

# Series 200, Model 16 High-Performance Personal Computers

 HEWLETT  
PACKARD



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# Introduction



## A Personal Computer For Those Who Can't Afford to Wait

If you need the results to complex problems quickly, a conventional 8-bit personal computer may not be enough. You'll need the HP Series 200 Model 16, a 16/32-bit computer for solving the most demanding business or technical problems.

The Model 16 is five times faster than most personal computers.\* And that speed can help you be more productive.

Its power comes from Model 16's Motorola MC68000 central processor. Its 32-bit internal addressing handles more information at a time than an 8-bit computer, so you can process more information faster. What's more, three other processors are incorporated into the Model 16's architecture. They offload dedicated tasks from the 68000, so its power is fully capitalized.

All that problem-solving power means that you get the results to complex problems quickly. Problems like analyzing projected sales volume and predicting its impact on cash flow . . . doing a sales forecast using past sales figures to predict future trends . . . or even simulating pressure and heat stresses on the component of an engine as it is being designed.

## More Solutions to Your Problems

The HP Model 16 has over 70 software packs on everything from word processing to optical design.

For demanding business applications, the Context MBA<sup>†</sup> software combines the five functions you need most: spreadsheet modeling, word processing, graphics, database management and telecommunications. Enter the data just once. Analyze several scenarios using the spreadsheet and graphs that automatically adjust as you alter the data. Then write up your proposal, with data and graphs inserted to support your decision. Once the report is complete, electronically file the information away for later use.

Other software packs let you use your Model 16 to generate professional looking overhead slides for presentations. Maintain an up-to-date mailing list and generate mailing labels. Plan a project and evaluate alternative approaches. Create "what-if" scenarios. Set budgets and manpower projections. Control inventory or generate payroll. Analyze investments and calculate rates of return.

For scientific or engineering tasks, the Model 16 has software to do finite element analysis, regression analysis, 2-D drafting, instrument calibration and many other design and testing tasks. Use it to design a digital filter. Or generate NC (numerical control) tapes to program lathes and other machines. Analyze a circuit. Test a product prototype and then analyze the results.

HP's Enhanced BASIC language makes the Model 16 a powerful tool for the engineer, scientist, or programmer. It has more than 200 operators, functions, and statements – more than four times what standard ANSI BASIC offers. It contains some of the best features from Pascal or FORTRAN, like IF...THEN...ELSE statements for block structured programming, callable subprograms with labeled COMMon blocks, and OUTPUT/ENTER/IMAGE statements to provide complete flexibility in formatting data.

In addition, Enhanced BASIC provides over 60 I/O commands – so you don't have to write a lot of extra code for computer-aided test applications. Similarly, one high-level statement permits you to invert a matrix, a powerful advantage in computer-aided design. HP BASIC combines the ease-of-use of the BASIC language with graphics extensions, editing and debugging tools, and many other enhancements that can save you programming time.

Our Pascal Language System lets you finetune your program by using compiled code or Assembly Language for subroutines where speed is critical. Its structured approach to programming makes altering programs easy. HP Pascal also provides protection from program modification, a useful feature in some applications. It is compatible with UCSD Pascal and offers enhancements not found in other Pascal systems – an I/O Procedure Library, a Graphics Library, Assembly Language and debugging tools.

## It'll Grow On You

The Model 16's terminal emulation capability extends it from a personal computer to a gateway to a large computer. You can send data to a mainframe computer or download to your Model 16. So you get just the information you need.

\* In performance comparisons cited in Byte Magazine's June, 1983 issue, the Model 16 performed the benchmarks five to twelve times faster than the other personal computers tested.

† Context MBA is a trademark of Context Management Systems.

As your needs grow, you can network a number of Model 16s into a local cluster to share information and high-performance peripherals. Or you can easily expand from the Model 16 into the entire line of HP technical workstations through software compatibility.

### **As Unobtrusive as Your Telephone**

Even with all that power lurking inside, the Model 16 won't take up much room on your desk. Because we think if a computer's going on a professional's desk, it should look like it belongs there. Its "footprint" is one of the smallest in the industry.

### **Everything You Need From One Company**

With the Model 16, you get everything you need to build a complete computing system from *one* vendor — your choice of printers, plotters, disc drives, test instruments. No other company offers the breadth of personal computer products. And all these elements were designed to work together, so using them will be easy.

You also get the service and the support to keep your system working for you. HP has authorized dealers and sales offices throughout North America and around the world. You're not far from one of them.

The Model 16: large computer technology in a small, easy-to-use personal computer. Unleash it on your complex problems.



# Hardware Specifications

These specifications apply to the Model 16 hardware as supported by the BASIC 2.0 Language System, BASIC Extensions 2.1, and the Pascal 2.1 Language System.

## Processor\*

Type ..... Motorola MC68000  
 Clock frequency ..... 8 MHz Internal  
 Internal architecture... 32-bit data and address registers  
 Address range ..... 16M bytes  
 Data bus ..... 16-bit asynchronous  
 Instruction types ..... 56  
 Major data types ..... 5  
 Addressing modes ..... 14  
 Interrupt levels ..... One non-maskable and 6 maskable

## Rotary Control Knob<sup>†</sup>

Pulse resolution ..... 120 pulses per revolution (nominal)  
 Pulse count range ..... - 128 to 127 net pulses since last interrupt  
 Pulse count sign  
 Positive ..... Net clockwise  
 Negative ..... Net counterclockwise  
 Interrupt generation period ..... .01 sec to 2.55 sec

## Clock and Timers<sup>†</sup>

Real-time clock  
 Resolution ..... 10 msecs  
 Accuracy ..... 50 ppm (4.3 sec./day)  
 Power-on reset ..... Midnight, January 1  
 Timers  
 Match interrupt ..... Match on time of day, 0.00 to 84600.00 seconds  
 Delay interrupt ..... 10 msecs to 1.94 days  
 Cycled interrupt ..... 10 msecs to 1.94 days

## Built-in Interfaces

HP-IB (IEEE-488)  
 RS-232 (Serial)

## Beeper<sup>†</sup>

Range (nominal) ..... 81.375 Hz to 5208 Hz  
 Resolution ..... 81.375 Hz nominal  
 Duration ..... .01 sec to 2.55 sec

## Environmental Range

Operating  
 temperature ..... 0°C to 55°C  
 Humidity ..... 5 to 95% R.H. non-condensing  
 Maximum wet-bulb  
 temperature ..... 40°C  
 Storage environment - 40°C to 75°C  
 Maximum altitude ... 4572m (15 000 ft.)  
 EMI ..... Conducted and radiated interference meets VDE 0871/0875 CISPR publication 11, and FCC class B standards.

Line transient spike immunity (1 nsec. rise, 800 nsec. duration) ..... 1KV  
 Additional regulatory compliance ..... UL, CSA, IEC, SEV, FEI

## CRT Display

Size ..... 229 mm (9 in.) diagonal  
 Alphanumeric capacity  
 On screen ..... 25 lines x 80 characters  
 Total scrolling ..... 39 lines x 80 characters, 3 120 characters  
 Character height ..... 1.2 mm wide x 2.8 mm high (.05 in. x .11 in.) capital letters  
 Display enhancements ..... Inverse video, underlining, blinking, half bright  
 Graphics capability  
 Resolution ..... 400 dots horizontal x 300 dots vertical  
 Density ..... 25 dots/cm. (63 dots/in.)  
 Raster size ..... 160 mm x 120 mm (6.3 in. x 4.72 in.)

Display buffering ..... Dedicated 2K byte alpha buffer, 15K byte graphics buffer (can be displayed simultaneously)  
 Soft-key labeling ..... Up to 10 user-definable soft-key labels, 14 characters per label  
 Character set ..... 256 characters  
 Character font ..... 7 x 8 dot character matrix in a 10 x 12 character cell  
 Intensity ..... Adjustable up to 30 ft-lamberts  
 Refresh rate ..... 60 Hz standard with 50 Hz user selectable  
 Implosion protection Tension band  
 Tube phosphor ..... P4  
 Cursor ..... Blinking underline

## Power Requirements

Source consumption  
 (A max. @ ~V, switch selectable) ... 1.5A (@ 90 - 125 V, 0.8 A @ 198 - 250 V)  
 Line frequency ..... 48 - 66 Hz  
 Power  
 Watts max ..... 80  
 Btu/hr ..... 280

## Physical

Height ..... 282 mm (11.10 in.)  
 Width ..... 315 mm (12.40 in.)  
 Depth ..... 488 mm (19.21 in.)  
 Cube ..... .043 m<sup>3</sup> (1.53 ft.<sup>3</sup>)  
 Net weight ..... 8.9 kg (19.5 lb.)  
 Shipping weight ..... 11.3 kg (25.0 lb.)

\* DMA available with the Series 200 2-channel DMA controller (98620A).  
<sup>†</sup> Pascal access documented in Systems Internals Documentation.



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# General-purpose Software

## Context MBA™\*

Context MBA brings together five functions that you as a professional use most: spreadsheet modeling, graphics, word processing, database management, and telecommunications. † Once information is entered in the data base, it can be used in spreadsheet analysis, writing reports or creating graphics based on the data. No changing floppies, transferring files or remembering separate commands for different programs.

### Applications

Context MBA is very useful to managers and other professionals who need to analyze data for decision-making, and then summarize the results for reports or presentations.

The applications for Context MBA include:

- generating reports analyzing current sales data
- predicting, then describing budget requirements based on current year expenses
- creating a model to compare planned inventory with actual inventory on hand and then reporting the findings
- writing executive memos and reports.

### Operation

The Context MBA software includes spreadsheet, graphics, word processing, database management and telecommunications. The five MBA functions all work with the same information – once information is entered all parts of the program have access to it. So a change in a spreadsheet immediately causes a change in a displayed graph.

The windowing feature allows more than one function to appear onscreen at a time so data can be analyzed easily

#### Features

- Easy to set up
- Easy to use
  
- Integrated
  
- Ability to examine information many different ways
- Combine tables & graphs in written documents
- Graphic display of information
- Telecommunications†
  
- High-powered formulas –  
Net Present Value, IRR, MIRR  
Math functions  
Logical operators

#### Benefits

- Start realizing benefits quickly.
- Learn how to use it quickly so you can reduce the time you spend planning and forecasting.
- All five functions use same data so changes made in one function are made everywhere.
- Pick the best way to present information.
  
- Eliminates switching programs and cutting and pasting in diagrams.
- Helps you spot trends quickly.
- Incorporate information from larger computers into your reports.
- Develop sophisticated, computerized financial models.

several different ways. You can change, sort, and graph results, spot trends and readjust information until you are satisfied.

The Spreadsheet function offers sophisticated modeling aids including high-powered formulas such as Net Present Value, Internal Rate of Return, Modified Rate of Return, a full set of trigonometric functions; If...Then; True/False branching, logical operations, look-up tables. It is similar in capabilities and operations to other advanced spreadsheet packs. For example, you can vary column widths or copy a portion of one spreadsheet into another.

The Graphics function allows you to create concise, high-impact images to quickly analyze and effectively communicate information. When you modify your spreadsheet data, graphics are redrawn automatically for immediate feedback. The graphs can be included in printed reports.

Word Processing lets you quickly compose and edit memos. You can

easily copy a table of numbers from your model into a written report or illustrate your key points with graphs.

Database Management helps you organize and retrieve pertinent information on a selective basis. You can store, search, retrieve and sort information so that it's in the best form to help you make a decision. For example you can organize sales information to determine the top sales by region, by salesperson, or by product.

Telecommunications give you access to the most current information from your company's larger computer, other MBA users or timesharing systems for your own reports and analyses.

\* Context MBA is a trademark of Context Management Systems.

† Telecommunications and multiple color plotting will be supported on Context MBA Version 2.2, which will be available in the near future. Registered owners of MBA Version 1.5 will receive a free upgrade to Version 2.2.



## Specifications

### Computer

HP Model 16S with 512K RAM (US ASCII keyboards only)

### Mass storage

One of the following mass storage devices with the Model 16S

- HP 9121D 3½" Dual Flexible Disc Drive
- HP 82901M 5¼" Dual Flexible Disc Drive
- HP 9133A 4.6 Mbyte Winchester/3½" Floppy
- HP 9135A 4.6 Mbyte Winchester/5¼" Floppy

### Printers

One of the following:

- HP 82905B Low-cost Graphics Impact
- HP 2671G Thermal
- HP 2673A Intelligent Thermal Graphics
- HP 2631G Impact Graphics

### Plotters<sup>+</sup>

One of the following:

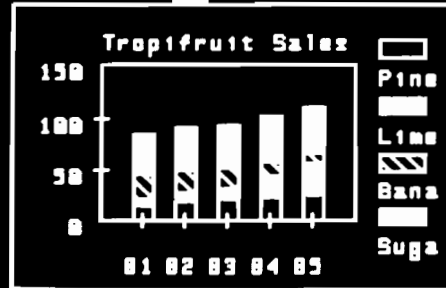
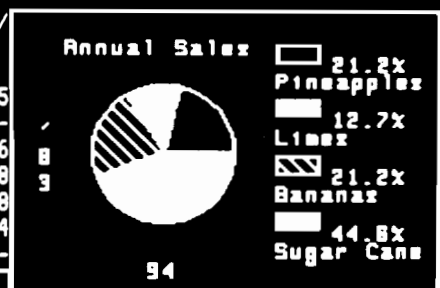
- HP 7470A Low-cost Plotter
- HP 9872C/T 8-pen Plotter
- HP 7580A "D" Size Plotter
- HP 7585A "E" Size Plotter

### Interfaces

- Built-in HP-IB or HP 98624A
- Built-in Serial Interface or HP 98626A

M B A: FOLDER-04: DEMOS, DOCMNT-TROPIFRUITSALES, CONTEXT-MODEL)B0 10

Tropifruit	A	B	C	D	E	F
1Tropifruit Annual Sales (Millions)						
2Product	'81	'82	'83	'84	'85	
3-----						
4Pineapples	\$15	\$18	\$28	\$23	\$26	
5Limes	5	18	12	28	38	
6Bananas	25	22	28	16	18	
7Sugar Cane	48	41	42	43	44	
8-----						



To: All Sales Personnel  
 From: V-P Sales  
 Subject: Stagnant Sugar Cane Sales

Please note the relative stagnation of Sugar Cane sales in our sales forecasts. I want each of you to report to me by next Monday any ideas you have about how

## How to Order

The Context MBA software package is available according to the terms and conditions of the Hewlett-Packard Software Purchase Agreement.

- Order:
  - Context MBA (Single User License HP Part No. 97038JA)
- Also specify:
  - Opt. 630 For use with HP 9121D or HP 9133A 3½" discs
  - Opt. 650 For HP 82901M or HP 9135A 5¼" discs

## HP Support

HP provides direct sales support through phone-in consulting (PICS) centers for the Context MBA software package on the HP Model 16 computer.

VisiCalc allows the user to set up a form or worksheet, enter changes to one or more figures in a matrix, and quickly assess the impact of those changes on related data. It saves considerable time and provides a way to explore many different options in a short period of time.

## Applications

VisiCalc is an extremely useful tool for people who analyze sales or any other numerical data. Applications include:

- calculating sales projections
- estimating costs
- computing financial ratios
- analyzing statistical data

## Operation

VisiCalc's "electronic worksheet" is segmented into rows and columns to create cells. These cells contain either text, values or mathematical expressions. When the numerical data in one cell is changed, the related entries in other cells and totals will be changed automatically.

The computer's screen becomes a window into this large electronic worksheet. This window can be moved vertically or horizontally so any part of the worksheet is visible. It can also be split such that any two sections of the worksheet can be viewed simultaneously.

The example shown here is a simple sales quota analysis. Changing, for example, the purchase amount of Fluidics in quarter 2 (cell C9) from 79 to 138 has an immediate effect on other numbers on the screen, notably the totals, quotas and YTD totals at the bottom.

Features	Benefits
<ul style="list-style-type: none"> <li>• Recalculation ability</li> </ul>	Allows you to change any variable or mathematical expression and immediately see the effects on related information.
<ul style="list-style-type: none"> <li>• Replicate feature</li> </ul>	Can reproduce individual columns, rows or cells of information anywhere on the worksheet.
<ul style="list-style-type: none"> <li>• Windowing feature</li> </ul>	Can split screen into two areas, vertically or horizontally, so that separate portions of the worksheet can be viewed simultaneously.
<ul style="list-style-type: none"> <li>• Understands –                             <ul style="list-style-type: none"> <li>Basic math functions (+, -, *, /)</li> <li>Business functions (sum, average, net present value, minimum, maximum, internal rate of return, counting, mean, standard deviation)</li> <li>Engineering functions (trigonometric functions, div, mod, log, ln)</li> </ul> </li> </ul>	Gives you a wide range of analytical capabilities.

C9 (V) 138					AC 99510
	A	B	C	D	E
1	Mid Atlantic Sales Region				
2					
3	Salesman: Joe Waterman		Quota= 1100		
4					
5	1981				
6	Customer	Q1	Q2	Q3	Q4
7	-----				
8	Endive	60	44	51	138
9	Fluidics	17	138		65
10	Riptide	21			83
11	Saltforms		47	275	
12	Wavedump	122			53
13	Misc 1	4	6	15	2
14	-----				
15	Total	224	235	341	341
16	Qtr Quota	220	256	294	330
17	% Quota	102	92	116	103
18	-----				
19	YTD Total	224	459	800	1141
20	YTD %	102	96	104	104

\* VisiCalc is a registered trademark of VisiCorp, Inc.

## Specifications

### Minimum Computer Configuration

Model 16 with 320K total memory. The software will automatically configure itself to utilize more memory if it is available.

### Required Peripherals

One of the following disc drives:

- HP 9121S/D 3½" Flexible Disc Drive
- HP 82901M 5¼" Dual Flexible Disc Drive
- HP 82902M 5¼" Flexible Disc Drive
- HP 9133A 4.6 Mbyte Winchester/3½" Flexible Disc
- HP 9135A 4.6 Mbyte Winchester/5¼" Flexible Discs
- HP 9134A 5¼" Winchester Disc Drive

One of the following printers:

- HP 2602A Opt. 046 Daisywheel Printer
- HP 2631G Impact Printer
- HP 2671G Graphics Printer

## Order

- 98810A VisiCalc software
  - Opt. 630 for 3½" discs
  - Opt. 650 for 5¼" discs
- 98810M VisiCalc Right to Reproduce Without Sublicense – confers the right to reproduce without sublicensing one copy of the VisiCalc package.
  - Opt. 630 for 3½" discs
  - Opt. 650 for 5¼" discs

## Support

HP provides direct sales support for the VisiCalc software package on the HP Model 16.

# Graphics Presentations

The Graphics Presentations software allows you to easily create professional looking overhead slides with a Model 16 computer and a graphics plotter. This versatile pack allows you to generate – on acetate or paper – bar charts, pie charts, line charts and text material that will impress your audience and hold their attention.

## Applications

This software will help you create slides for:

- customer presentations
- sales meetings
- management reports and much more.

## Operation

The Graphics Presentations software is very easy to use. Conversation-like user prompts appear on the CRT to guide you through the program. Special function keys allow most operations to be executed with a single keystroke.

You can create text slides using smooth, Roman or Gothic characters for variety and emphasis. Or combine text and simple drawings such as organization charts.

When creating charts, you can specify input as graphic by moving to the desired position or as numeric by

Features	Benefits
<ul style="list-style-type: none"><li>● Friendliness and ease of use</li><li>● Charting module, including negative bar charts</li><li>● Full screen plots</li><li>● Four fonts – Normal, Smooth, Roman and Gothic</li><li>● Nine text sizes</li><li>● Line drawing</li><li>● Composing feature</li><li>● Centering</li><li>● “Block” moves</li><li>● Interactive graphics</li></ul>	<p>Create graphic images the first day.</p> <p>Lets you quickly create bar, pie and line charts.</p> <p>Give you large working area and allows you to photograph screen for slides.</p> <p>You can choose the best type font to emphasize or add variety to your text.</p> <p>Allows you to stress certain words, “fill up” the page, or “squeeze” more text on a page.</p> <p>Provides an easy way of boxing, underlining or highlighting certain parts of the slide.</p> <p>Lets you easily combine text and charts.</p> <p>Allows you to quickly align text for a more professional look.</p> <p>Provides the ability to move – left/right or up/down – a segment of text.</p> <p>Lets you instantly see the text chart or line you’ve created for instant feedback or corrections.</p>

keying in the values. Once this is done, the program automatically scales the axes and draws the graph.

Specifying color for your chart will add even more clarity and professionalism to your presentation. To help keep lines and surfaces clearly defined on your chart, eight different types of lines and surface textures, plus solid fill, are provided.

Once you have created a slide, you may wish to make changes – moving certain portions to another area of the slide, deleting or adding information, etc. With the routines provided in this pack, such editing is quick and easy. Once you’ve modified the slide to your satisfaction, you can store it on a mass storage device for later use.

