs (23 kg).
Dimensions:	5.6" (14,22 cm) high, 17-3/4" (49,09 cm) wide at keyboard (maximum), 21" (53,34 cm) deep.

For more information, call your local HP Sales Office or **East** (201) 265-5000 • **Midwest** (312) 677-0400 • **South** (404) 436-6181 • **West** (213) 877-1282. Or write: **Hewlett-Packard, Calculator Products Division**, P.O. Box 301, Loveland, Colorado 80537. In **Europe**: P.O. Box 85, CH-1217 Meyrin 2, Geneva, Switzerland; **Canada**: 275 Hymus Boulevard, Pointe Claire, 730, Quebec; **Japan**: YHP, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151; Other areas of the world: **HP International**, 3200 Hillview Ave., Palo Alto, California 94304.