### Specifications

#### Computer

HP Model 16 Computer with 180K user read/write memory plus BASIC language system\*

#### Peripherals

One of the following plotters:

- HP 7470A Two-pen plotter
- HP 9872C/T Eight-pen plotter
- HP 7580A Eight-pen D/A1-size Drafting Plotter
- HP 7585A Eight-pen E/A0-size Drafting Plotter

One of the following mass storage devices:

- HP 9121D 3½" Dual Flexible Disc Drive
- HP 82901M 5¼" Dual Flexible Disc Drive
- HP 9133A 4.6 Mbyte Winchester/3½" Flexible Disc Drive
- HP 9135A 4.6 Mbyte Winchester/5¼" Flexible Disc Drive

\* See Configuration Section for the memory required to run BASIC.

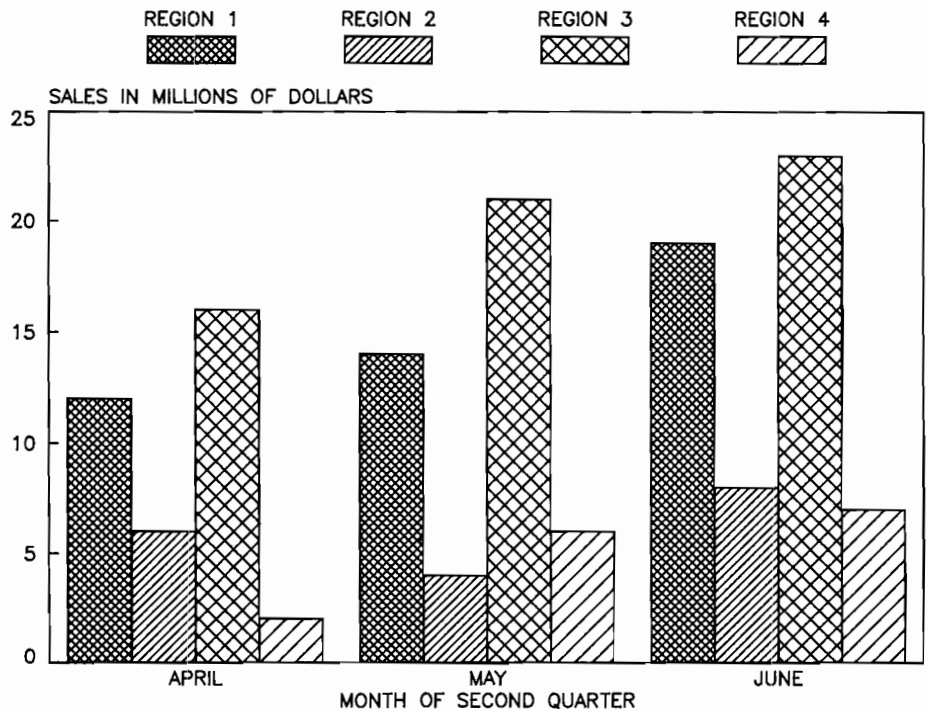
### Order

- HP 98815A Graphics Presentations
- Also specify:
  - Opt. 630 3½" Flexible Discs
  - Opt. 650 5¼" Flexible Discs

### Support

HP provides direct sales support for the Graphics Presentations software on the Model 16.

## ABC BICYCLE COMPANY SALES FOR THE SECOND QUARTER OF 1982



# Master Word Processor Supplied by University Software Associates

The Master Word Processor is a full-screen, cursor-driven, word-processing program suitable for the preparation of large documents such as reports and manuals as well as routine correspondence. It is controlled by a series of straightforward command menus and can be used after a few minutes introduction.

Sophisticated formatting and printing capabilities are available to the advanced user without confusing the beginner.

## Operation

The features of the Master Word Processor include text editing, text formatting, print enhancements, I/O error trapping, document management and full documentation.

Text is displayed with paragraph margins, line spacing and auto word wraparound as specified; a full update occurs as changes are made. Most keys function as they do in the operating system. Special-function keys for text formatting are defined in a screen display. Capabilities include individual paragraph formatting, moving or copying text within or copying text between documents. Pages can be accessed directly without scrolling through previous pages. Document size can be from 1 to 200 pages.

Text formatting offers auto word wraparound with user-specified silent hyphenation, auto paragraph or line centering, auto right justification, and auto pagination with forced new page and unbreakable text blocks. Margins and line spacing can differ from paragraph to paragraph. Paragraph widow controls breaking paragraphs across pages. Top justification removes blank lines from the tops of pages. The program also allows auto page numbering and running titles.

Print enhancements, which are dependent on printer type, include: shadow, underscore, double strike, superscripts and subscripts (which are displayed on the screen), and proportional spacing. A print pause character allows print wheel changes.

Document Management offers complete listing or listing by author or key word, copy, purge, backup and optional individual password.

Extensive I/O ERROR trapping prevents loss of data through medium overflow and other errors. Access data medium by user-given name (CRTSPECS) or address (i.e. HP8290X,700,1). A 70+ page manual offers full documentation, including a step-by-step introduction, examples, and detailed information in addition to an on-line help key.

## Support

The Master Word Processor software is supported by University Software

## Specifications

### Computer

HP Model 16 computer with BASIC 2.0 Language System and 500K total memory

### Peripherals

HP external mass storage and printer required

Associates. Support services include:

- phone-in consulting,
- mail-in support,
- on-site consulting, and
- program modification.

## Order

To order the Master Word Processor software, please contact:

University Software Associates  
RFD #1, Box 6  
Fitchville, CT 06334 U.S.A.  
(203) 889-5641

When ordering, specify computer, printer, and interface types.

```

MASTER WORD PROCESSOR
University Software Associates

  FETCH
  document
  location

  CREATE
  document
  location
  # using document

  LIST
  document(s)
  location
  # key word
  # author

  PRINT
  document(s)
  location

  COPY
  document(s)
  from location
  to location
  purge duplicates ? (Y/N)

  ERASE
  document(s)
  location

  # = optional

  copyright 1983
  version 101

  Start Command List: Choose a command, press EXECUTE; press PAUSE to exit.

  Next      Previous      Program      System Default      HELF!
  Command   Command   Demonstration   List
  
```

# Terminal Emulator Software



The HP Series 200 Terminal Emulator software package manages the keyboard, CRT and mass storage of the HP Model 16 computer so that it responds like an intelligent terminal, bridging the gap between two computing environments – the powerful, stand-alone personal computer and the central host computer.

The Terminal Emulator's friendly features allow the HP Series 200 computers to be more than just glass Teletypes; they make it easy for you to get the datacomm channel up and running. In other words, you can "log-on" to your central host and transfer data without having to write a program on the personal computer to do it.

## Applications

The Terminal Emulator software allows the Model 16 user to:

- access time-sharing systems
- develop programs on the host computer using line or character editors
- access host peripherals
- download data files from the host computer for local processing and analysis
- upload locally collected data for archiving and report generation.

## Emulator Operation

The Series 200 Terminal Emulator provides a feature set similar to that of the HP 2621 terminal. It is written in Pascal, and includes a Pascal execution environment so that it runs independently of the language systems. It requires the built-in serial port, 98628A Datacomm Interface, or 98626A Serial Interface.

Features	Benefits
<ul style="list-style-type: none"> <li>• File Transfer</li> </ul>	Allows sharing of data between the Model 16/26/36 and a central host; permits distributed processing.
<ul style="list-style-type: none"> <li>• Menu Driven</li> </ul>	Allows you to get system running quickly.
<ul style="list-style-type: none"> <li>• Operates as a stand-alone system</li> </ul>	Access to a large host is independent of language used in other applications.
<ul style="list-style-type: none"> <li>• Display Functions</li> </ul>	Provides a quick debugging tool to insure the Datacomm channel is up and running.
<ul style="list-style-type: none"> <li>• 24-line CRT</li> </ul>	An industry standard.
<ul style="list-style-type: none"> <li>• XON/XOFF/Master/Slave</li> </ul>	Flexibility.
<ul style="list-style-type: none"> <li>• Auto-dial to 13265A 300 Baud Modem Pod (US/CANADA Only)</li> </ul>	You don't need to manually dial for every connection.
<ul style="list-style-type: none"> <li>• Line Modify Mode</li> </ul>	Allows mistakes to be easily corrected and retransmitted.
<ul style="list-style-type: none"> <li>• Status Display</li> </ul>	Immediate verification of the datacomm link and emulator configuration.

The Terminal Emulator software can be operated in LINE MODIFY mode or CHARACTER mode. In CHARACTER mode each key is sent to the computer as soon as it is pressed. LINE MODIFY mode is used to correct and retransmit a line of input. In this mode the input line is not retransmitted until one of the end-line-keys (ENTER, EXECUTE) is pressed.

The file transfer allows you to share data with a host computer. With this

capability you can transfer ASCII files from the Series 200 computer to the host or vice versa by pressing the UPLOAD or RECORD special-function key and specifying the source/destination files.

The menu-driven configuration allows you to tailor the emulator for the datacomm characteristic of your particular host computer. The following variables may be changed:

Characteristic	Legal Values	Default Values
Speed (Baud rate)	50 baud – 19.2K baud	2400 baud
Bits/character	5, 6, 7 or 8	7 bits/character
Number of stop-bits	0, 1, 1.5 or 2	1 stop bit
Parity	Odd, Even, "0" or "1", NONE	odd parity
Software Handshake	ENQ/ACK, DC1/DC3 host or terminal	ENQ/ACK
Modem Handshake	Full-duplex or handshake off	Handshake off
Prompt sequence	Any two ASCII characters	DC1
End-of-Record sequence	Any two ASCII characters	C <sub>r</sub>
End-of-File sequence	Any two ASCII characters	None
Check Parity	ON or OFF	ON

## Specifications

### Hardware Required

The following hardware is required to run the terminal emulator.

- Model 16 computer
- 384K bytes RAM
- Model 16 serial port or 98628A Opt 100 with any cable option, or 98626A Opt. 001 or 002

The following optional hardware is supported:

- Pods
  - 13265A 300 Baud Modem (US/CANADA only)
- Printers
  - HP 2631G Graphics Printer
  - HP 2671G Graphics Printer
  - HP 2673A Graphics Printer
- Mass Storage
  - HP 9121 D/S 3¼" Micro Flexible Disc Drive
  - HP 8290x Family 5¼" Flexible Disc Drive
  - HP 913x Family 5¼" Winchester Disc Drive
  - SRM Shared Resource Manager

The user has the option of saving the current configuration in a file for the next powerup. At powerup the system will take the configuration values from the configuration file. If it is not present, then the default values will be taken from the switch settings on the interface.

## Order

The Terminal Emulator can be ordered for the Series 200 Model 16 computer on one of two media options using the following 10-digit product numbers:

- 09800-10380 3½" micro flexible disc
- 09800-10580 5¼" mini flexible disc

## Support

HP provides direct support for the Terminal Emulator software on the Model 16.

```

      _TERMINAL CONFIGURATION      DATA_COMM CONFIGURATION
      remote                        SPEED      : 2400
      _connected                    BITS_CHAR: 7
      ^ASYNC protocol                STOP_BIT : 1
LOC_ECHO :off                       PARITY   : odd
DISP_FNS :off                       PTCL_HK  : eq/ak
HARDCOPY :off                       MODEM_HK : mdmhk off
HARD_SC  :781                       PROMPT   : g
DCOMM_SC :9                          D_SET_RDY: 0
UPLOADING:off                       CHK_PARITY: off
RECORDING:off
EOR chrs :g
EOF chrs :
INS_MODE :off
LINE_MODY:off
AUTOLF   :off
PHONE #  :
AVAILABLE MEMORY: 179212

      SAVE_DNF | FWRU_VAL |
-----|-----|
      term of databcomm files | main |

```



# Applications Software for the Model 16

The Model 16 software gives you solutions for a variety of tasks — from general-purpose programs that let you do graphics or electronic spreadsheet planning to software that's designed for a specific profession or industry. And the list of software packs is growing daily.

All this software means that your Model 16 computer can help you improve your on-the-job effectiveness in many ways.

To find the software that fits your needs, look in the appropriate sections. The software is listed in the following categories:

- word processing
- spreadsheet
- graphics
- file management
- project management
- business applications
- mathematics/statistics
- engineering/scientific
- utilities
- other.

The software listed here is available worldwide unless otherwise noted.

## Word Processing



### Protrastar

This word-processing pack is designed for engineering, office, manual writing and general use. It is very easy to use but also has extensive features for more advanced word processing. These features include keyed searches, automatic text changes, automatic name insertion, customized form letters, alphabetized lists, and a spelling checker/dictionary program.

Supplied by Protracoa, 1134 Aster Avenue, Suite K, Los Altos, CA 94022 U.S.A (415) 948-6611.

### Wordwise

Wordwise is a high-performance full-screen word processor designed

for use by authors. It features continuous display of text in its final form and is very easy to use. Its features include underlining, alignment, insertions, deletions, centering, single stroke word or phrase entry, search and replace, move, copy, saving and retrieving, and recovery.

Supplied by L.W. James and Associates, 1525 East County Road 58, Fort Collins, CO 80524 U.S.A. (303) 484-5296

### Wordwise 2 Word Processor

Wordwise 2 is a high-performance, cursor-driven word processor with an integral 50,000-word dictionary. It features continuous display of text in its final form, a spelling checker and corrector, and an active text length limited only by the amount of memory available.

Supplied by L.W. James and Associates, 1525 East County Road 58, Fort Collins, CO 80524 U.S.A. (303) 484-5926

### Automated Office, Pac 1, Wordwise

This package features the Wordwise word-processor software and a mailing list coupled to a custom text editor specifically designed to write and edit correspondence. It includes mailing list for auto-addressing, mailing labels, custom mass mailings, etc.

Supplied by L.W. James and Associates, 1525 East County Road 58, Fort Collins, CO 80524 U.S.A. (303) 484-5926

### Minipro: 6 Word Processor

This low-cost word processor is simple to use and has a short learning time. It has the basic word-processing features needed for producing letters, reports and other general documents, plus a spelling checker program.

Supplied by Protracoa, 1134 Aster Avenue, Suite K, Los Altos, CA 94022 U.S.A. (415) 948-6611

## Spreadsheet



### Programmable Tabular Data Manager (Protratables)

This advanced capability spreadsheet has numerous manipulations and presentations not found in other calculating arrays, including the ability to coordinate with filed data from your own programs. It is designed for easy customizing to your applications after tables and calculations are set up.

Supplied by Protracoa, 1134 Aster Avenue, Suite K, Los Altos, CA 94022 U.S.A. (415) 948-6611

### Minitables: Calculating Spreadsheet

This tabular data manager (spreadsheet) is very simple to learn and use. It is designed for computers with 57K to 187K user memory and adjusts data array size according to the amount of memory available.

Supplied by Protracoa, 1134 Aster Avenue, Suite K, Los Altos, CA 94022 U.S.A. (415) 948-6611

## Graphics



### Diagram\*

This graphics package helps you produce diagrams, presentation aids, and office layouts. It operates in an interactive mode by which the user controls the placement, size and color of symbols, lines and text to produce organization charts, flow diagrams and presentation aids.

Supplied by Computer Support Corporation, 4215 Beltwood Parkway, Dallas, TX 75234 U.S.A (214) 661-8960

### CSC/Linear\*

CSC/Linear is a menu-driven program that produces linear charts from a single menu in a one-pass operation. It provides you with a simple means of presenting data in a linear format, with emphasis on one-step production of fully annotated charts.

\* Available in U.S. and Canada only.

Supplied by Computer Support Corporation, 4215 Beltwood Parkway, Dallas, TX 75234 U.S.A (214) 661-8960

#### **CSC/Pie Charts\***

This menu-driven graphics software generates presentation-quality pie charts with provisions for text on the chart. It gives the user precise control over the size, placement and organization of a pie chart plus allows rotation, multiple title lines, footnotes and general notation anywhere on the page.

Supplied by Computer Support Corporation, 4215 Beltwood Parkway, Dallas, TX 75234 U.S.A (214) 661-8960

#### **CSC/Vertical Bar Charts\***

This menu-driven graphics software generates presentation quality vertical bar charts with provisions for text on the chart. Bar charts can be created in any of four basic formats: simple, stacked, comparative and overlapping.

Supplied by Computer Support Corporation, 4215 Beltwood Parkway, Dallas, TX 75234 U.S.A (214) 661-8960

#### **CSC/Horizontal Bar Charts\***

This menu-driven graphics software generates presentation-quality horizontal bar charts similar to those provided in the vertical bar chart pack. In addition, labels may be placed inside the bar, and a bi-directional axis can be drawn from a mid-point value.

Supplied by Computer Support Corporation, 4215 Beltwood Parkway, Dallas, TX 75234 U.S.A (214) 661-8960

#### **Plan/Variance\***

This menu-driven graphics software is designed for the presentation of Financial/Accounting data, particularly for contrasting current data to estimated or historical data. It calculates variance and generates two graphs per page combining lines and bars.

Supplied by Computer Support Corporation, 4215 Beltwood Parkway, Dallas, TX 75234 U.S.A (214) 661-8960

#### **Drafting Package 16/36\***

Drafting Package 16/36 software provides a straight-forward, easy-to-use two-dimensional drafting system laid out for drafting people, designers and engineers. It contains the generally accepted line-types, iine functions, circles, arcs and dimensional capabilities that are routinely used in drafting.

Supplied by Com-Code Associates, 3989 Research Park Drive, Ann Arbor, MI 48104 U.S.A. (313) 665-8811

### **File Management**



#### **Protra-Formdata**

With the Protra-Formdata software, you can create your own database forms, plus store, compute, search, retrieve and present data. It offers powerful, freeform simplicity in database entry, retrieval, search and manipulation.

Supplied by Protracoa, 1134 Aster Avenue, Suite K, Los Altos, CA 94022 U.S.A. (415) 948-6611

### **Project Management**



#### **Project Management**

This software helps you plan and organize a project. Through network analysis, you can follow the project closely, anticipating problem areas, evaluating alternative plans and achieving the economic and timing objectives of the project. It incorporates the following network methods:

- PERT – Program Evaluation and Review Technique,
- CPM – Critical Path Method, and
- MPM – Metra Potential Method.

Available through Hewlett-Packard HP 98817A

#### **BAI\*PERT<sup>†</sup>**

This planning, scheduling and control system requires no knowledge of computer programming. Utilizing an easy-to-use predecessor/successor format, it allows a user to build a project "on the fly," explore alternatives, and quickly identify cost effective procedures.

Supplied by B & A, Inc., 225 Santa Monica Blvd., Santa Monica, CA 90401 U.S.A (213) 451-1743

### **Business**



#### **Accounting System<sup>†</sup>**

This package includes a General Ledger, Payroll, Accounts Payable, Inventory Control, Order Entry and Accounts Receivable.

Supplied by Amalgamated Business Systems, Inc., 7910 South Memorial Parkway, Suite H, Huntsville, AL 35802 U.S.A. (205) 882-2360

#### **Job Cost System<sup>†</sup>**

This software package computes labor cost directly from time cards, producing employee performance records and providing specific and overall views of the status of each program. The following reports are provided: Pay Period Report, Time Card Report, Utilization Report, Project Report, and Status Report.

Supplied by Amalgamated Business Systems, Inc., 7910 South Memorial Parkway, Suite H, Huntsville, AL 35802 U.S.A. (205) 882-2360

#### **Forecasting**

This forecasting software has statistical routines that analyze and smooth initial raw data under a variety of assumptions to determine trends, seasonality, and random variations. It includes forecasting methods for sales forecasting, cash planning, setting expense and budgets, manpower

\* Available in U.S. and Canada only.  
† Available in U.S. only.

projections and production/inventory planning and control.

Available through Hewlett-Packard  
HP 98818A

### **PHD: Protracoa Heavy-Duty Integrated System**

This integrated software offers word processing, spreadsheet, forms, database and a data processing printout system including numerous support programs and graphs. It combines these key functions so that they can be used together. This system can utterly simplify or eliminate the need for programming.

Supplied by Protracoa, 1134 Aster Avenue, Suite K, Los Altos, CA 94022 U.S.A. (415) 948-6611

### **Investment Analyzer (Protravest)**

This financial software calculates IRR (Internal Rate of Return) for complex scenarios of future cash flows, investments, borrowings and any combinations thereof. It also calculates present value of future complex scenarios of investments, borrowing, etc. These calculations can be performed either with or without tax implication.

Supplied by Protracoa, 1134 Aster Avenue, Suite K, Los Altos, CA 94022 U.S.A. (415) 948-6611

## **Mathematics/Statistics**



### **Statistical Library**

This pack includes basic statistics and data manipulation, statistical graphics, regression analysis (both linear and non-linear), Analysis of Variance, Monte Carlo Simulation and principal components and factor analysis.

Available through Hewlett-Packard  
HP 98820A

### **Simple-Stats**

This statistics software provides a simple way of using Monte Carlo and

traditional analysis in solving probability and other statistical problems. It provides fast, direct solutions with a minimum of traditional programming or use of complicated formulas, tables and methods. It is a proven instructor for probability and statistics courses.

Supplied by Protracoa, 1134 Aster Avenue, Suite K, Los Altos, CA 94022 U.S.A. (415) 948-6611

### **Numerical Analysis**

This software contains a large number of numerical analysis techniques written in the form of subroutines that may be added to application programs. Simple drivers for the subroutines are also included so that they may be used as stand-alone programs. Routines include: root finders, integration, ordinary differential equations, linear algebraic systems, Eigen Analysis, interpolation and Fourier Analysis.

Available through Hewlett-Packard  
HP 98821A

### **Linear Systems Analysis**

This software is capable of analyzing single input/single output linear systems as a control system block diagram or a single transfer function in Laplace (S) notation. It includes modules for entering the system design into the computer, plotting the routines for analyzing the system performance and editing tools that are used for modifying the system design.

Available through Hewlett-Packard  
HP 98826A

## **Engineering/Science**



### **Multi-Layer Dielectric Optical Filters**

This software package contains a series of programs which calculate the transmission and reflection of multi-layer dielectric filters with an increasing degree of accuracy and sophistication. You can use them for

something as simple as calculating the effect of a quarter wave coating on the transmission of a piece of glass, or as complex as designing a 30-40 layer bandpass filter.

Supplied by L.W. James and Associates, 1525 East County Road 58, Fort Collins, CO 80524 U.S.A. (303) 484-5926

### **ELAN – NC-CNC Programming System<sup>‡</sup>**

This conversational, interactive graphics programming system can be used for programming lathes, mills, machining centers, punch presses, wire EDM and all other NC machine tools. It handles contouring on two axes and positioning in up to five axes.

Supplied by D.P. Technology Corp., 223 E. Thousand Oaks Blvd., Suite 415, Thousand Oaks, CA 91360 U.S.A. (805) 496-9493

### **AC Circuit Analysis**

This circuit analysis software allows you to quickly and easily model your AC circuits and accurately analyze their performance. It performs computations for resistors, capacitors, inductors, voltage controlled sources, and independent current sources.

Available through Hewlett-Packard  
HP 98825A

### **Digital Filter Design**

This interactive, menu-oriented program will help you analyze and design digital filters. You can use the Model 16 to compute, tabulate, and plot filter coefficients.

Available through Hewlett-Packard  
HP 98828A

### **FESDEC**

FESDEC (Finite Element System for Desktop Computers) is a general-purpose finite element analysis program for static and dynamic structural analysis and heat transfer. The program incorporates a

<sup>‡</sup> Available in Western United States only.

full range of elements covering all classes of 2- and 3-dimensional problems and offers many of the facilities available in mainframe finite element analysis systems.

Supplied by H.G. Engineering Ltd., 260 Lesmill Road, Don Mills, Ontario, M3B 2T5, Canada (416) 447-5535

**Structural Dynamics Modification (SDM 3.0)**

This software package allows you to investigate the effects of potential design modifications upon the dynamics of test structures, including changing the mass, stiffness, or damping properties of a structure. This software is designed for use with most popular dual-channel FFT analyzers.

Supplied by Structural Measurement Systems (SMS), 645 River Oaks Parkway, San Jose, CA 95134 U.S.A. (408) 263-2200

**Structural Dynamics Modification (SDM 2.0)**

This software package allows you to investigate the effects of potential design modifications upon the dynamics of test structures, including changing the mass, stiffness, or damping properties of a structure. It is designed specifically for use with the HP 5423A Structural Dynamics Analyzer.

Supplied by Structural Measurement Systems (SMS), 645 River Oaks Parkway, San Jose, CA 95134 U.S.A. (408) 263-2200

**Parameter Estimation Package PEP 2.0**

This software contains various algorithms for estimating model parameters, poles and zeroes, and polynomial coefficients from frequency response measurements. It operates exclusively with the HP 5423A Analyzer and provides multi-degree-of-freedom curve fitting capability for the analyzer.

Supplied by Structural Measurement Systems (SMS), 645 River Oaks Parkway, San Jose, CA 95134 U.S.A. (408) 263-2200

**Forced Response Simulation (FRS 2.0)**

This package calculates the response of a structure due to any combination of random, transient or sinusoidal force inputs. It is designed specifically to operate with the HP 5423A Analyzer.

Supplied by Structural Measurement Systems (SMS), 645 River Oaks Parkway, San Jose, CA 95134 U.S.A. (408) 263-2200

**Forced Response Simulation (FRS 3.0)**

FRS 3.0 calculates the response of a structure due to any combination of random, transient or sinusoidal force inputs. It is designed to operate with most popular dual-channel FFT analyzers.

Supplied by Structural Measurement Systems (SMS), 645 River Oaks Parkway, San Jose, CA 95134 U.S.A. (408) 263-2200

**Modal Analysis 3.0**

This low-cost analysis package identifies the modal properties of test structures. It is designed to operate with most popular multi-channel FFT analyzers.

Supplied by Structural Measurement Systems (SMS), 645 River Oaks Parkway, San Jose, CA 95134 U.S.A. (408) 263-2200

**MADAM**

MADAM is a modal analysis and spectral data management program for noise and vibration control and structural dynamic analysis. It provides spectrum data storage, plotting and manipulation capabilities for dual-channel fourier analyzers.

Supplied by Anatrol Corporation, 11305 Reed Hartman Highway, Suite 227, Cincinnati, OH 45241 U.S.A. (513) 489-2255

**AIMS**

The AIMS (Acoustic Intensity Measurement System) program can be used for studying sound radiation of noise sources. It was developed to overcome the costly and time-consuming problem of identifying and ranking various noise radiating components of a complex mechanical system.

Supplied by Anatrol Corporation, 11305 Reed Hartman Highway, Suite 227, Cincinnati, OH 45241 U.S.A. (513) 489-2255

**SMAP**

This speed-spectrum mapping program analyzes data from rotating equipment for condition monitoring. It shows the variation of measured or analytical functions (time, frequency, or other domain) as a function of some other parameter, such as operating speed, temperature, pressure, flow, voltage, valve position, etc. on a three-dimensional plot.

Supplied by Anatrol Corporation, 11305 Reed Hartman Highway, Suite 227, Cincinnati, OH 45241 U.S.A. (513) 489-2255

**PRISM**

This software is a modal analysis and spectral data management program for noise and vibration control and structural dynamic analysis. It provides spectrum data storage, plotting and manipulation capabilities for dual-channel fourier analyzers.

Supplied by Anatrol Corporation, 11305 Reed Hartman Highway, Suite 227, Cincinnati, OH 45241 U.S.A. (513) 489-2255

**ETREND (Entel Vibration Trending)**

ETREND is used with Entek's EPRAN program to perform machinery vibration trending. It controls the measurement of a vibration spectrum on a single- or dual-channel spectrum analyzer.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**EBALANCE (Entek Multiplane Balancing)**

This software is used for multiplane balancing of rotating machinery. It was developed to eliminate the need for time-consuming manual vector plotting on polar graph paper or computing complex numbers by hand.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**EKPRAN (Entek programmable analyzer)**

EKPRAN is used to transform a single- or dual-channel spectrum analyzer into a programmable instrument.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**EMAP**

EMAP (Entek Mapping System) is used to generate a 3-dimensional system map of speed-, time-, or temperature-spectrum data. Applications include diagnosis or rotating equipment (including order tracking), flow noise evaluation, conditioning monitoring/periodic maintenance, and non-linear temperature or time-dependent property studies.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**EMDOF**

This software enhances the use of the modal analysis technique by making available several methods of curve-fitting frequency response functions to extract modal parameters.

These parameters are used to define the dynamic characteristics of mechanical systems.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**EMESH (Entek Mesh Generation)**

This powerful, stand-alone utility program pack is designed to interactively construct a set of measurement locations for use by ESIM and EMODAL. It allows you to use standard shape elements to define simple or complex sets of measurements for entering data.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**EMODAL 4 (Entek Modal Analysis)**

This software is used with dual-channel spectrum analyzers to allow engineers to conduct modal analysis studies. Using EMODAL with the HP Model 16 enables a test engineer to quickly determine potential design flaws in a product and/or optimize proposed design changes.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**ESHAPE (Entek Deflection Shape Analysis)**

This software is used with a single-channel spectrum analyzer to perform operating deflection shape analysis. Using ESHAPE on the Model 16 allows engineers to quickly determine potential design flaws in operating systems such as fans, turbines, drivelines, etc.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**ESIM (5) (Entek Sound Intensity Measurement)**

The ESIM program is used to perform two-microphone sound intensity measurements for identifying and ranking noise sources of a complex mechanical system.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**ESMOD (Entek Structural Modelling)**

This pack allows test engineers to evaluate the changes in dynamic characteristics of structures when mass, stiffness or damping properties are changed.

Supplied by Entek Scientific Corporation, 4480 Lake Forest Drive, Suite 316, Cincinnati, OH 45242 U.S.A (513) 563-7500

**OSLO Optical Design**

This computer-aided design tool converts the HP Model 16 into a stand-alone optical design center for designing and evaluating image-forming optical systems. Evaluation performed by the program includes paraxial ray tracing, exact ray tracing, spot diagram analysis, and computation of aberration coefficients.

Supplied by Sinclair Optics, Inc., 20 North Main Street, Pittsford, NY 14534 U.S.A. (716) 381-9100

**Calibration\***

This software is a comprehensive calibration scheduling and control system for gages and test instruments. This easy-to-use system is designed to reduce manufacturing costs and improve productivity.

Supplied by Hansford Data Systems, Inc., 3055 Brighton-Henrietta Town Line Road, Rochester, NY 14623 U.S.A. (716) 442-7110

\* Available in U.S. and Canada only.

### **Process Analysis\***

This software provides analytical tools for statistical quality control applications. It offers data storage, data management, and analytical tools that can help increase productivity and reduce manufacturing costs.

Supplied by Hansford Data Systems, Inc., 3055 Brighton-Henrietta Town Line Road, Rochester, NY 14623 U.S.A. (716) 442-7110

### **CADEC I/II**

This program for designing electronic circuits features the capabilities of optimization of circuits to measured or desired data, numerical and graphic output of results, reuse of calculated or measured results within a new analysis and Fourier Transform. CADEC II includes field effect transistors and micro-wave components with automatic end effect correction for the open stub micro strip techniques corrected up to 4.0 GHz.

Supplied by Communications Consulting Corp., 52 Hillcrest Drive, Upper Saddle River, NJ 07458 U.S.A. (201) 825-7966

### **Site Computation & Design**

This package offers design and drafting tools for civil and surveying applications. With intelligent prompts and an easy format, the user does not have to be an upper-level technician to understand and operate its features.

Supplied by Land Innovation, 7359 Berkshire Court, Maple Plain, MN 55369 U.S.A. (612) 420-6811

### **ATA-METER (Automated Meter Calibration)\***

This software allows easy generation and execution of automated calibration procedures for digital, analog or GPIB meters. This highly structured software consists of the following major components: procedure files, generator, driver, and documenter.

Supplied by Automated Technology Associates, 7098 Nother Shadeland Avenue, Suite D-1, Indianapolis, IN 46220 U.S.A. (317) 842-9488

### **Topography (Digital Terrain Modeling)**

This general-purpose surface modeling software offers options to perform a variety of mapping functions and computations including contouring, 3-D, sections, relief shading, volume computations and more.

Supplied by Pacsoft, 733 Seventh Avenue, Kirkland, WA 98033 U.S.A. (206) 827-0551

### **Profile and Cross Sections**

This option to the TOPOGRAPHY software computes and plots vertical alignments. Regardless of how the field data are recorded (radially, from an aerial photo, etc.), accurate sections can be drawn along a baseline falling anywhere within the boundary of the modeled terrain.

Supplied by Pacsoft, 733 Seventh Avenue, Kirkland, WA 98033 U.S.A. (206) 827-0551

### **Digitized Modeling**

Digitized Modeling will convert graphical information (existing contour maps) into digital data (X-Y-Z coordinates). The converted data is stored directly in the gridded topo file. Either the plotter or a separate digitizer may be used as the input device.

Supplied by Pacsoft, 733 Seventh Avenue, Kirkland, WA 98033 U.S.A. (206) 827-0551

### **Interactive Modeling**

This software allows interactive modeling and editing of surface models for TOPOGRAPHY programs.

Supplied by Pacsoft, 733 Seventh Avenue, Kirkland, WA 98033 U.S.A. (206) 827-0551

### **Earthwork Volume Computations**

This software performs cut and fill volume computations between surfaces. It is available as an option to the TOPOGRAPHY software. The truncated prism method is used, making it ideal for analyzing construction sites, mines, reservoirs, and landfills.

Supplied by Pacsoft, 733 Seventh Avenue, Kirkland, WA 98033 U.S.A. (206) 827-0551

## **Utilities**

### **9816 Utilities Package**

This package contains a universal Cartesian plotting program plus several other utilities that make your Model 16 easier to use. Additional utilities include an autostart utility for setting the internal clock; a routine to give you the time, date and day from the internal clock; a routine for packing a disc that gives you maximum free space on the disc; a calendar; a routine for comparing files and a utility which converts random numbers into graphic designs.

Supplied by L.W. James and Associates, 1525 East County Road 58, Fort Collins, CO 80524 U.S.A. (303) 484-5926

### **Text Editor for Basic Save Files**

This text editor provides many editing functions useful for program debugging, modification and documentation. It simplifies moving blocks of lines, converting subroutines to subprograms, changing variable names, stripping comments, etc.

Supplied by L.W. James and Associates, 1525 East County Road 58, Fort Collins, CO 80524 U.S.A. (303) 484-5926

### **Start-Up (Autostart Utility)\***

This software provides fast and friendly operator startup for HP Model 16 applications programs written in BASIC.

Supplied by Automated Technology Associates, 7098 Nother Shadeland Avenue, Suite D-1, Indianapolis, IN 46220 U.S.A. (317) 842-9488

### **Basic Utilities Library**

This utilities pack provides media and system management utilities and programming aids, plus mainframe feature and application demonstration programs for the BASIC language system. (Shipped with every BASIC 2.0 Operating System.)

Available through Hewlett-Packard

- 09800-10300 for 3½" discs
- 09800-10500 for 5¼" discs

### **Loader Utility**

This utility allows loading of BASIC 2.0 system and binary program with one operation. It uses disc drives in the 3.0 Boot ROM to load other drivers from an external disc or SRM. (Shipped with every BASIC 2.0 Language System)

Available through Hewlett-Packard

- 09800-10310 for 3½" discs
- 09800-10510 for 5¼" discs

### **System Test Discs**

These discs provide mainframe diagnostics and peripheral and I/O exercisers for the entire Series 200 product line.

Available through Hewlett-Packard

- 09800-10330 for 3½" discs
- 09800-10530 for 5¼" discs

### **CSUB Utilities**

This software converts modules compiled in Pascal or assembled in assembly language for use in BASIC. It is recommended only for experienced Pascal programmers.

Available through Hewlett-Packard

- 09800-10340 for 3½" discs
- 09800-10540 for 5¼" discs

### **Series 200/CS80 Exerciser**

This software allows the Model 16 computer to exercise a CS80 (Command Set 80) discs drive.

Available through Hewlett-Packard

- 09800-10360 for 3½" discs
- 09800-10560 for 5¼" discs

### **Series 200/IBM 3740 Data Exchange Utility**

This software is used for data transfer between Series 200 and IBM 3740 disc formats. It allows one or all files to be converted from one format to the other.

Available through Hewlett-Packard

- 09800-10370 for 3½" discs
- 09800-10570 for 5¼" discs

### **9835/45 To Series 200 Basic Language Translator**

This translator helps you convert a program from HP 9835/45 BASIC to Series 200 BASIC. The pack also translates 8" flexible disc data files created on the HP 9835/45 to LIF data files.

Available through Hewlett-Packard.

- 09800-10390 for 3½" discs
- 09800-10590 for 5¼" discs

## **Other**



### **Adventure**

This computer game involves exploring a colossal cave for hidden treasures. The computer functions as your eyes and ears, telling you the dangers or treasures discovered in your search. This version of the original Adventure game by Crowther and Woods has been translated into HP BASIC.

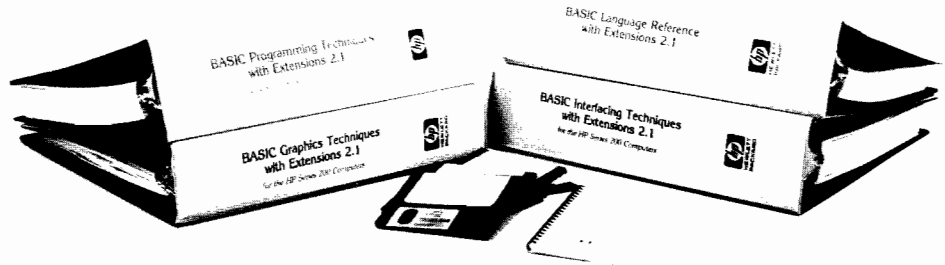
Supplied by L.W. James and Associates, 1525 East County Road 58, Fort Collins, CO 80524 U.S.A. (303) 484-5926

### **Interior Design**

Interior Design is a software package for interior design and architectural applications. It includes standard graphic items in the following categories: floor plan items, chair and table selection, kitchen selection, bathroom selection, entertainment selection, bedroom selection, accent selection, and office and commercial selection.

Supplied by Land Innovation, 7359 Berkshire Court, Maple Plain, MN 55369 U.S.A. (612) 420-6811

# BASIC 2.0 Capabilities



The BASIC 2.0 Language System is anything but basic. It adds to the inherent simplicity of BASIC the computational power usually found in FORTRAN, ALGOL and APL. Beyond that, high-performance, I/O-intensive constructs are incorporated, giving this BASIC the highest performance found in a personal computer on the market today.

BASIC 2.0 puts mini-computer architecture and power on YOUR desk, bench or test-bay, not down the hall. With the BASIC Language System, high performance and easy programming are not mutually exclusive – both are provided for your benefit. This increase in your software productivity is applicable to a wide spectrum of task and project demands because this BASIC provides an impressively rich command set at your finger-tips. Sophisticated applications can be met with state-of-the-art hardware power as your resource. At the same time simple tasks can be solved in minutes, not hours.

BASIC 2.0 gives you high performance AND easy software development, taking you from problem definition to solution quickly and efficiently. You generate results, not just software.

## Features

- A stand-alone computer system
- Interactive editing
- Statement syntaxing at program entry
- Extensive debug and trace tools
- Structured programming constructs
- Independent subprograms
- Dynamic variable allocation
- Labeled COM
- A unified device and mass storage I/O system
- 16M bytes of address space including memory-mapped I/O with the Motorola MC68000
- Intrinsic I/O drivers
- Optimized transactional I/O

## Benefits

You don't have to wait to log on. You have full computer power at your fingertips.

The editor is always there. A rotary control knob lets you quickly scroll through your program.

You don't have to run your program to find syntax errors; BASIC 2.0 proofreads your code.

You can single-step your program one line at a time to check program logic flow and variable assignments. Tracing tools allow a line-by-line log of line numbers and variable changes to be printed while your software is running.

Complex algorithms are easier to develop, document and maintain.

You can break your software down into smaller modules to simplify development and coding and to develop disc-resident subprogram utility libraries.

You can efficiently manage memory space as you go.

This increases the flexibility of your subprograms. You can have several independent "common" variable blocks, allowing easy subprogram variable usage and subprogram communication.

You can easily redirect to and from devices and files. In essence, your I/O routines can access a mass-storage file in the same way as an external device providing an excellent test harness for your I/O dependent code.

As applications grow, you won't outgrow your memory space or system performance. High-volume data acquisition can be done directly to memory.

BASIC 2.0 is optimized for I/O so you don't have to write or "link in" separate I/O drivers – they're already there.

I/O path set-up times are reduced to the bare minimum. Short data transfers are just that – short. BASIC 2.0 gives your I/O-dependent software unparalleled "agility."



## Features

- The richest HP-IB I/O command set in the industry
- Fifteen levels of prioritized software interrupt

## Benefits

Instrument control over HP-IB is quick and to-the-point. More than 20 commands are dedicated to HP-IB I/O to give you performance and flexibility in letting the bus work for you.

You can optimize I/O operations to closely match peripheral device speeds without tying down the system. Interrupt priorities allow you to service critical interrupts before less important ones. Even the keyboard rotary control knob can be used as a system interrupt source in addition to the soft keys.

## BASIC 2.0 Operating Characteristics

### Language System Memory Requirements

ROM-based  
1 ROM board and 21K bytes RAM  
RAM-based  
277K bytes RAM

### Range

#### Real Precision

-1.797693134862315E + 308 to  
-2.225073858507202E - 308

0

2.225073858507202E - 308 to  
1.797693134862315E + 308

#### Integer Precision

-32768 to +32767

### Math Hierarchy

Highest priority .. ( )

User defined and built-in functions

↑

\*, /, MOD, DIV

+, - (unary and binary + and -)

=, <>, <, >, ≤, ≥

NOT

AND

Lowest priority .. OR, EXOR

### Built-In Functions

Mathematical and trigonometric functions and operations are included in the following with typical execution times in milli-seconds.

Absolute (ABS) . . . . . 0.041 (integer 0.033)  
Integer quotient (DIV) 0.449 (integer 0.075)  
Digit round  
(DROUND) . . . . . 1.498  
e<sup>x</sup> (EXP) . . . . . 3.485  
Integer (INT) . . . . . 0.090  
Ln (LOG) . . . . . 3.706  
Log (LGT) . . . . . 3.800  
Modulus (MOD) . . . . . 0.801 (integer 0.074)  
Random number  
(RND) . . . . . 0.419  
Sign (SGN) . . . . . 0.055  
Square root (SQR) . . . . . 1.743  
Sine (SIN) . . . . . 3.621  
Cosine (COS) . . . . . 4.200  
Tangent (TAN) . . . . . 4.200  
Arcsine (ASN) . . . . . 5.009  
Arccosine (ACS) . . . . . 5.004  
Arctangent (ATN) . . . . . 3.398  
↑ . . . . . 7.155  
/ . . . . . 0.432  
\* . . . . . 0.302 (integer 0.080)  
+ . . . . . 0.137 (integer 0.069)  
- . . . . . 0.161 (integer 0.069)

#### Logical Operators

AND

OR

EXOR

NOT

#### Relational Operators

= . . . . . Equal

< . . . . . Less than

> . . . . . Greater than

≤ . . . . . Less than or equal to

≥ . . . . . Greater than or equal to

≠ . . . . . Not equal to

#### String Operator

& . . . . . Concatenation

## BASIC 2.0 Keyword Summary

### General Functions

- ABS - returns the absolute value of its argument.  
ACS - returns the principal value of the arccosine of its argument.  
AND - returns the logical conjunction of its arguments.  
ASN - returns the principal value of the arcsine of its argument.  
ATN - returns the principal value of the arctangent of its argument.  
BINAND - returns the value of a bit-by-bit AND of its arguments.  
BINCMP - returns the value of the 1's complement of its argument.  
BINEOR - returns the value of a bit-by-bit exclusive OR of its arguments.  
BINIOR - returns the value of a bit-by-bit inclusive OR of its arguments.  
BIT - returns an INTEGER representation of the contents of one bit of its argument.  
COS - returns the cosine of its argument.  
DIV - returns the integer portion of the quotient of the dividend divided by the divisor.  
DROUND - returns the value of a numeric expression, rounded to the specified number of significant digits.  
ERRL - returns a value of 1 if the most recent execution error occurred during the specified line.  
ERRN - returns the number of the most recent program execution error.  
EXOR - returns the exclusive disjunction of its arguments.  
EXP - raises the base of the natural logarithm (Naperian e, =2.718281828459045...) to the power of the argument.  
INT - returns the greatest integer which is less than or equal to the evaluated expression.  
KNOBX - returns the net number of pulses generated by the rotary control knob since the last interrupt.  
LGT - returns the logarithm (base 10) of its argument.  
LOG - returns the natural logarithm (base e) of its argument.  
MOD - returns the remainder after performing division of its arguments.  
NOT - returns the logical complement of its argument.  
NPAR - returns the number of parameters passed in the call to the currently executing subprogram or multi-line function.  
OR - returns the logical disjunction of its arguments.

PI – returns an approximate REAL value for pi.  
 RND – returns a pseudo-random number which is greater than zero and less than one.  
 ROTATE – returns an INTEGER value representing the value obtained by creating a bit-string version of its argument and rotating the argument the number of bit positions specified.  
 SGN – returns an INTEGER value of one if the given expression is positive, zero if it equals zero, and -1 if it is negative.  
 SHIFT – returns an INTEGER value representing the value obtained when its argument is converted to a 16-bit string pattern and shifted the number of positions specified.  
 SIN – returns the sine of its argument.  
 SQR – returns the square root of its argument.  
 TAB – moves the print position to the specified column on the current printing device.  
 TABXY – moves the print position to the column and line specified on the internal CRT.  
 TAN – returns the tangent of its argument.  
 TIMEDATE – returns the current value of the real-time clock.

### String Functions

CHRS – converts a numeric value into a character byte.  
 LEN – returns an integer representing the current number of characters in a string expression.  
 NUM – converts the first character of the string expression to its equivalent decimal value ASCII character code.  
 POS – determines the position of a substring within a string.  
 VAL – converts a string expression into a numeric value.  
 VALS – returns a string which represents the value of its argument.

### General Statements

ALLOCATE – dynamically reserves memory space for string variables, string arrays and numeric arrays during execution.  
 ALPHA OFF/ON – enables or disables the CRT alphanumeric area for viewing.  
 BEEP – outputs an audible tone with programmable frequency and duration.  
 CALL – transfers program execution to the specified subroutine subprogram and specifies values for the pass parameters.  
 CASE, CASE ELSE – structured sequence used with SELECT for selecting alternative actions depending on the result of a conditional test (see SELECT).

COM – dimensions and reserves space for simple and array variables in a special “common” memory area so more than one program segment can access the variables.  
 CONT – resumes program execution without pre-run initialization (see PAUSE).  
 DATA – allows numeric values or string literals to be defined and assigned with the READ statement.  
 DEALLOCATE – reclaims the memory space reserved for use by the ALLOCATE statement.  
 DEF FN – defines a multi-line function which returns either a single REAL value or a string value to a calling program segment.  
 DEG – sets degree mode for results and arguments of trigonometric functions and graphics rotational commands.  
 DEL – deletes all program lines within the range specified by the beginning and ending line identifiers.  
 DELSUB – deletes one or more subprograms or multiple line functions from memory.  
 DIM – dimensions and reserves memory for REAL numeric arrays, simple strings and string arrays.  
 DISABLE – disables all active ON (event) statements except ON ERROR, ON END and ON TIMEOUT.  
 DISP – causes the values of the print list to be sent to the display line on the CRT.  
 DISP USING – causes the values of the print list to be sent to the display line on the CRT according to the format specified by the image specifier.  
 DUMP ALPHA – transfers the contents of the CRT screen to the device currently specified by DUMP DEVICE IS.  
 EDIT – accesses the editor to enter a new program or for modification of program lines.  
 ELSE – is part of the IF...THEN...ELSE...END IF construct, provides an alternative action to be performed.  
 ENABLE – re-enables all ON (event) statements which were suspended by DISABLE.  
 END – marks the end of a main program segment.  
 END IF – marks the end of an IF...THEN...ELSE...END IF construct.  
 END LOOP – marks end of LOOP construct.  
 END SELECT – marks end of SELECT construct.  
 END WHILE – marks end of WHILE construct.  
 EXIT – provides exit from a structured LOOP (see LOOP).  
 FN – is used to call a user-defined, multiple-line function subprogram.

FNEND – is the last statement in a multiple-line function subprogram.  
 FOR...NEXT – defines a loop which is repeated until the loop counter exceeds its final value.  
 GOSUB – transfers program control to the subroutine that begins at the specified line.  
 GOTO – transfers program execution to the specified line.  
 IF...THEN, IF...THEN...ELSE...END IF – provides conditional branching or execution of one or more statements when the specified condition is true.  
 INTEGER – dimensions and reserves memory for integer variables and arrays.  
 LET – assigns a value to a simple numeric variable or assigns a set of characters to a simple string variable.  
 LIST – causes the entire program, or lines specified within a range list to be output to the current PRINTER IS device.  
 LIST # – causes the entire program, or lines specified within a range list to be output to the specified printing device.  
 LOOP...EXIT – repeats statements in a structured loop as long as the EXIT expression is FALSE.  
 OFF/ON ERROR – disables/enables an event-controlled branch to occur whenever a trappable error occurs.  
 OFF/ON KEY – disables/enables an event-controlled branch to occur when a Special-function Key is pressed.  
 OFF/ON KNOB – disables/enables an event-controlled branch to occur every specified number of seconds if the rotary control knob has generated pulses since the last interrupt.  
 ON event GOTO/GOSUB/CALL/RECOVER – is used with ON ERROR, ON END, ON KEY, ON INTR, ON KNOB and ON TIMEOUT to cause a branch in program execution based on the specified GOTO, GOSUB, CALL or RECOVER statement. With RECOVER, the branch will occur regardless of the current program environment.  
 ON expression GOSUB – transfers program execution to one of several subroutines depending on the value of the expression.  
 ON expression GOTO – transfers program execution to one of several line identifiers depending on the value of the expression.  
 OPTION BASE – specifies the lower bound of subscript values for all array dimensions when the lower bound is not explicitly stated in the array declaration.  
 OPTIONAL – is used in formal parameter lists to declare which parameters are optional when passing to a subprogram or FN function.

PAUSE – halts program execution without altering the data or state information so program operation can be continued.

PRINT – prints the specified items in the print list to the current system printer.

PRINT USING – outputs the items in the list according to the format specified by the image specifier.

PRINTALL IS – assigns a destination printing device for output which is normally sent to the display line of the CRT.

PRINTER IS – specifies the current printing device for any PRINT, PRINT USING, CAT and LIST statements.

RANDOMIZE – is used to modify the seed used by the computer's random number generator.

RAD – sets radian mode for results and arguments of trigonometric functions and graphics rotational commands.

READ – assigns values to program variables in conjunction with the DATA statement.

REAL – reserves storage for full precision, floating point variables and arrays.

REM or ! – allows comments to be inserted into your program.

REN – renumbers the program line numbers.

REPEAT...UNTIL – this loop construct repeats the statements in a structured loop until the expression following UNTIL is true.

RESTORE – repositions the data pointer for a program segment.

RESUME INTERACTIVE – enables the EXECUTE, PAUSE, STOP, STEP, CLR I/O, and RESET keys after a SUSPEND INTERACTIVE statement.

RETURN – marks the end of a subroutine. RETURN expression - the last executed statement of a multi-line function.

RUN – enables program execution at the specified line identifier.

SCRATCH – erases all or selected portions of memory, depending on the secondary keyword.

SELECT – this structured statement allows the execution of several different actions depending upon the result of a conditional test when used with CASE or CASE ELSE. SELECT must end with END SELECT.

SET TIME – sets the time-of-day given by the real-time clock.

SET TIMEDATE – sets the time-of-day and the date given by the real-time clock.

STOP – terminates execution of the program.

SUB – is the first statement in a subroutine subprogram and specifies the formal parameter list for the subprogram.

SUBEND – is the last statement of a subroutine subprogram and transfers

execution back to the calling program segment.

SUBEXIT – can be used within the body of a subroutine subprogram to transfer execution back to the calling program segment.

SUSPEND INTERACTIVE – disables EXECUTE, PAUSE, STOP, STEP, CLR I/O and RESET keys.

TRACE ALL – allows the tracing of program flow and variable assignments while a program is running.

TRACE OFF – disables all tracing activity enabled by TRACE ALL or TRACE PAUSE.

TRACE PAUSE – causes program execution to pause before executing the specified line.

UNTIL – used with REPEAT for looping (see REPEAT).

WAIT – nondestructively suspends program execution for an approximate amount of time in seconds.

WHILE – repeats a structured loop as long as its expression is true.

### Mass Storage Statements

ASSIGN – links an @name to a device or file, providing a unified I/O structure to a program.

ASSIGN @name TO \* – cancels an @ name assignment and its attribute.

CAT, CAT TO – list the contents of a mass storage medium's directory.

COPY – provides the capability to copy single files or to BACKUP entire media.

CREATE ASCII – creates an ASCII type file on the mass storage device.

CREATE BDAT – creates files which hold binary data types.

GET – reads the specified ASCII file into the computer's program memory.

INITIALIZE – sets up directory for a new medium. Data previously on a disc is destroyed.

LOAD – retrieves and places in memory any program file (PROG) which was previously stored with the STORE statement.

LOAD BIN – retrieves and puts into memory a binary program file (BIN) which was previously stored with the STORE BIN statement.

LOADSUB ALL FROM – loads all of the BASIC subprograms in a program file (PROG) into the computer's memory.

MASS STORAGE IS – specifies the current system mass storage device. (See MSI below.)

MSI – can be used to abbreviate MASS STORAGE IS.

OFF END – deactivates the end-of-statement branch previously activated by an ON END statement.

ON END – enables an event-controlled branch to occur when an end-of-file condition occurs for a mass storage device.

PROTECT – establishes (or changes) the protect code used on non-ASCII files.

PURGE – deletes a file's entry from the mass storage medium's directory.

RE-SAVE – copies all, or part, of the program currently in the computer's memory into an ASCII file as source code strings.

RE-STORE – copies a BASIC program and all binary programs in the computer's memory onto a mass storage medium in internal format.

RE-STORE BIN – writes all binary programs currently in the computer to the specified file.

RENAME – changes the file's name on the mass storage medium's directory.

SAVE – creates an ASCII file and stores all, or part, of the BASIC program in the computer's memory into it as source code strings.

STORE – creates a PROG file and stores the entire BASIC program and all binary programs in computer memory into it in internal format.

STORE BIN – creates a BIN file and stores all of the binary programs currently in the computer's memory into it.

### I/O Functions

KBD\$ – returns the contents of the keyboard buffer.

PPOLL – returns a byte representing the 8 status-bit messages of those devices on the HP-IB capable of responding to a parallel poll.

READIO – allows the reading of either bytes or words from any interface register.

SPOLL – returns an integer whose low order byte contains the serial poll response from the addressed device.

### I/O Statements

ABORT – resets the interface functions for an HP-IB interface.

ASSIGN – links an @ name to a device or file, providing a unified I/O structure to a program.

ASSIGN @name TO \* – cancels an @ name assignment and its attribute.

CLEAR – allows the active controller to put HP-IB devices into a defined device-dependent state.

CMD – is used with the SEND statement to send numeric or string expressions over HP-IB with ATN true.

CONTROL – sends control information to an interface or to the internal table associated with an @ name.

**DATA** – is used with the SEND statement to send numeric or string expressions over HP-IB with ATN false if the computer is the active controller and is addressed to talk.

**DISABLE INTR** – sends a word to the interrupt-enable register of the specified interface, disabling all interrupts from that interface.

**ENABLE INTR** – enables the specified interface to generate an interrupt which can cause end-of-statement branches.

**ENTER, ENTER (@ name** – is used to read data from a device, file or string and assign the values read to the variables in the list.

**ENTER USING** – is used to read data from a device, file or string and assign the values read to the variables in the list according to the specified IMAGE.

**FORMAT OFF/ON** – specifies whether data is to be interpreted as ASCII (ON) or Series 200 internal format (OFF).

**IMAGE** – is referenced by the USING clause of the PRINT, OUTPUT, DISP, LABEL and ENTER statements to provide formats for I/O operations.

**INPUT** – is used to assign keyboard input to program variables.

**LINPUT** – assigns characters entered from the keyboard to a string variable or substring.

**LISTEN** – is used with the SEND statement to specify one or more primary addresses.

**LOCAL** – returns all specified devices to their local state.

**LOCAL LOCKOUT** – sends the LLO (local lockout) message, preventing an operator from returning the device to local control by its front panel.

**MTA** – is used with the SEND statement to send the HP-IB interface card's talk address.

**MLA** – is used with the SEND statement to send the HP-IB interface card's listen address.

**OFF/ON INTR** – disables/enables an event-controlled branch to occur when an interface card (enabled by ENABLE INTR) requests an interrupt. Priority may also be specified.

**OFF/ON KBD** – disables/enables interrupt branching when a key is pressed.

**OFF/ON TIMEOUT** – disables/enables an event-controlled branch to occur when an I/O timeout occurs on the specified interface.

**OUTPUT, OUTPUT (@ name** – copies data from the variables in the output list to the specified destination.

**OUTPUT USING** – copies data from the variables in the output list to the specified destination according to the specified IMAGE.

**PPOLL CONFIGURE** – programs the logical sense and data bus line on which the

specified device responds to a parallel poll.

**PPOLL UNCONFIGURE** – disables the parallel poll response of the specified devices.

**REMOTE** – places HP-IB devices having remote/local capabilities into the remote state of operation.

**SEC** – is used with the SEND statement to send secondary commands and addresses over HP-IB.

**SEND** – sends control information and data to an HP-IB interface.

**STATUS** – provides the status value from an interface register, or the internal table associated with an @ name, into the specified numeric variables.

**TALK** – is used with the SEND statement to define which devices talk on the HP-IB.

**TRIGGER** – initiates device-dependent action from either a selected device or all devices addressed to listen on the HP-IB.

**UNL** – is used with the SEND command to send the bus unlisten message (UNL) on the HP-IB.

**UNT** – is used with the SEND command to send the bus untalk message (UNT) on the HP-IB.

**USING** – used by the PRINT, OUTPUT, DISP, LABEL and ENTER statements, provides formats for I/O operations.

**WRITEIO** – writes either bytes or words to any interface register.

### Graphics Functions

**RATIO** – returns a value equal to the ratio of the physical dimensions of the graphic device's hard clip limits.

### Graphics Statements

**AXES** – draws a pair of axes with optional equally spaced tic marks.

**CLIP** – redefines the soft clip area.

**CLIP ON/OFF** – specifies whether the current clipping area is the soft clip area (ON) or the hard clip area (OFF).

**CSIZE** – sets the size and aspect ratio for labeled characters.

**DRAW** – draws a line from the pen's current position to the specified X,Y coordinate position using the current line type and pen number.

**DUMP GRAPHICS** – copies the contents of graphics memory onto the device currently specified by DUMP DEVICE IS.

**DUMP DEVICE IS [EXPANDED]** – specifies which device receives the data when DUMP GRAPHICS or DUMP ALPHA is executed. EXPANDED allows a 2 for 1 expansion along each axis, and rotates the resulting image 90°.

**FRAME** – draws a frame around the current clipping area using the current pen number

and line type.

**GCLEAR** – clears the plotter's background.

**GLOAD** – allows you to load the contents of an integer array into graphics R/W memory for display.

**GINIT** – resets all global graphics parameters to their power-on values.

**GRAPHICS ON/OFF** – turns the CRT graphics raster on/off.

**GRID** – draws a full grid pattern.

**GSTORE** – allows the copying of graphics R/W memory contents in coded form into an integer array.

**IDRAW** – draws to a position specified as an increment to the current position of the pen.

**IMOVE** – moves to a position specified as an increment to the current position of the pen.

**IPLOT** – incremental plot is similar to IDRAW and IMOVE. The pen control is determined by a value following the X and Y coordinates.

**LABEL** – directs text and the contents of variables to the current plotting device.

**LABEL USING** – directs text and the contents of variables to the current plotting device according to the specified IMAGE.

**LDIR** – determines the angle at which labeling statements draw the characters.

**LINE TYPE** – selects a line type and repeat length for lines, labels, frames, axes and grids.

**LOCATE** – syntaxes to VIEWPORT.

**LOGR** – specifies the position of the characters being labelled relative to the current pen position.

**MOVE** – updates the current position of the pen to the specified X,Y coordinate position.

**PEN** – selects the pen used by the plotter.  
PEN – 1 erases lines on the CRT.

**PENUP** – lifts the physical pen from the plotting surface.

**PIVOT** – specifies a rotation of axes which is applied to all lines drawn by DRAW and IDRAW statements.

**PLOT** – moves or draws to the specified X,Y coordinate. Pen control is specified following the X,Y coordinates.

**PLOTTER IS** – selects a plotter to receive the plotting statements.

**RPLOT** – relative plot moves or draws to the X,Y position relative to the last absolute pen position. Pen control follows the X,Y values.

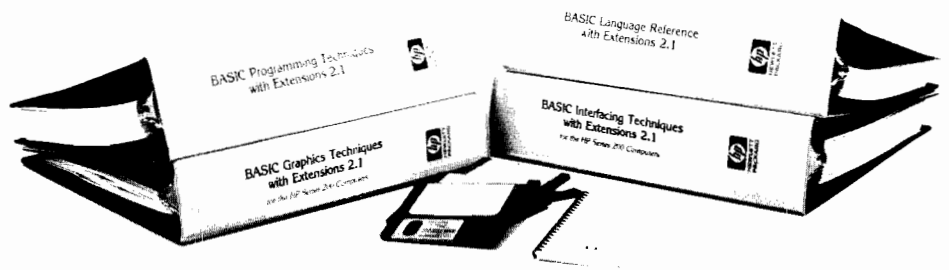
**SCALE** – syntaxes to WINDOW.

**SHOW** – isotropically defines the plotting units mapped on the VIEWPORT area.

**VIEWPORT** – specifies an area on which a scale specified by the WINDOW, and SHOW statements, are mapped.

**WINDOW** – specifies the minimum and maximum values for the plotting area specified by VIEWPORT.

# BASIC Extensions 2.1 Capabilities



BASIC Extensions 2.1 includes over 200 keyword additions or extensions to enhance the already powerful BASIC 2.0 Language System and make it the most powerful personal computer language in the industry. The command set for BASIC Extensions 2.1 was designed to contribute to the features already available in other HP language sets. These features include advanced I/O such as DMA, fast handshake and interrupt buffer transfers, matrix operations, new interface cards, and mass storage enhancements. Other features were added to support new peripherals including the 9133B/34B 10M Winchester disc, external color monitors, and Shared Resource Management.

BASIC Extensions 2.1 is provided as six separate binary programs: Advanced Programming, Color Graphics, XREF, and BCD. ROM or RAM-based BASIC 2.0 must be resident in the computer prior to loading any of these binaries. The binary programs can be loaded separately or stacked together to provide optimum memory utilization. For instance, if you are only using the matrix statements, you only need the Advanced Programming binary loaded.

## Features of BASIC Extensions 2.1

The features provided by the BASIC Extensions can be divided into these categories:

- Entry and Editing Enhancements
- Debugging Extensions
- Matrix Operations
- String Utilities
- Timer Routines and Event Controls
- I/O Enhancements including DMA and Fast Handshake
- Buffered I/O Capabilities

- Formatting Enhancements
- Mass Storage Enhancements
- 9133B/34B 10M Winchester Disc Support
- Command Set 80 Disc Support
- Callable Pascal or Assembly Language Subroutines (with separate CSUB utility programs)
- 98623A BCD Interface Support
- Shared Resource Manager Support
- Color Video Graphics Extensions for 98627A Interface
- 98253A EPROM Development Kit Support
- 98255A EPROM Card Support
- 98625A High-Speed Disc Interface Support
- 98259A 128K byte Bubble Memory Card Support
- RAM Memory Mass Storage Volume Support

## Advanced Programming Binary Keyword Summary

### General Functions

- CRT – returns the select code for the internal CRT.
- ERRDS – Error Device Status – returns the address of the I/O resource involved in the most recent error.
- ERRL – Error Line – extended for TRANSFER.
- ERRN – Error Number – returns the number of most recent error; extended for TRANSFER.
- FRACT – returns the fractional part of the specified value.
- KBD – returns select code of the built-in keyboard.
- MAX – returns the largest value in a list of values.
- MIN – returns the smallest value in a list of values.
- PROUND – the power-of-ten rounding function returns a value rounded to the power of ten specified.
- PRT – returns the value 701, the most common select code for a peripheral printer.
- SC – returns the select code of an @ name.

### String Functions

- DATE – accepts a date in the form of DD MMM [-]YYYY and converts it to the number of seconds between that date and the Julian date: 24 Nov – 4713.

- DATES – computes date in DD MMM [-]YYYY format from Julian date.
- DVAL – returns the whole number value of the string expression in the radix specified.
- DVALS – returns the ASCII string containing the specified whole number converted to the radix specified.
- ERRMS – Error Message – returns the text of the error message of the most recent error.
- IVAL – returns the integer value of the string expression from – 32768 to 32767 in the radix specified.
- IVALS – returns the ASCII string of the integer value converted to the specified radix.
- LWCS – Lower Case – converts alpha characters to their lower case equivalents in the current lexical order.
- REV\$ – returns the specified string in reverse order.
- RPTS – returns a string containing a string repeated the specified number of times.
- SYSTEMS – returns system status and configuration information. SYSTEMS request items are:
- AVAILABLE MEMORY
  - CRT ID
  - DUMP DEVICE IS
  - GRAPHICS INPUT IS
  - KEYBOARD LANGUAGE
  - LEXICAL ORDER IS
  - MASS MEMORY
  - MASS STORAGE IS
  - MSI
  - PLOTTER IS
  - PRINTALL IS
  - PRINTER IS
  - SERIAL NUMBER
  - SYSTEM ID
  - SYSTEM PRIORITY
  - TRIG MODE
  - VERSION: BASIC
- TIME – converts a string of the form HH:MM:SS to seconds between midnight and the specified time.
- TIMES – converts the Julian time to a string of the form HH:MM:SS.
- TRIMS – returns a string with any leading or trailing blanks removed.
- UPCS – Upper Case – converts all lower case alpha characters in a string to the corresponding upper case characters in the current lexical order.

### Commands

- CHANGE – searches the program for the specified string and replaces it with the specified replacement string.
- COPYLINES – copies lines of a program from one location to be inserted at another location in a program.

EDIT KEY – allows “edit-key” mode to be entered for defining the special function keys as typing aids.

FIND – searches a program for the specified string.

INDENT – indents your program to reflect the structure based on the statements used.

LOADSUB FROM – provides a library feature by loading all undefined subroutines or functions from a mass storage file.

MOVELINES – moves lines from one location in a program to another.

REN – Renumber – extended to selectively renumber portions of a program.

SCRATCH – erases the program in memory; extended to provide for immediate termination of TRANSFER operations.

SCRATCH A – erases all variables, programs, scratchable binaries and common; extended to provide for immediate termination of TRANSFER operations.

SCRATCH C – erases common area; extended to provide for immediate termination of TRANSFER operations.

SCRATCH KEY – deletes special function key definitions.

XREF – the cross reference command lists the variables, I/O path names line labels and other identifiers used in a program. Provided as a separate binary program.

### General Statements

CALL – extended to access Pascal or Assembly generated subprograms (see CSUB also).

COM – extended to allow for BUFFER specification.

CSUB – the compiled sub statement is used to identify a compiled Pascal or Assembly language subprogram.

DELSUB – the delete subprogram statement is extended to allow for deletion of compiled Pascal or Assembly language subprograms.

DIM – extended to allow for BUFFER specification.

INTEGER – extended to allow for BUFFER specification.

LIST KEY – list the definition of the special function keys.

REAL – extended to allow for BUFFER specification.

### Event Programming Statements

OFF CYCLE – disables ON CYCLE event branching.

OFF DELAY – disables ON DELAY event branching.

OFF EOR@ – cancels ON EOR@ event branching.

OFF EOT@ – cancels ON EOT@ event branching.

OFF SIGNAL – disables ON SIGNAL software interrupts (see SIGNAL).

OFF TIME – disables event branches set by ON TIME.

ON CYCLE – sets up and enables a periodic event branch each time the specified number of seconds elapses.

ON DELAY – sets up and enables an event branch to occur the specified number of seconds after ON DELAY is executed.

ON EOR@ – sets up and enables an event branch whenever a record terminator is encountered in a TRANSFER operation.

ON EOT@ – sets up and enables an event branch when the last byte is encountered in a TRANSFER operation.

ON SIGNAL – sets up and enables an event branch when a SIGNAL statement is executed.

ON TIME – sets up and enables an event branch when the time specified matches the time in the computer’s real time clock.

SIGNAL – generates a software interrupt; used with ON SIGNAL.

SYSTEM PRIORITY – sets system priority for event interrupts.

### I/O Statements

ABORTIO@ – causes early termination of a transfer to an I/O path.

ASSIGN@ – extended for assigning an I/O path name to a buffer. Also extended to support the following attributes: BYTE or WORD, CONVERT IN or OUT, EOL or EOL OFF, PARITY OFF or ODD or EVEN or ZERO or ONE and RETURN.

BREAK – causes Break sequence to be sent on the RS-232 or Datacomm interface.

BUFFER – used in the DIM, COM, INTEGER, REAL and ASSIGN@ statements to define the buffer area to hold data for the TRANSFER statement.

BYTE – defines byte (8-bit) type transfer for an interface as opposed to word type transfer (used with ASSIGN@).

CONT – used in the TRANSFER statement to indicate that the transfer is to continue until an end-of-transfer condition is encountered.

CONTROL – extended for new device registers and control operations on a buffer.

CONVERT IN or OUT – used in the ASSIGN@ statement to define conversion tables for ENTER (IN) or OUTPUT (OUT). The conversion table can be set up to convert by INDEX into a table or by PAIRS of characters in the table: the original character and its replacement.

CONVERT IN/OUT OFF – causes code conversion set up by CONVERT IN/OUT to be discontinued.

COUNT – used in the TRANSFER statement to terminate a transfer when the specified number of bytes have been transferred.

DELIM – used with the TRANSFER statement to assign a delimiter for terminating an inbound transfer.

END – used with the TRANSFER statement to specify an interface-dependent message for terminating an inbound transfer (such as EOI for HP-IB).

ENTER – extended to allow entering data from a buffer.

EOL – defines End-Of-Line sequence to be sent with PRINT and OUTPUT.

EOL ... [END,DELAY] – allows terminating I/O attributes when used with the ASSIGN statement.

EOL OFF – Resets EOL to Carriage Return/Line Feed.

EOR – used in the TRANSFER statement to specify the End-of-Record delimiter.

IMAGE – extended to include several new format specifiers.

LEXICAL ORDER IS – defines the collating order used by all string relational operators and the UPC\$ and LWCS\$ functions. Six language tables are preset: ASCII, STANDARD, FRENCH, GERMAN, SPANISH, and SWEDISH.

OUTPUT – extended for output to buffers.

PARITY – used with ASSIGN@ to specify parity type.

PASS CONTROL – used to pass active control on the HP-IB to another controller on the bus.

PPOLL RESPONSE – stores the specified value in the parallel poll response register of the HP-IB interface.

PRINT – extended to support WIDTH and EOL sequence.

PRINTALL IS – extended to support WIDTH and EOL sequence.

PRINTER IS – extended to support WIDTH and EOL sequence.

RECORDS – used in the TRANSFER statement to specify the number of records to be transferred.

REQUEST – used to request service from the active controller on HP-IB.

RESET – resets an interface, file or buffer.

RETURN – when used with the ASSIGN@ statement, returns a value indicating the outcome of an assign statement.

STATUS – extended to return status information of buffers and additional device registers.

TRANSFER – provides for unformatted DMA, interrupt and fast handshake buffer transfers.

WAIT – used in the TRANSFER statement to cause the transfer to execute in serial mode.

WAIT FOR EOR@ – suspends overlapped program execution until a record boundary is reached in a transfer operation.  
 WAIT FOR EOT@ – suspends overlapped program execution until the completion of a transfer operation.  
 WIDTH – used in the PRINTER IS and PRINTALL IS to specify the printer width.  
 WIDTH OFF – used in the ASSIGN@, PRINTER IS, and PRINTALL IS statements to set the printer width to infinite.  
 WORD – used with ASSIGN@ to define word (16-bit) type of interface transfer.

### Mass Storage Statements

CAT – extended to catalog the binary programs and subprograms needed by a PROG type file and the binaries in a BIN type file. New control options have also been added (see COUNT, NO HEADER, SELECT and SKIP).  
 CAT TO – extended to catalog a mass storage directory to a string array.  
 CHECKREAD OFF – disables verification of data written to a mass storage file.  
 CHECKREAD ON – enables verification of data written to a mass storage file.  
 CONT – see I/O statements. Can also be used on files.  
 COUNT – used in the CAT statement to return the number of items listed.  
 DELIM – See I/O statements. Can also be used on files.  
 END – See I/O statements. Can also be used on files.  
 EOR – See I/O statements. Can also be used on files.  
 LOAD KEY – loads the definitions of the special-function keys from the specified mass storage file.  
 LOADSUB subprogram FROM – used to load a single subprogram by specifying the subprogram name.  
 MASS STORAGE IS – extended to include support for 7908, 7911 and 7912 discs, the HP9885M/S, HP913X, BUBBLE, EPROM, and MEMORY.  
 NO HEADER – used with the CAT statement to disable header information in a catalog listing.  
 RECORDS – See I/O statements.  
 RE-STORE KEY – stores special function keys into a previously used file name.  
 SELECT – used with the CAT statement to select entries that begin with the specified characters.  
 SKIP – used with the CAT statement to skip the specified number of items before listing catalog entries.  
 STORE KEY – stores the special-function key definitions onto the specified file.

WIDTH – see I/O statements. Can also be used on files.

### Matrix Functions

BASE – returns the lower bound for the specified dimension of an array.  
 DET – returns the determinant of the specified matrix or the last matrix inverted.  
 DOT – returns the inner (dot) product of the two specified vectors.  
 RANK – returns the number of dimensions in an array.  
 SIZE – returns the number of elements in the specified dimension of an array.  
 SUM – returns the sum of all elements in an array.

### Matrix Statements

MAT +, -, \*, /, <, <=, =, <>, >=, > – perform the specified array math, element by element, on the specified numeric arrays (. is for element by element multiply.)  
 MAT\* – matrix multiplication.  
 MAT ... = – array assignment or initialization.  
 MAT REORDER – used to rearrange the data in an array according to an associated pointer vector.  
 MAT SORT – used to reorder an array or set up a reorder vector according to specified keys in either ascending or descending order.  
 MAT CSUM – computes a column sum on the specified matrix.  
 MAT IDN – sets a square matrix to the identity matrix: the main diagonal becomes all 1's, all other elements become 0's.  
 MAT INV – produces the inverse of the specified matrix.  
 MAT RSUM – computes the row sum on the specified matrix.  
 MAT TRN – computes the transpose of the specified matrix.  
 REDIM – Redimension – changes the subscript bounds of a list of arrays.

## Graphics Binary Keyword Summary

### Graphics Statements

AREA COLOR – specifies a fill color using the HSL color model. Used with output statements requiring area fill.  
 AREA INTENSITY – specifies the fill color using the RGB color model. Used with output statements requiring area fill.  
 AREA PEN – specifies a pen number to use as the fill color. This is used with output statements requiring area fill.

DIGITIZE – determines the X and Y coordinates of the current graphics input device's locator when the digitize button (or stylus) is pressed.  
 DUMP GRAPHICS – extended to allow specification of the source device.  
 EDGE – used in the IPLOT, PLOT, POLYGON, RECTANGLE, RPLOT and SYMBOL statements to specify that the lines making up the edges of an area are to be drawn using the current line type and pen.  
 FILL – used in the IPLOT, PLOT, POLYGON, RECTANGLE, RPLOT and SYMBOL statements to specify that the figure drawn is to be filled with the current fill color.  
 GESCAPE – is used for making a request to a graphics device driver. This is a device and driver dependent command.  
 GLOAD – extended to allow specification of the destination device and loading of a subset of the graphics memory.  
 GRAPHICS INPUT IS – defines the device for graphics input.  
 GSTORE – extended to allow specification of the source device and storing of a subset of the graphics memory.  
 IPLOT – extended to allow incremental plotting by specifying a sequence of commands in an array.  
 PEN – specifies the pen or line color to be used.  
 PLOT – extended to allow a sequence of plot commands in an array.  
 PLOTTER IS – initializes a plotting device and enables it for subsequent output. Extended to allow graphics output to external color displays.  
 POLYGON – outputs a closed regular polygon or part of a regular polygon.  
 POLYLINE – outputs an unfilled regular polygon or part of a regular polygon.  
 READ LOCATOR – determines the X and Y coordinates of the current graphics input device's locator without requiring the digitize button (or stylus) to be pressed.  
 RECTANGLE – draws a rectangle with dimensions specified as displacements from the current position.  
 RPLOT – extended to allow relative plotting by specifying a sequence of commands in an array.  
 SET ECHO – sets the current graphics output device's locator position to the specified position.  
 SYMBOL – allows labelling with user-defined symbols.  
 TRACK ... IS ON/OFF – enables the graphics input device's locator to be tracked by the current graphics output device's cursor (or pen) position.

WHERE – returns the current pen position into X and Y variables. It also can return information on whether the pen is up, down, inside or outside the viewport and hard clip boundaries.

## Shared Resource Management Binary Keyword Summary

The following BASIC 2.0 Mass Storage Statements are expanded to encompass the use of Shared Resource Management mass storage files:

ASSIGN	PROTECT DELETE
CAT	PROTECT MANAGER
CONTROL	PROTECT READ
COPY	PROTECT WRITE
CREATE ASCII	PURGE
CREATE BDAT	RENAME
GET	RE-SAVE
LOAD	RE-STORE
LOAD BIN	RE-STORE BIN
LOAD SUB	SAVE
LOAD SUB ALL FROM	STORE
MASS STORAGE IS	STORE BIN

The following BASIC keywords are added for use with Shared Resource Management mass storage files.

CREATE DIR – creates a directory file.  
LOCK ... CONDITIONAL – prevents other Shared Resource workstations from accessing a shared file which is currently in use.  
UNLOCK – removes exclusive access to a file which was protected by the LOCK statement.

## Shared Resource Management Advanced Programming Binary Keyword Summary

The following BASIC Extensions 2.1 Mass Storage Statements are expanded to encompass the use of Shared Resource Management mass storage files.

CAT – with new options ALL, PROTECT.  
CAT PROG  
CAT TO  
LOAD KEY

LOADSUB FROM – command only.

LOADSUB ... FROM  
RE-STORE KEY  
STORE KEY  
TRANSFER

The Advanced Programming capabilities on SRM require that the Advanced Programming and the Shared Resource Management Binary programs are loaded in before the AP SRM binary.

### XREF Binary

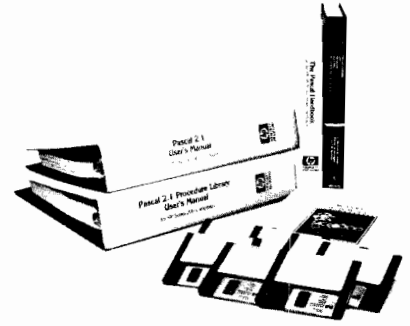
Adds the XREF keyword (described in Advanced Programming keyword summary). This was included as a keyword in AP2\_0. It can now be used stand-alone with BASIC 2.0 or loaded in with the other BASIC Extensions.

### BCD Binary

Contains the drivers for the BCD (98623A) Interface card. BCD card drivers provide BASIC 2.0 programming capabilities. The BCD card drivers cannot take advantage of the advanced programming capabilities. The BCD Binary can be used stand-alone with BASIC 2.0 or loaded in with the other BASIC Extensions.



# Pascal 2.1 Language System Capabilities



The Pascal 2.1 Language System gives you all the advantages of a compiled language and more. It offers you high speed and protection from program modification, plus extensive enhancements not found in other Pascal systems.

The system brings to the HP Model 16:

- Powerful and versatile data and programming structures
- An I/O Procedure Library providing sophisticated device I/O
- A Graphics Library with full peripheral support
- A Librarian allowing the user to create custom procedure libraries
- A comprehensive Editor to speed up program development
- Extensive debugging capability for software troubleshooting
- Support for three different directory formats, including Shared Resource Management
- Motorola MC68000 Assembly Language
- A high-performance compiler which produces ready-to-run MC68000 object code.

These powerful features can now be delivered directly to your desk or test bay packaged in the state-of-the-art hardware of the Model 16.

## Minicomputer Tools at Your Fingertips

This system brings you the sophisticated program development tools of a minicomputer. A menu-driven Command Interpreter is used to load the various program development subsystems (Editor, File Manager, Compiler, etc.) from mass storage or to make the subsystems part of RAM-resident libraries for almost instantaneous access.

### Features

- Flexible program design
- Structured program design
- Modular program development
- Simplified program maintenance
- Extensibility
- Compatibility
- Compiled code and Assembly Language

### Benefits

Extremely flexible data types allow the language to be adapted to the problem, rather than the reverse.

A large program can be easily broken down into its component parts to yield a simpler and more efficient solution.

Frequently used procedures and data types can be compiled into module libraries and then selectively imported into programs and procedures.

Pascal gives you a "handle" on the costs of software maintenance. The final program is readable and understandable, so it's easier to maintain and adapt to the changing needs of the application.

Libraries let you expand the language to the demands of the application.

Your software investment is protected now and in the future.

You can finetune performance to get speed where you need it.

## Standard I/O Procedures and More

I/O Procedures of HP Standard Pascal (the same Pascal used on the HP 1000 and HP 3000) simplify program development by providing support for a full range of printers and mass storage devices. An enhanced I/O Procedure Library is supplied as an integral part of the system. This library allows you to solve complex interfacing tasks by providing such sophisticated capabilities as DMA and interrupt transfers, plus HP-IB bus control. All of this is made available through the familiar method of high-level Pascal procedure calls.

## Enhanced Graphics Procedure Library

A powerful 48-procedure graphics library simplifies your data display and 2-D modeling requirements. The library is a functional subset of the DGL graphics offered on the HP 1000 Series computers so that most DGL graphics programs will transport with little or no trouble. The library allows you to create drawings with any combination of lines, text, and polygons with or without filling on a wide range of supported peripherals. Support for cross-hatching, dithering and area fill lend professionalism to, and aid comprehension of, your drawings. Graphics performance on the internal CRT ranges up to 2 500 1/4-inch vectors per second.

## Fine-tuned Program Performance

A Motorola MC68000 Assembler lets you write speed-critical or frequently executed algorithms directly in Assembly language. These routines can then be called from Pascal programs.

## The Efficiency of a Modular System

Before installing programs for an application, unneeded parts of the system can be easily removed. For instance, the File Manager can be removed from the system to reduce storage requirements and to prevent tampering with files.

## The Programming Environment

The HP Standard Pascal Language System consists of a Command Interpreter and six separate subsystems – editor, file manager, compiler, assembler, debugger and linker/librarian.

### The Command Interpreter

The main job of the command interpreter is to load and run the other subsystems. The features of the Command Interpreter are:

- Menu driven – functions are executed by pressing a single key.
- Automatic loading and linking – programs can be compiled and executed by pressing one or two keys; compiling, loading, and linking is done automatically.
- Permanently loaded libraries – such libraries as the editor or file manager subsystems can be made memory-resident for almost instantaneous access.
- Memory resident volumes – allows you to reserve part of your

computer's memory for use as an ultra-fast mass storage medium.

### The Editor

A versatile screen-based editor allows you to create, change and store programs, documents and virtually any kind of text imaginable. The editor has a built-in prompt line which makes it easy to learn how to use while its single keystroke commands save you unnecessary typing. Features of the editor include:

- Insertion and deletion of text
- Use of the "knob" for high-speed scrolling
- User-defined "markers" that allow sections of text to be accessed directly
- String search and replace capability
- Moving and duplicating sections of text within the editor
- Copying sections of text into the editor from external files
- Optional auto indentation for text or program structuring
- Adjustable margins.

### The File Manager

The file manager provides a means of managing the volumes and files used by the Pascal Language System. A volume may consist of a series of files with a directory or it may be a device such a printer or CRT. The capabilities of the file manager include:

- Creating file directories
- Listing file directories
- Creating, removing and changing the names of files
- Copying a file or an entire volume of files for backup
- Removing an entire volume of files
- Listing files to an external device
- Packing volumes to regain unused mass storage space.

The file manager capabilities support three directory formats – Logical Interchange Format (LIF), Shared Resource Management (SRM) and the

Pascal 1.0 Workstation Format. LIF text files can be transported between the Pascal Language System and other Hewlett-Packard peripherals and computers which support LIF ASCII format, including Series 200 BASIC 2.0.

### The Compiler

The Pascal Language System compiler compiles HP Standard Pascal source code stored on mass storage files into MC68000 machine code. A list of the reserved words, standard procedures and functions, library procedures and functions, and compiler options is included in this publication.

The advantages of the compiler include:

- Performance – source code is compiled directly into executable MC68000 code; there is no intermediate interpreter to degrade execution speed.
- Language power – compiles HP Standard Pascal, the version of ISO (International Standards Organization) Standard Pascal that is also used on the HP 1000 and HP 3000 computers. The compiler can be directed to accept language extensions which are a significant aid in program development (see SYSPROG Compiler Directives).
- Compatibility – existing software investment is protected.

The compiler can be directed to accept only ISO Standard Pascal and to accept most UCSD Pascal extensions. The HP Standard extensions to ISO Standard Pascal and the UCSD extensions are indicated in the list of Reserved Words and Standard Procedures. A list of the UCSD Pascal extensions is also included.

- Flexibility – a comprehensive set of compiler directives is available to direct such details of the compilation as compiler listings, error checking and debugging.



## Range

### Real Precision

-1.797693134862315E + 308 to  
-2.225073858507202E - 308

0

2.225073858507202E - 308 to  
1.797693134862315E + 308

### Integer Precision

-2<sup>31</sup> to +2<sup>31</sup> - 1 (32-bit integer)

### Math Hierarchy

Highest priority .. ( )

NOT, UNARY +, UNARY

-

\*, /, DIV, MOD, AND, +,

- OR

Lowest priority .. =, ≤, >, ≥, <, IN

### Execution Times

All times for the following are in  
milliseconds:

Operation	Time	
	Real	Integer
For Loop	N/A	.009
Assignment	.010	.006
Addition	.106	.009
Subtraction	.131	.010
Multiplication	.285	
Division	.414	
Exponentiation	3.470	
Sine	3.600	
Square Root	1.720	
Log	3.690	
Procedure Call/Return	.030*	

\* Procedure Call/Return includes no parameter passing. Time can be reduced to .011 msec by use of flcheck, nge, and ackcheck compiler directives.

## The Assembler

The Pascal Language System includes a Motorola MC68000 Assembler. The Assembler gives the user access to the powerful MC68000 instruction set. Object code is generated from source files written via the editor. Assembled code can then be executed independently, or can be called as external procedures from Pascal programs. In certain cases speed can be increased for time-critical or frequently-executed sections of code by writing them in Assembly language.

## The Debugger

The Pascal Language System Debugger is a powerful debugging facility which can be used to debug Pascal and Assembly language programs. The Debugger maintains an independent display screen so that the user display can be toggled on or off during debugging.

The capabilities of the Debugger include:

- Stepping through programs one line at a time
- Setting program break points
- Display and modification of register contents
- Formatted display of memory contents
- Byte, word and long word modification of memory contents
- Display and traversal of the Pascal procedure stack
- Error trapping
- Register trace capability.

## The Linker/Librarian

The linker/librarian serves to create and maintain libraries. The libraries hold commonly used modules of code which can be automatically accessed by programs calling for them.

The benefits provided by the linker/librarian include:

- Leverage - frequently used routines and data types can be written once and then shared by many different programs.
- Modular program development - a group of programmers can independently work on sections of a program and then integrate them using the library facility.

The linker/librarian also provides a disassembler that can be used to list an assembly source version of the MC68000 code generated by a Pascal compilation or a MC68000 assembly.

Unlike many compiled systems, the linker/librarian need not be used before executing programs since linking is taken care of automatically at run time.

## The Pascal 2.1 Language System

### Reserved Words

The following list describes the words that are reserved by the Pascal 2.1 Language System. Those words not reserved by the UCSD or ISO language definitions have been indicated by “\*(not UCSD)” or “+ (not ISO)”.

- And - specifies the logical conjunction of its boolean operands.
- Array - a structured data type (see Data Types).
- Begin - used to delimit the start of a compound statement.
- Case - provides for execution of one of several statements depending upon the value of a selector variable.
- Const - precedes the constant definition block in a program, procedure or module.
- Div - provides division with truncation on integer operands.
- End - used to delimit the start of a compound statement.
- Export - precedes a list of procedure and data descriptors in a module to be made available to other programs (see Import, Implement) (\*, +).
- File - a structured data type (see Data Types).
- For...Do - defines a loop which is repeated until the loop counter exceeds its final value.
- Function - defines a function block which returns a value of the type assigned.
- Goto - provides an unconditional branch to a specified label.
- If...Then, If...Then...Else - provides for conditional execution of one of more statements or procedure calls.
- Implement - precedes the program block of a module. (see Export, Import) (\*, +).
- Import - precedes a list of module identifiers to be imported into the program block (see Export, Implement) (\*, +).
- In - tests for inclusion of an element in a set.
- Label - precedes the label declaration block in a program, module, or procedure.
- Mod - yields the remainder after division on integer operands.
- Module - identifies the heading of a module and specifies the module identifier (\*, +).
- Nil - a value associated with a pointer not assigned to an object.

Not – denotes the logical negation of its boolean operand.  
 Or – specifies the logical disjunction of its boolean operands.  
 Packed – used with Array to define a structured data type (see Data Types).  
 Procedure – identifies the heading of a procedure and specifies the identifier and formal parameter list for the procedure.  
 Program – identifies the heading of a program and specifies the identifier and a list of entities through which the program communicates with its environment.  
 Record – a structured data type (see Data Types).  
 Repeat...Until – defines a loop which is repeated until the specified condition comes true. Always executed at least once.  
 Set – a structured data type (see Data Types).  
 Type – precedes the variable declaration block in a program, module, or procedure.  
 Var – precedes the variable declaration block in a program, module, or procedure.  
 While...Do – defines a loop which is repeated while the specified condition remains true. The loop may terminate before the first execution.  
 With...Do – provides for accessing the fields of a record as variables.

## Standard Procedures and Functions

The following list describes the procedures and functions of the standard Pascal 2.1 Language System. Those functions and procedures not included as part of the standard UCSD or ISO language definitions have been indicated by “\* (not UCSD)” or “+ (not ISO)”. Differences in syntax are footnoted.

### File Handling

Reset(f) – procedure – file f is opened read only and positioned at the first component.  
 Rewrite(f) – procedure – file f is opened write only and positioned at the first component.  
 Close(f) – procedure – file f is closed from read and write states (+).  
 Put(f) – procedure – writes the value of the buffer variable f ↑ to the current component of f and advances to the next component.  
 Get(f) – procedure – advances the current position.  
 Open(f) – procedure – file f is opened for direct access (read/write) and positioned at the first component (\*, +).  
 Seek(f,k) – procedure – direct access file f is positioned at component k (+).

Position(f) – function – returns the index of the current component in file f (\*, +).  
 Maxpos(f) – function – returns the index of the last possible component of file f (\*, +).  
 Eof(f) – function – returns boolean true if the file f is not readable, otherwise returns boolean false and advances the file pointer to the next file component.  
 Eoln(f) – function – returns boolean true if an end-of-line is reached in textfile f, otherwise returns boolean false.

### Dynamic Allocation

New(p) – procedure – allocates a new variable and assigns p as a pointer to it.  
 Dispose(p) – procedure – deallocates the space associated with the variable pointed to by pointer p (\*).  
 Mark(p) – procedure – marks a space in the heap from which space is allocated with subsequent calls to New (+).  
 Release(p) – procedure – releases the entire space marked by the previous call to mark with pointer p (+).

### Arithmetic and Numeric

Abs – function – returns the absolute value of the argument.  
 Sqr – function – returns the squared value of the argument.  
 Sqrt – function – returns the square root of the argument.  
 Sin – function – returns the sine of the radian argument.  
 Cos – function – returns the cosine of the radian argument.  
 Arctan – function – returns the arctangent of the argument in radians.  
 Exp – function – raises the base of the natural logarithm to the power of the argument.  
 Ln – function – returns the natural logarithm of the argument.  
 Odd – function – returns boolean true if the argument is odd, false otherwise.  
 Trunc – function – returns the truncated integral part of its real or longreal argument.  
 Round – function – returns the value of its real argument rounded to an integer.  
 Pack(a,i,z) – procedure – moves the components of ARRAY a into PACKED ARRAY z starting at an offset i into z (\*).  
 Unpack(z,a,i) – procedure – moves the components of PACKED ARRAY z into ARRAY a starting at an offset i into a (\*).  
 Hex – function – returns the decimal integer value of its hexadecimal string argument (\*, +).  
 Octal – function – returns the decimal integer value of its octal string argument (\*, +).

Binary – function – returns the decimal integer value of its binary string argument (\*, +).

### Ordinal

Chr – function – returns the character whose ordinal value is given by the argument.  
 Succ – function – returns the value whose ordinal value succeeds that of the argument.  
 Pred – function – returns the value whose ordinal value precedes that of the argument.

### String

+ – operator – used infix for concatenation (+,1).  
 str(s,b,l) – function – returns a substring of length l beginning at character b from string argument s (+,2).  
 strlen(s) – function – returns the current length of its string argument (+,3).  
 strmax(s) – function – returns the maximum allowable length of the string argument (\*, +).  
 setstrlen(s,l) – procedure – sets the current length of the string s to length l (\*, +).  
 strmove(n,s1,p1,s2,p1) – procedure – moves n characters from string s1 at character p1 to string s2 beginning at character p2 (\*, +).  
 strwrite(s,p1,p2,l) – procedure – formats variable list l to string s beginning at character p1 and ending at character p2 using textfile conventions (+,4).  
 stread(s,p1,p2,l) – procedure – extracts formatted values from string s beginning at character p1 and ending at character p2 and puts it in variable list l using textfile conventions (\*, +).  
 strappend(s1,s2) – procedure – appends string s1 onto s2 (\*, +).  
 strinsert(s1,s2,n) – procedure – inserts s1 into s2 starting at character n (+,5).  
 strdelete(s,b,n) – procedure – removes n characters from string s beginning at character b (+,6).  
 strltrim(s) – function – removes leading blanks from string s (\*, +).  
 strrrtrim(s) – function – removes trailing blanks from string s (\*, +).  
 strpos(s1,s2) – function – returns the index of the characters s2 where the first occurrence of s1 begins (+,7).  
 strpt(s1,n) – function – returns a string of n concatenated copies of string s1 (\*, +).

1. Also supported by UCSD CONCAT function.
2. Also supported by UCSD COPY function; UCSD uses STR for different purpose.
3. Also supported by UCSD LENGTH function.

4. Limited version supported by UCSD STR function.
5. Also supported by UCSD INSERT function.
6. Also supported by UCSD DELETE function.
7. Also supported by UCSD POS function.

### Input and Output

- Read(f,v)** – procedure – performs a read operation of file *f* storing the result in variable *v*.
- Readln(f,v)** – procedure – equivalent to read, but skips to the beginning of the next line after completion.
- Write(f,p)** – procedure – performs a write operation to the file *f* of the write parameter *p*.
- Writeln(f,p)** – procedure – equivalent to write, but appends a line marker to the file *f*.
- Readdir(f,k,v)** – procedure – moves direct access file *f* to component *k* and then does the equivalent of a Read.
- Writedir(f,k,p)** – procedure – moves direct access file *f* to component *k* and then does the equivalent of a Write.
- Page(f)** – procedure – causes a top-of-form to be output when the textfile *f* is printed.
- Prompt(f)** – procedure – writes list without a carriage return.

## Data Types

### Standard Types

- Array** – structured type having a fixed number of components, all of the same type.
- Boolean** – simple type with values “true” and “false” with true > false.
- Char** – simple type with values defined by the 8-bit ASCII character set.
- File** – structured type specifying a data structure consisting of a sequence of components all of the same type, but not fixed in number.
- Integer** – simple type with whole number values ranging from  $-2^{31}$  to  $2^{31} - 1$ .
- Longreal** – simple type with value range same as Real.
- Packed Array** – an Array with components stored in compacted form.
- Real** – simple type of real numbers with precision of 64-bit binary floating point.
- Record** – a structured type having a fixed number of components, possibly of different types. Variant records are allowed.
- Set** – a structured type defining a range of values that can be operated on by the set operators.
- String** – a structured type representing a packed array of type Char with dynamically varying length (not part of ISO).

**Text** – a structured type having components of type File of Char, but structured into lines separated by line markers.

### Pointer Type

A type pointing to the components of a dynamic variable.

### Subrange Type

A type defined as a subrange of another ordinal type.

### Enumerated Type

A simple type defined by a user-defined list of values.

## Input/Output Procedure Library

The I/O procedure library provides enhanced I/O capabilities for those complex tasks where Pascal’s standard I/O procedures are not adequate. It contains a group of procedures which can be used with the following interface cards:

- 98622A GPIO Interface Card
- 98624A HP-IB Interface Card and internal HP-IB
- 98626A Serial Interface Card and internal Serial Interface
- 98628A Datacomm Interface Card

An optional DMA Controller (98620A) is available to support high-speed DMA transfers with the GPIO and HP-IB interfaces.

A group of general procedures can be used independent of the interface card. In addition, there are two groups of procedures designed to take advantage of the unique capabilities of the HP-IB and serial interface cards.

This library is not part of the standard Pascal language. It is provided as an external procedure library which is included as part of the Pascal 2.1 Language System. The I/O Procedure Library does not support branching to user-written interrupt service routines.

### General Procedures

This group of procedures can be used independent of the type of interface card.

- Abort\_transfer** – terminates a transfer on the specified buffer.
- Buffer\_data** – a function returning the number of characters available in the buffer.
- Buffer\_reset** – resets the buffer pointers of the specified buffer.
- Buffer\_space** – a function returning the available space in the specified buffer.
- lobuffer** – creates a buffer area of the specified number of bytes.

**locontrol** – outputs a value to the specified interface card control register.

**loinitialize** – resets the I/O system and its drivers.

**loread\_byte** – a function returning a byte from the specified interface card register.

**loread\_word** – a function returning a word from the specified interface card register.

**loreset** – resets the specified interface to its power-up state.

**lostatus** – a function returning the specified interface status register.

**lowrite\_byte** – writes a byte to the specified interface register.

**lowrite\_word** – writes a word to the specified interface register.

**Readbuffer** – reads a single byte from the specified buffer.

**Readbuffer\_string** – reads a specified number of string characters from a buffer into a string.

**Readchar** – reads a single byte from the specified interface.

**Readnumber** – performs a free field numeric entry from the specified interface.

**Readnumberln** – performs a free field numeric entry from the specified interface terminated by a line feed.

**Readstring** – reads characters into the specified string.

**Readstring\_until** – reads characters into the string until the specified termination character is received.

**Readuntil** – reads characters until the specified match character is received.

**Readword** – reads a single, 16-bit numeric value from the specified interface.

**Set\_timeout** – sets the minimum time the computer will wait for an I/O operation to the specified interface to complete.

**Skipfor** – reads, but does not store, the specified number of characters.

**Transfer** – transfers the specified number of bytes into or out of a buffer using fast handshake or DMA.

**Transfer\_end** – transfers data into or out of a buffer until an EOI is generated.

**Transfer\_until** – transfers data into a buffer until the specified terminator occurs.

**Transfer\_word** – transfers a specified number of 16-bit values into or out of a buffer.

**Writebuffer** – writes a single byte into a buffer.

**Writebuffer\_string** – writes the specified string into a buffer.

**Writechar** – writes a single byte of data to the specified interface.

**Writenumber** – performs a free field output with no terminator.

**Writenumberln** – performs a free field output terminated by carriage return/line feed.

Writestring – writes a string to the specified interface with no terminator.  
Writestringln – writes the string followed by a CR/LF.  
Writeword – writes a single, 16-bit value to the specified interface.

### HP-IB Procedures

This group of procedures is used for accessing the unique capabilities of the 98624A HP-IB interface card and internal HP-IB port.

Abort\_hplib – sends the abort message to all devices.  
Active\_controller – a function indicating whether the specified interface is in active controller state.  
Addr\_to\_listen – send interface talk address, device listen address.  
Addr\_to\_talk – send interface listen address, device listen address.  
Clear – sends a device clear or selected device clear message.  
Clear\_hplib – clears the specified HP-IB control line.  
End\_set – function indicating whether EOI was sent on last byte read.  
Hplib\_line – a function returning the current state of the specified HP-IB control line.  
Listen – sends the specified listen address over the bus.  
Listener – a function indicating whether the specified interface is addressed to listen.  
Local – puts the indicated device(s) in local state.  
Local\_lockout – sends the local lockout message to the bus.  
Locked\_out – a function indicating whether the specified interface is in local lockout state.  
My\_address – a function returning the HP-IB address of the specified interface.  
Pass\_control – passes control from the specified interface to another device on the bus.  
Ppoll – performs a parallel poll of the bus.  
Ppoll\_configure – configures the specified device on the bus for a particular parallel poll response.  
Ppoll\_unconfigure – causes the specified device(s) on the bus to disable the parallel poll response.  
Remote – puts the specified bus device(s) in remote programming state.  
Requested – a function indicating whether service is being requested.  
Secondary – sends a secondary command byte to the bus.  
Send\_command – sends a single specified command byte to the bus (ATN true).

Request\_service – used to set up the serial poll response byte and to request service from the active controller.  
Set\_hplib – sets the specified HP-IB control line.  
Spoll – performs a serial poll on the specified device.  
System\_controller – a function indicating whether the specified interface is system controller.  
Talk – sends the specified listen address over the bus.  
Talker – a function indicating whether the specified interface is addressed to talk.  
Trigger – sends the trigger command to the specified device(s) on the bus.  
Unlisten – sends an unlisten command over the bus.  
Untalk – sends an untalk command over the bus.

### Serial Procedures

This group of procedures is used for accessing the unique capabilities of the 98626A/98628A interface cards and the built-in Serial Interface.  
Clear\_serial – clears the specified serial link.  
Send\_Break – sends a break sequence over the specified serial link.  
Serial\_line – a function returning the state of the specified serial line.  
Set\_baud\_rate – sets the baud rate of the specified serial interface.  
Set\_char\_length – sets the character length of the specified serial interface.  
Set\_parity – sets the parity mode of the specified serial interface.  
Set\_serial – sets the specified serial interface modem line.  
Set\_stop\_bits – sets the number of stop bits of the specified serial interface.

### Graphics Procedure Library

Await\_locator – waits for and reads from locator device.  
Clear\_display – clears the graphics display.  
Convert\_wtodmm – convert from world coordinates to millimeters on the graphics display.  
Convert\_wtolmm – convert from world coordinates to millimeters on the locator surface.  
Display\_finit – enables a file as the logical graphics display (permits plotter spooling on SRM 2.0).  
Display\_init – enables a device as the graphics display.  
Display\_term – disables current graphics display.

Graphics\_init – initializes the graphics system.  
Graphics\_term – terminates the graphics system.  
Gtext – outputs graphical text to the graphics display.  
Input\_esc – invokes a device-dependent inquiry from the graphics display.  
Inq\_color\_table – inquires the color modeling parameters from the color capability table.  
Inq\_pgn\_table – inquires the polygon style parameters from the polygon style table.  
Inq\_ws – inquires about characteristics of the graphics system.  
Int\_line – draws a line to the integer coordinates specified.  
Int\_move – moves to the integer coordinates specified.  
Int\_polygon – draws one or more integer polygons with currently specified style parameters.  
Int\_polygon\_dd – draws one or more polygons with device-dependent style parameters.  
Int\_polyline – draws single integer polygon without fill.  
Line – draws a line to the real coordinates specified.  
Locator\_init – enables the locator device for input.  
Locator\_term – disables the locator device.  
Make\_pic\_current – guarantees all primitives have been sent to graphics display.  
Marker – draws a plotting symbol on the graphics display.  
Move – moves to the real coordinates specified.  
Output\_esc – performs a device-dependent function on the graphics display.  
Polyline – draws single real polygon without fill.  
Polygon – draws one or more real polygons with currently specified style parameters.  
Polygon\_dev\_dep – draws one or more real polygons with device-dependent style parameters.  
Sample\_locator – samples the locator device.  
Set\_aspect – redefines the aspect ratio of the virtual coordinate system.  
Set\_char\_size – sets the character size for graphical text.  
Set\_color – sets current color for lines and graphical text using color table.  
Set\_color\_model – sets which color model to use (RGB or HSL).  
Set\_color\_table – sets color table entries.  
Set\_display\_lim – defines the limits of the graphics display in millimeters.  
Set\_echo\_pos – defines the locator echo position on the graphics display.

Set\_line\_style – sets current line style for lines and text.  
 Set\_locator\_lim – redefines the locator limits of the graphics locator.  
 Set\_line\_width – sets current line width for lines and text.  
 Set\_pgn\_color – sets current color for polygon interiors using color table.  
 Set\_pgn\_ls – sets current line style for polygon interiors.  
 Set\_pgn\_style – sets current polygon style parameters using polygon style table.  
 Set\_pgn\_table – sets polygon style table entries.  
 Set\_text\_rot – specifies the direction for graphical text.  
 Set\_timing – sets timing mode for graphics output (immediate updates or buffering).  
 Set\_window – defines the displayable portion of the world coordinate system.  
 Set\_viewport – maps the displayable portion of the world coordinates into a specified location on the graphics display.

### Compiler Directives

ALIAS – specifies an external name for a procedure.  
 ANSI – causes error message to be issued for any non-ANSI Standard feature of HP Standard Pascal.  
 CALLABS – chooses between 32-bit absolute and 16-bit program counter relative jumps for forward and external procedure calls.  
 CODE – causes executable code to be emitted.  
 CODE\_OFFSETS – causes line number/program counter pairs to be printed for each executable statement listed.  
 COPYRIGHT – places a string in the object file indicating the program copyright ownership.  
 DEBUG – causes text to be compiled with debug capabilities.  
 DEF – specifies the number of logical records allowed for external definitions.  
 IF...END – allows for condition compilation of the delimited region of text.  
 HEAP\_DISPOSE – allows disposed objects to be reused.  
 INCLUDE – specifies a text file to be included at the indicated position in the program.  
 IOCHECK – causes error checks to be emitted following calls on system I/O routines.  
 LINENUM – causes the integer parameter which follows to become the current line number; useful in listing and debugging.  
 LINES – specifies number of lines per listing page.  
 LIST – causes the source to be listed.  
 OVLFCHECK – causes overflow checks to be emitted for all in-line arithmetic operations.

PAGE – causes listing to resume at top of next page.  
 PAGEWIDTH – specifies number of characters per printer line.  
 PARTIAL\_EVAL – suppress evaluation of the right operand of AND (OR) operator when the left operand is FALSE (TRUE).  
 RANGE – causes run time checks to be emitted for array and case indexing, subrange assignment and pointer dereferencing.  
 REF – specifies the number of logical records allowed for external references.  
 SAVE\_CONST – causes compile time storage for structure constants to be retained for the scope of the constant's name.  
 SEARCH – specifies the name and order of files to be searched to satisfy IMPORT references.  
 STACKCHECK – causes stack overflow checks to be emitted at procedure entry.  
 SYSPROG – enables the compiler for the following four system programming extensions, such as:  
 TRY...RECOVER – statement for error trapping.  
 SIZEOF – function returning the size of a data type or variable, ADDR – function returning the address of a variable.  
 ANYVAR – disables type compatibility checking for procedure variables.  
 Note: These features are not part of HP Standard Pascal.  
 TABLES – causes symbol table information to be printed after the listing of each procedure.  
 UCSD – makes UCSD Pascal standard procedures and function available (see UCSD COMPATIBILITY).

## UCSD Compatibility

Pascal 2.1 provides for compatibility with most of the standard procedures and functions of UCSD Pascal. The main objective is to allow UCSD Pascal programs to be moved easily to the Model 16 to protect existing software. Future versions of HP Standard Pascal will probably not provide UCSD compatibility. While compatibility with UCSD Pascal is not perfect, most programs will transport with minimal effort. Here is a list of UCSD features and the corresponding level of support on the Series 200:

<b>UCSD Feature</b>	<b>Series 200 Support</b>
Default string length 80	.. unsupported; no default length
Maximum string length 255	..... supported

Arbitrary string type as actual parameter ..... procedure must specify STRING

### Strings

Setting length of string ... supported  
 LENGTH of string function ..... supported  
 POS string position function ..... supported  
 CONCAT string function supported  
 COPY substring function supported  
 DELETE substring function ..... supported  
 INSERT substring function ..... supported  
 SCAN string/character array procedure ..... supported  
 MOVELEFT byte-oriented data moving ..... supported  
 FILLCHAR byte stream fill supported

### I/O

Untyped files ..... supported  
 UNITREAD direct I/O ... supported  
 UNITWRITE direct I/O ... supported  
 UNITBUSY I/O test ..... supported  
 UNITCLEAR I/O flush ... supported  
 BLOCKREAD direct I/O ... supported  
 BLOCKWRITE direct I/O supported  
 IORESULT variable ..... supported  
 SEEK random access positioning ..... supported, but with index base  
 CLOSE file options LOCK,NORMAL,PURGE,CRUNCH ..... option must be a string  
 UNITWAIT I/O idle ..... supported  
 INTERACTIVE text files ... specifier not allowed, but equivalent behavior provided by HP TEXT files

Standard units PRINTER, CONSOLE, SYSTEM, GRAPHIC ..... supported

### Data Structures

SIZEOF variable or type .. supported  
 HALT program termination ..... supported  
 GOTOXY cursor positioning ..... supported  
 MEMAVAIL heap space interrogation function ... supported, but returns bytes, not words  
 Program heading w/o files listed ..... supported  
 EXTERNAL procedures/functions ... supported

SETs with up to 4k elements ..... support limited to 255 elements

16-bit integer ..... normal integer 32 bits; may declare subrange - 32768 to 32767

Long BCD integer to 36 digits ..... unsupported; have 9.5 digit integer

STR long integer to string conversion ..... HP Pascal has more general STRWRITE

32-bit real numbers ..... Series 200 uses 64-bit reals

LOG function ..... only LN supported

TIME functions ..... returns different format

PWROFTEN function ..... unsupported

Multiword comparison of arrays, records ..... unsupported

Nested comments ..... unsupported

Packing rules ..... totally different; machine dependent

CASE statement for illegal selector ..... must add OTHERWISE clause

EXIT statement ..... unsupported; can be simulated by SYSPROG TRY/RECOVER

SEGMENT procedures ..... unsupported

Separate compilation

  UNITS ..... HP Pascal MODULES provide a similar facility; some translation is required.

#### Compiler Options

F (byteflip) ..... unsupported (irrelevant)

C (copyright) ..... supported as COPYRIGHT

D (debugging) ..... supported as DEBUG

G (goto's allowed) ..... unsupported (always allowed)

I (iochecks) ..... supported as IOCHECK

Intermixed declarations in

  INCLUDE ..... supported

L (listing control) ..... supported as LIST

P (page eject) ..... supported as PAGE

Q (quiet screen) ..... unsupported (irrelevant)

R (range checks) ..... supported as RANGE

S (swapping compiler segments) ..... unsupported (irrelevant)

U (user mode compilation) ..... unsupported (irrelevant)

## Pascal 2.1 Interface Capabilities

In addition to the built-in HP-IB interface and Serial Interface, there is a choice of several interface cards.

- 2-channel DMA Controller (98620A)
- GPIO (98622A)
- HP-IB (98624A)
- Serial (98626A)
- Color Video (98627A)
- Datacomm (98628A)
- Shared Resource Management (98629A)
- Programmable Datacomm (98691A)



# CP/M-68K<sup>®\*</sup> Operating System

CP/M-68K brings the popular CP/M<sup>®\*</sup> operating system to the MC68000-based Model 16, enabling the migration of many 8-bit software packs to 16-bit computers. CP/M is currently being used on more than 600,000 end-user systems. In addition, more than 3,000 independent software vendors write CP/M-compatible software.

This single-user, single-tasking operating system is easy to learn and use. It includes a reliable file system, a C compiler, and a run-time library. Its time-tested, modular design allows it to be customized to run in a particular hardware environment. System dependent input/output device handlers are located in a module called the Basic Input/Output System (BIOS). The BIOS, written by HP, interfaces to the logical, hardware-independent portion of the operating system.

CP/M is an attractive operating system for systems with minimum memory. The memory-resident portion requires less than 40K bytes. Many applications will run with less than 128K bytes of memory.

## CP/M and CP/M-86 Compatibility

CP/M-68K supports an enhanced version of the file system used by CP/M Version 2 and CP/M-86 Version 1. The CP/M-68K file system is compatible with all other CP/M and MP/M<sup>®\*</sup> file systems. This simplifies conversions of CP/M and CP/M-86 software to run on CP/M-68K.

The end-user will notice no significant difference between CP/M-68K and previous versions of CP/M. Commands such as DIR, TYPE, PIP, STAT, and ED respond the same way in both systems. The program interface is also unchanged – CP/M-68K calls for system services have the same

### Features

- CP/M and CP/M-86<sup>®\*</sup> compatible
- Supports from 64 Kilobytes to 7 Megabytes of RAM
- C Language
- Allows full access to MC68000 hardware features

### Benefits

An industry-standard operating system compatible with the operating systems of approximately 700 computer products. Software written in high-level languages can be easily converted.

Doesn't require a lot of memory but will take advantage of the full memory space available.

Compatible with UNIX<sup>†</sup> and CP/M application software written in C.

Allows you to capitalize on the performance of the MC68000.

function numbers as CP/M and CP/M-86.

Upgrading existing CP/M and CP/M-86 application software written in high-level languages to run under CP/M-68K is straightforward, because CP/M-68K is so similar to its predecessors. Programs written in CBASIC or C should recompile with little or no modification. However, assembly language programs will require recoding.

## Memory Support

CP/M-68K is capable of using as little as 64K or as much as 7 Mbytes of RAM. It takes full advantage of the memory available.

## Disc Format

CP/M recognizes two disc formats: the IBM format on single-sided eight-inch discs and the HP CP/M format on 5¼- and 3½-inch flexible discs and hard discs. The HP CP/M disc format is also used on the Series 80 and Series 100 CP/M systems.

Because the CP/M disc format differs from that used by other Model 16 operating systems, a special set of utilities is provided with CP/M-68K. These utilities can be used to transfer

ASCII data files from one format to the other.

## C Language

The CP/M-68K package includes a C compiler and run-time library that are subset compatible with UNIX Version 7. This will help provide a bridge between UNIX and CP/M-68K through C programs.

## Software Development Tools

The CP/M-68K package includes the following set of software development tools:

- A C compiler and C run-time library compatible with UNIX software.
- An assembler that supports standard Motorola MC68000 assembly language.

## Standard CP/M Utilities

### PIP

The Peripheral Interchange Program provides file transfer between devices and disc files. Various reformatting and concatenation operations may also

\* CP/M, CP/M-68K, CP/M-86 and MP/M are registered trademarks of Digital Research.  
† UNIX is a trademark of Bell Laboratories, Inc.

be performed with PIP. These include: parity bit removal, case conversion, subfile extraction, tab expansion, line number generation, and pagination.

### **ED**

The CP/M-68K text editor allows creation and modification of ASCII files using extensive commands: string substitution, string search, insert, delete and block move. ED allows text to be located by context, line number, or relative position. A macro command allows making repetitive text changes with a single command line.

### **STAT**

The STAT utility alters and displays I/O device and file status including free space computations, status of online discs and physical-to-logical device assignment.

### **SUBMIT**

The SUBMIT command lets the user execute a command sequence stored in a disc file.

### **DUMP**

The DUMP utility displays any file with side-by-side hexadecimal and ASCII representations. Output may be redirected to a file or the listing device if desired.

## **Full Access to MC68000 Hardware**

CP/M-68K gives the applications program complete access to the advanced features of the MC68000 microprocessor.

### **Support**

HP provides direct support through phone-in consulting (PICS) centers for the CP/M-68K operating system on the Model 16 computer.

### **Order**

HP 98052JA

- Opt. 630 for 3½-inch discs
- Opt. 650 for 5¼-inch discs

## **Hardware Specifications**

### **Computer**

Model 16 computer with 128K RAM

### **Peripherals**

One of the following disc drives:

- HP 9121D Dual 3½" drive
- HP 82901M Dual 5¼" drive
- HP 9133A 3½" drive with Winchester
- HP 9135A 5¼" drive with Winchester
- HP 9895 Dual 8" drive‡

**Note:** If you are using a Winchester drive, we recommend that you order a partitioned drive. (Order the standard, no option.) Because the CP/M disc format differs from other Model 16 disc formats, all of an unpartitioned hard disc will have to be in CP/M format. With the partitioned drive, one or more of the partitions can be CP/M and the remainder can be LIF format, the Series 200 disc format.

One of the following printers:

- HP 82905B Graphics Printer
- HP 2671G Thermal Printer
- HP 2673A Intelligent Graphics Printer
- HP 2631G Graphics Printer
- HP 2602A Letter-quality Printer

‡ Available through HP sales representatives only.

# FORTRAN 77 Language System

Supplied by International Electronic Machinery, Inc. (IEM)

The FORTRAN 77 language system is a standard implementation of FORTRAN for those who prefer to use this formula-oriented programming language. It is compatible with the ANSI Standard FORTRAN 77 full language.

Operating under the HP Pascal Language (Operating) System, all programming tools and features within the operating system are available for use in FORTRAN programs. IEM FORTRAN is compatible with other FORTRAN 77s running on mainframes and other computers, including the HP 1000 and HP 9000.

With the addition of FORTRAN, the Model 16 computer user now has access to the extensive library of FORTRAN software already in existence. This includes, but is not limited to, programs in:

- CAD/CAE engineering applications
- data monitoring/acquisition/processing packages
- statistical analysis packages
- simulations
- user-created programs currently running on large mainframes.

## IEM FORTRAN 77

The FORTRAN language provided by IEM conforms with the ANSI Standard FORTRAN 77 Full Language as defined in the ANSI publication X3.9-1978. The IEM FORTRAN 77 Compiler runs under a multi-language operating system environment and supports graphics, peripherals, and independent subroutine/function compilation. Compiled FORTRAN code is portable between Series 200 computers. FORTRAN 77 programs from IEM's PDS 35/45 FORTRAN 77 can also be carried over for the compilation by the Series 200 FORTRAN 77 compiler.

### Features

- Compatible with FORTRAN 77 full language ANSI Standard.
- FORTRAN 77 programs developed on the Model 16 can be used on other computers with FORTRAN compilers.
- Access to Pascal and Assembly Language libraries and creation of subprogram libraries accessible by Pascal.
- Access to Graphics and I/O support libraries.
- Separate compilations of FORTRAN subprograms.
- Programmer-controlled automatic subprogram overlays.

### Benefits

- More than 80% of all FORTRAN programs can be easily converted to the Model 16. Software development only needs to be done once.
- Easy library development of general purpose subprograms. Also one language can take advantage of the other; for example, the records and powerful data structures of Pascal.
- Performs the same Graphics and I/O as Pascal with the same efficiency.
- Simple development and modification of large programs.
- Infrequently used subprograms can be kept on disc until needed.

IEM FORTRAN 77 includes such full language definition capabilities as complex numbers (complex data type), character substring manipulation, IF...THEN...ELSE structure, and logical operations using .EQV. and .NEQV.

FORTRAN 77 is capable of calling a wide variety of graphics and I/O routines available in the Pascal Language Library. The programmer also has full access to all keys on the typewriter and miscellaneous keys on the keyboard. Available terminal display modes include underlining, inverse video, and blinking.\*

IEM FORTRAN 77 programs are portable. FORTRAN 77 programs compiled on any Series 200 computer will execute on any other Series 200 computer. For example, a FORTRAN program compiled on a Model 16 can be executed without recompilation on a Model 26. In addition, FORTRAN 77 programs prepared under IEM's Program Development System on the HP 9835/45 computers will also compile on the Model 16 (this excludes graphics and I/O calls).

IEM FORTRAN 77 contains a number of useful extension capabilities:

- Increased variable name length: Variable names can run up to 72 characters (all significant) in length.
- Unlimited array dimensions: Arrays can be declared with as many dimensions as the user requires.
- Compiler directives: Allows the user to transmit special instructions to the compiler at program compilation. For example, the user can request compiler listings, program debuggings, etc.
- Pascal compatibility: FORTRAN 77 programs can call compiled Pascal procedures/functions; Pascal programs can call compiled FORTRAN 77 subroutines/functions. In addition, FORTRAN 77 programs may call machine language routines assembled by the assembler.
- Graphics support: FORTRAN 77 programs are capable of calling Pascal Language Graphics Library procedures/functions.

\* Available on machines with serial number prefixes 2320A or greater.

- I/O support: FORTRAN 77 programs are capable of calling Pascal Language I/O Interface Library procedures/functions.

## The Programming Environment

The IEM FORTRAN 77 Compiler is offered as an alternative or additional compiler to the Pascal compiler that runs under the HP Pascal Language (Operating) System. Consequently, the FORTRAN programmer has access to all programming tools and subsystems during FORTRAN program development.

The HP Pascal Language (Operating) System is a Hewlett-Packard product which is also available from IEM. The following are the various subsystems of this operating system.

### Command Interpreter

The Command Interpreter's primary responsibility is the loading and execution of all subsystems. The IEM FORTRAN 77 Compiler may be invoked from this level.

### Editor

The Editor is screen-oriented, allowing creation, editing, and storing of program text files, and documentation.

### Compiler

The HP Pascal Language (Operating) System comes with the Pascal Compiler assigned as the default system compiler. The IEM FORTRAN 77 is provided in the form of a code file which runs under this Operating System in the same manner as the Pascal Compiler.

The FORTRAN 77 Compiler may be invoked from the Command Interpreter level in two different ways:

- If FORTRAN 77 is assigned as the default system compiler, it may be invoked via the C command.
- If Pascal is retained as the default system compiler, the FORTRAN 77 Compiler may be invoked via the X command.

The FORTRAN 77 Compiler translates ANSI Standard FORTRAN 77 programs stored on mass storage as text files directly into native MC68000 machine code.

### File Manager

The File Manager permits the user to manage files and volumes used by the operating system. This includes handling file directory information and file transfers.

### Assembler

The Pascal Language (Operating) System assembler generates MC68000 machine code from Assembly source files. These routines may be executed independently, or can be called as external procedures from FORTRAN 77 and Pascal programs.

### Debugger

The Debugger allows the user to debug programs via several features: single stepping, display and modification of variables, formatted display of memory contents, and error trapping.

### Linker/Librarian

The Linker/Librarian allows the creation and maintenance of library modules. These modules may be independently compiled FORTRAN 77 or Pascal procedures/functions, or assembled machine language routines.

A Disassembler is also available to generate assembly source versions from assembled or compiled programs.

## FORTRAN 77 Language Features

### Data Types and Ranges

#### Integer

32-bit integer precision

Range . . . . . - 2147483648 to 2147483647

#### Real

Default to double precision

#### Double Precision

A processor approximation of a real number

Range . . . . . - 1.797693134862315E + 308

to

- 2.225073858507202E - 308

0.0

2.225073858507202E - 308 to

1.797693134862315E + 308

#### Complex

Two real numbers representing the real and imaginary parts respectively

#### Character•n

ASCII 8-bit character strings

Size range . . . . 1 ≤ n ≤ 255

#### Logical

8-bit, 16-bit, and 32-bit logical values

## ANSI FORTRAN 77 Statement List

ASSIGN - assigns a label to an integer variable.

BACKSPACE - positions a sequential file at the previous record.

BLOCK DATA - identifies the program unit as a block data subprogram.

CALL - transfers control to a subroutine.

CLOSE - terminates the connection of a logical unit to a physical file.

COMMON - reserves a block of memory that can be referenced and accessed by more than one program unit; also used to hold arrays of very large size.

CONTINUE - creates a reference point in a program unit.

DATA - assigns initial values to variables before execution.

DIMENSION - defines the name, dimensions, and bounds of an array.

DO - causes a specific group of statements to be executed a specified number of times.

**ENDFILE** – writes an endfile record to a particular file.  
**ELSE** – references a block of statements optionally executed based on a preceding block IF condition.  
**ELSE IF** – references a block of statements conditionally executed based on a preceding block IF condition and a succeeding IF condition.  
**END** – specifies the end of a program unit.  
**END IF** – references the end of an IF...THEN...ELSE or IF...THEN block.  
**ENTRY** – provides an alternate entry point into a function or subroutine.  
**EQUIVALENCE** – associates variables such that they share the same location in memory.  
**EXTERNAL** – identifies a symbolic name as an external procedure, permitting the name to be used as an actual argument.  
**FORMAT** – describes how Input/Output information is to be arranged.  
**FUNCTION** – identifies the program unit as a function subprogram.  
**GOTO(assigned)** – transfers control to the statement whose label was most recently assigned by the execution of an ASSIGN statement.  
**GOTO(computed)** – transfers control to one of a list of labeled statements, based on the results of an expression evaluation.  
**GOTO (unconditional)** – transfers control to the statement specified by the statement label.  
**IF (arithmetic)** – transfers control to one of three labeled statements, based on the relationship of an expression to the value zero.  
**IF (logical)** – conditionally executes a statement based on a logical value.  
**IF (block)** – allows execution of a statement block, based on the value of a logical expression.  
**IMPLICIT** – specifies the type associated with the first letter of a variable name.  
**INQUIRE** – obtains properties of a particular file or unit.  
**INTRINSIC** – identifies a symbolic name as an intrinsic function, allowing the name to be used as an actual argument.  
**OPEN** – connects a physical file to a logical unit name.  
**PARAMETER** – defines named constants and allows use of that name synonymously with a constant variable.  
**PAUSE** – temporarily suspends program execution.  
**PRINT** – transfers data from memory to the standard output unit.  
**PROGRAM** – globally identifies the program unit as the main program.

**READ** – transfers data from a file or from the standard input to program variables in memory.  
**RETURN** – transfers control from the subprogram back to the calling program unit.  
**REWIND** – positions a sequential file at the first logical record.  
**SAVE** – retains values of listed variables following execution of a RETURN or END statement in a subprogram.  
**STOP** – terminates program execution.  
**Statement Function** – defines a single statement function.  
**SUBROUTINE** – identifies the program unit as a subroutine subprogram.  
**Type Statement** – assigns an explicit type to a variable.  
**WRITE** – transfers data from memory to a file or the standard output unit.

## Intrinsic Functions

**Absolute value** – returns the absolute value of the argument  
 ABS CABS DABS IABS  
**Arc cosine** – returns the arc cosine of the argument in radians  
 ACOS DACOS  
**Arc sine** – returns the arc sine of the argument in radians  
 ASIN DASIN  
**Arc tangent** – returns the arc tangent of the argument in radians  
 ATAN DATAN  
**Arc tangent 2** – returns the arc tangent of the result of argument (1) divided by argument (2)  
 ATAN2 DATAN2  
**Character string** – returns the character whose ASCII value corresponds to the argument  
 CHAR  
**Character value** – returns an integer value representing the ASCII value of the character argument  
 ICHAR  
**Common Log** – returns the base 10 logarithmic value of the argument  
 ALOG10 DLOG10  
**Conjugate** – returns the conjugate of a complex number  
 CONJG  
**Cosine** – returns the cosine of the argument in radians  
 COS CCOS DCOS  
**Difference in magnitude** – returns the positive difference in magnitude between the argument (1) and argument (2)  
 DIM DDIM IDIM

**Double precision product** – returns product of argument (1) multiplied by argument (2) as a double precision value  
 DPROD  
**Exponential** – returns the base of the natural logarithm raised to the power of the argument  
 EXP CEXP DEXP  
**Hyperbolic cosine** – returns the hyperbolic cosine value of the argument in radians  
 COSH CCOSH DCOSH  
**Hyperbolic sine** – returns the hyperbolic sine value of the argument in radians  
 SINH CSINH DSINH  
**Hyperbolic tangent** – returns the hyperbolic tangent value of the argument in radians  
 TANH DTANH  
**Imaginary** – returns the imaginary part of the complex argument  
 AIMAG  
**Locate maximum value** – returns the largest value in the list of arguments  
 MAX0 AMAX1 DMAX1 AMAX0 MAX1  
**Locate minimum value** – returns the smallest value in the list of arguments  
 MIN0 AMIN1 DMIN1 AMIN0 MIN1  
**Locate Substring** – returns an integer value corresponding to the starting location of a substring within a character array element  
 INDEX  
**Modulo** – returns the remainder value of a division of argument (1) by argument (2)  
 MOD AMOD DMOD  
**Natural Log** – returns the natural logarithmic value of the argument  
 ALOG CLOG DLOG  
**Nearest integer value** – returns the rounded off integer value of the argument  
 NINT IDNINT  
**SIGN** – returns the sign convention of the argument  
 SIGN DSIGN ISIGN  
**Sine** – returns the sine value of the argument in radians  
 SIN CSIN DSIN  
**Square root** – returns the square root of the argument  
 SQRT CSQRT DSQRT  
**Tangent** – returns the tangent value of the argument in radians  
 TAN DTAN  
**Whole number truncate** – returns the truncated whole number of the argument  
 AINT DINT  
**Whole number nearest integer** – returns the whole number nearest to the argument  
 ANINT DNINT  
**n → complex** – these functions convert integer, double precision, and real values into complex values  
 CMLPX DCMLPX RCMLPX

n → double – these functions convert complex, integer, and real values into double precision values  
 CDBLE IDBLE RDBLE

n → integer – these functions convert real, complex, and double precision values into integer values  
 INT ICINT IDINT IFIX

n → real – these functions convert complex, double precision, and integer values into real values  
 CREAL SNGL REAL FLOAT

## Compiler Directives

ANSI – causes an error message to be issued for any non-ANSI Standard FORTRAN 77 feature<sup>†</sup>

AUTOPAGE – allows for eliminating automatic pagination<sup>†</sup>

SCODE – allows for inhibiting the compiler from producing a code file<sup>†</sup>

SCOPYRIGHT – allows for insertion of a character string in the object file indicating program copyright ownership<sup>‡</sup>

SDEBUG – indicates the program code is to be generated with debug capabilities<sup>‡</sup>

SDEF – allows for changing the default number of physical records to be reserved for the definitions intermediate file<sup>‡</sup>

SEXT – used to declare separately compiled routines<sup>‡</sup>

SIMPORT – specifies the name of separately compiled units to be used by the current compilation<sup>‡</sup>

SINCLUDE – specifies inclusion of a text file at the indicated program position<sup>‡</sup>

SLINENUM – allows for changing the sequence of line numbers<sup>‡</sup>

SLINESPERPAGE – allows for changing the default number of lines per listing page<sup>‡</sup>

SLIST – allows for turning the listing on or off<sup>‡</sup>

SMODULE – used to name the compilation unit (library) for later reference by other programs<sup>‡</sup>

SPAGE – directs an unconditional form feed in listing<sup>‡</sup>

SPAGEWIDTH – allows for changing the default character width of the printer line<sup>‡</sup>

SRANGE – provides for emission of run-time checks for array indexing<sup>‡</sup>

SREF – allows for changing the default number of physical records to be reserved for the Reference intermediate file<sup>‡</sup>

\$SEARCH – indicates the names and sequences of files to be searched when processing the \$IMPORT directive<sup>†</sup>

\$STACKCHECK – provides for stack overflow checks to be emitted at procedure entry<sup>†</sup>

\$TABLE – causes printout of symbol table information after the listing of each subroutine or function<sup>‡</sup>

\$TITLE – allows the user to indicate a title heading for listing pages<sup>‡</sup>

SUNIT – operates identical to \$MODULE<sup>‡</sup>

SUSES – operates identical to \$IMPORT<sup>‡</sup>

\$XREF – causes printout of cross referenced symbol table information after the listing of each subroutine or function<sup>‡</sup>

## Support Services

IEM provides a 90-day warranty during which any modifications will be sent to the customer free of charge. The customer can also purchase additional support services such as phone-in consulting, systems engineering, and training. The customer should arrange for such services directly with IEM. For further information, contact International Electronic Machinery, Inc.

## Ordering Information

To order FORTRAN 77 and its language options, please contact:

International Electronic Machinery, Inc.

P.O. Box 1818  
 Fort Collins, CO 80522  
 Phone (303) 226-6672  
 TWX 910 930 9445

## Product Specifications

### Computer

- Model 16 with a minimum of 512K bytes of R/W memory
- HP Pascal Language (Operating) System Version 2.0 (or later release)

### Supported Peripherals

IEM FORTRAN 77 supports the same peripherals that are supported by the HP Pascal Language System, including:

- HP 2631G Graphics Printer
- HP 2673A Serial Thermal Printer
- HP 9876A Thermal Graphics<sup>§</sup>
- HP 9885M/S Flexible Disc Drive<sup>§</sup>
- HP 9895A Flexible Disc Drive<sup>§</sup>
- HP 9133A Winchester/Flexible Disc Drive
- HP 9121D Flexible Disc Drive

Other hard discs are also supported.

## Product Components

### Documentation

- "IEM FORTRAN 77 for HP Series 200 Desktop Computers"
- "FORTRAN 77 for Humans" by Page and Didday, a reference book with a good treatment of programming techniques.

### Media

One 3½-inch, 5¼-inch or 8-inch flexible disc

### Security Module

A small HP-IB device (2" x ½" x 1½") used to prevent unauthorized access to the IEM software. The IEM FORTRAN 77 will not run if this module is not connected at some location on the HP-IB bus.

<sup>†</sup> These options cause a change in default values.

<sup>‡</sup> These options cause actions to happen that would not happen otherwise.

<sup>§</sup> Available from HP sales representative only.

# Multi-FORTH Language System

Supplied by: Creative Solutions, Inc.

HP Series 200 Multi-FORTH is a high-performance, uniquely interactive programming approach. It is designed to optimize programmer efficiency and hardware performance in difficult process control and laboratory environments.

An interactive, heuristic programming approach is encouraged in which modular programming objectives are conceived, coded, and rapidly tested within a simple yet powerful user environment.

FORTH is designed to be comfortably utilized by the applications engineer or scientist, who best understands the nature of the problem to be solved, without any requirement for substantial background in computer science.

## I/O and Graphics Support

HP Series 200 Multi-FORTH is able to fully utilize the extensive I/O and graphics features available in the Model 16. Many application source code examples are supplied with the system.

## Support

A bi-monthly newsletter to owners of Series 200 Multi-FORTH is available for \$125 per year. The newsletter contains technical information and application notes concerning the use of the product.

The following support services for the Series 200 Multi-FORTH Language System are available: telephone consultation, system engineering, customer training, manual updates, and software maintenance. The customer should arrange directly with CSI for such services.

### Features

- Multitasking
- In-line structured assembler
- HP floating point
- HP LIF file compatibility
- Full screen editor
- Computer-aided Instruction Course

Additional features are available through Creative Solutions, Inc.

### Benefits

- Can create and monitor from the console a large number of background tasks.
- Can code in-line assembly language sequences for interrupt handlers and tight loops.
- Can extend Series 200 Multi-FORTH to utilize the same floating point provided by HP Pascal, BASIC and HPL.
- Can read and write HP Logical Interchange Format files to interchange with other HP computers and other Series 200 languages.
- Can perform screen editing on source text. Proportional space characters in graphics mode are used to provide this feature on the Model 16.
- This course introduces users to the FORTH environment. It leads the student through language primitives, simple programs, and rules of usage integral within the FORTH programming environment.

### Product Specifications

#### Computer

HP Model 16 computer system

#### Required Mass storage

Any HP-IB mass storage device

#### Optional Supported Hardware

- Any HP-IB printer
- 98622A GPIO Card
- 98624A HP-IB Interface
- 98620A DMA Controller
- 98626A Serial Interface
- 98627A Color Video Interface

#### Software Environment

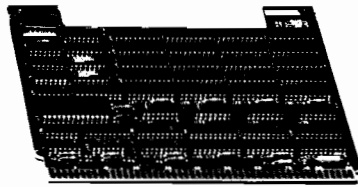
HP Series 200 Multi-FORTH operates as a stand-alone operating system, which does not require any other ROM- or RAM-based language system.

## Ordering Information

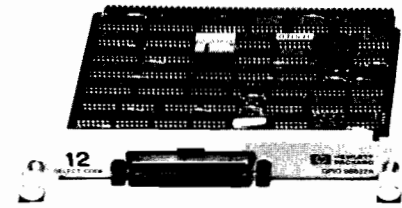
To order the Series 200 Multi-FORTH, please contact:

Creative Solutions, Inc.  
4801 Randolph Road  
Rockville, MD 20852  
(301) 984-0262

# Model 16 Interface Cards



98620A DMA Controller



98622A GPIO Interface

In addition to the built-in HP-IB and RS-232 Serial interfaces, there is a choice of external interface cards and internal memory enhancements: 2-channel DMA Controller, GPIO, BCD, HP-IB, Serial (98626A), Color Video, Datacomm, Programmable Datacomm, EPROM and 128K byte Bubble Memory (98259A).

See the Interface card listing in the Configuration Section for more information on the language systems that support these cards.

## DMA Controller Card

The 98620A DMA Controller Card enhances the Series 200's interfacing capability by providing two DMA channels for I/O data transfers. This high-speed I/O capability works with the 98622A GPIO, 98624A HP-IB and internal HP-IB interfaces. Although the 98620A can accommodate DMA transfer rates up to memory cycle rates (approx. 1.2M transfers/sec) lower DMA rates can be expected since actual rates are dependent on a number of factors. The typical maximum transfer rate for the 98622A GPIO Interface is approximately 750K transfers per second, and for the 98624A HP-IB Interface approximately 330K transfers per second.

## GPIO Interface

The 98622A GPIO Interface provides 16 bits of latched input and output data for bidirectional transfer of information. Extended control and status lines are available for applications that require more than one signal from the computer. Several handshake modes are also available to permit interfacing to a variety of equipment.

### Data Input/Output

There are 16 output data lines and 16 input data lines. The output lines provide high current/voltage drivers, using open-collector buffers. The input data lines are terminated by a resistive divider of 3K Ohms to +5V and 6.2K Ohms to ground accepting standard TTL signals.

### Electrical Characteristics for Data Output Lines

	Min.	Max.	Units
Output Low Voltage ( $\alpha$ 16 mA)		0.4	V
Output Low Voltage ( $\alpha$ 40 mA)		0.7	V
Output High Voltage (open collector)	30.0		V
Output Low Current	40.0		mA
Output High Current ( $\alpha$ Output High Voltage)		0.25	mA

### Electrical Characteristics for Data Input Lines

	Min.	Max.	Units
Input Low Voltage		0.8	V
Input High Voltage	2.0		
Input Current ( $\alpha$ Input Low Voltage = 0.4V)		-0.8	mA
Input Current ( $\alpha$ Input High Voltage = 2.7V)		40	$\mu$ A

### Control Lines

Ten lines provide control information between the peripheral and the 98622A GPIO Interface. The outgoing lines are electrically equivalent to the open-collector data output lines. The incoming lines have the following characteristics:

### Electrical Characteristics for Control Input Lines

	Min.	Max.	Units
Input Low Voltage		0.6	V
Input High Voltage	1.9		V
Hysteresis	0.4		V
Input Low Current ( $\alpha$ Input Low Voltage = 0.4V)		-0.4	mA
Input High Current ( $\alpha$ Input High Voltage = 2.7V)		20	$\mu$ A

The control lines and their meanings are:

PCTL Peripheral Control – indicates that the Series 200 computer is ready for input data or that data is ready for output; PCTL is reset by a ready-to-busy transition on PFLG or by an interface reset.

PFLG Peripheral Flag – indicates to the computer that the peripheral has completed the data transfer; also used to request peripheral interrupt when enabled.

PSTS Peripheral Status (optional) – indicates to the Series 200 computer the readiness of the peripheral; PSTS is sampled by the computer whenever communication with the peripheral is requested.

STI0, STI1 Extended Status (optional) – driven by the peripheral and may be used for any purpose; examined by reading the 98622A peripheral status register.

CTL0, CTL1 Extended Control (optional) – driven by the computer and may be used for any suitable purpose by the user; asserted by writing to the 98622A peripheral control register.

I/O Direction indicates to the peripheral the direction of the current data transfer.

PRESET Peripheral Reset – used to initialize a peripheral when the computer is turned on, when the RESET key or CLEAR I/O key are pressed or when the 98622A peripheral reset register is written to.

EIR External Interrupt Request – used to generate an interrupt request based on some external event or termination of a DMA buffer transfer.

### Interrupt Capability

The 98622A is capable of generating interrupts to the Series 200 computer under the following conditions:

- PCTL clear
- PCTL clear & PFLG ready
- EIR asserted

### DMA Capability

The 98622A is capable of carrying out DMA transfers via the optional two channel 98620A DMA Controller Card. The following DMA capabilities are supported by the 98622A:

- Word or Byte Mode DMA
- Regular or Burst DMA transfer

### Switch Configuration

The following switches can be configured on the interface card:

Select Code – the factory select code setting for the 98622A card is 12; the select codes available for interface cards are language dependent.

Interrupt Level – the factory interrupt priority level setting for the 98622A card is three; the 98622A card can have an interrupt level setting from three to six.

Output Data Line Sense – a 1-bit switch allows the output data lines to use either positive-true or negative-true logic even with fast read/write and DMA transfers.

Input Data Line Sense – a 1-bit switch allows the input data lines to use either positive-true or negative-true logic even with fast read/write and DMA transfers.

PFLG Line Sense – a 1-bit switch allows the peripheral flag line to use either positive-true or negative-true logic.

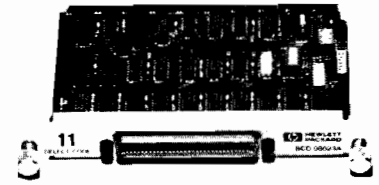
PCTL Line Sense – a 1-bit switch allows the peripheral control line to use either positive-true or negative-true logic.

PSTS Line Sense – a 1-bit switch allows the peripheral status line to use either positive-true or negative-true logic.

Handshake Mode – a 1-bit switch allows selection of full or pulsed handshake mode.

Data In Clock Source – a 6-bit switch allows selection of when input data is to be clocked into the 98622A input latches. The upper and lower input bytes can have separate clock sources chosen from PFLG ready to busy transition, or busy to ready; or when the computer reads the input latch.





98623A BCD Interface

## BCD Interface

The 98623A BCD Interface connects the Series 200 computer with bit-parallel, digit-parallel, binary-coded decimal devices for data input. Up to eight significant BCD digits, two sign bits (mantissa and exponent), exponent digit, function code digit, and an overload bit can be read. Input format is selectable, allowing two independent instruments to be read from one 98623A Interface Card. Data can also be accepted as five input bytes of pure binary information. Eight data output lines are also provided for use as general purpose control and/or data output.

### Data Input/Output

The 98623A BCD interface provides 43 data input lines (eight BCD digits, mantissa sign, exponent sign, exponent digit, and an overload bit) for BCD data entry or five bytes of bit-parallel data entry. Eight data output lines are also provided for general purpose data output or control. The data input and output lines have low-power Schottky TTL receivers and drivers.

### Electrical Characteristics for Input Data Lines

	Min.	Max.	Units
Input Low Voltage		0.8	V
Input High Voltage	2.0		V
Input Low Current @ Input Low Voltage = 0.4V		-0.4	mA
Input High Current @ Input High Voltage = 2.7V		20	μA

### Electrical Characteristics for Output Data Lines

	Min.	Max.	Units
Output Low Voltage @ 12 mA		0.4	V
Output Low Voltage @ 24 mA		0.5	V
Output High Voltage	3.4		V
Output Low Current		24	mA
Output High Current		-15	mA

### Control Lines

Five control lines provide control information between the peripheral(s) and the 98623A BCD Interface. The incoming and outgoing control lines use open collector receivers and drivers with the following electrical characteristics:

### Electrical Characteristics for Control Input Lines

	Min.	Max.	Units
Input Low Voltage		0.5	V
Input High Voltage	1.9		V
Hysteresis	0.4		V
Input Low Current @ Input Low Voltage = 0.4V		-0.4	mA
Input High Current @ Input High Voltage = 2.7V	20		μA

### Electrical Characteristics for Control Output Lines

	Min.	Max.	Units
Output Low Voltage @ 16 mA		0.4	V
Output Low Voltage @ 40 mA		0.7	V
Output High Voltage (open collector)		30	V
Output Low Current		40	mA
Output High Current @ Output High Voltage		0.25	mA

The control lines and their meanings are:

- CTLA, CTLB Peripheral Control A and B – indicates that the Series 200 computer is requesting input data or that data is ready for output; CTLA(B) can be reset by a ready-to-busy or busy-to-ready transition on FLGA(B) or by an interface reset.
- FLGA, FLGB Peripheral Flag A and B – indicates to the computer that the peripheral has completed the data transfer; also used to request peripheral interrupt when enabled.
- PRESET Peripheral Reset – used to initialize a peripheral when the computer is turned on, when the RESET key or CLEAR I/O key are pressed or when writing to the 98623A reset register.

### Data Formats

Two BCD data input formats are supported by the 98623A which are switch selectable on the interface card. This switch status can then be interrogated by the language system to insure that the incoming data is being formatted correctly.

Standard – Up to 8-BCD-digit signed mantissa, 1-BCD-digit signed exponent, 1-digit function code and overload indication.

Optional – Up to 4-BCD-digit signed mantissa from one device. Up to 5-BCD-digit signed mantissa with positive exponent from a second device.

Data Codes – 8421 binary-coded decimal weighting with codes 0-9 representing digits 0-9 and other codes as follows:

1010	(LF)	line feed
1011	(+)	plus
1100	(,)	comma
1101	(-)	minus
1110	(E)	exponent
1111	(.)	decimal point

### Additional Input Information

Exponent, Function Code: 8421 binary-coded decimal weighting (codes 0 – 9 only), Mantissa sign, Exponent sign, Overload: 1 binary bit.

### Interrupt Capability

The 98623A BCD Interface is capable of generating interrupts to the computer under the following condition: FLGA ready & FLGB ready

### Switch Configuration

The following switches can be configured on the interface card:

- Select Code – the factory select code setting for the 98623A card is 11. Select codes available for interface cards are language dependent.
- Interrupt Level – the factory interrupt priority level setting for the 98623A card is 3; the 98623A card can have an interrupt level setting from 3 to 6.
- Input Data Line Sense – a 1-bit switch allows the input data lines to use either positive-true or negative-true logic.
- CTLA(B) Line Sense – a 1-bit (ea.) switch allows the peripheral control line to use either positive-true or negative-true logic.
- DFLGA(B) Line Sense – a 1-bit (ea.) switch allows the peripheral flag line to use either positive-true or negative-true logic.
- CTLA(B)-2 – a 4-bit (ea.) switch allows selection of full or pulsed mode handshake.
- Option Format – a 1-bit switch selects standard (one device) or optional (two devices) data format.
- SIGN1(2) Line Sense – a 1-bit (ea.) switch allows the mantissa and/or exponent sign lines to use either positive-true or negative-true logic.
- OVLN Line Sense – a 1-bit switch allows the overload line to use either positive-true or negative-true logic.

## HP-IB Interface

In addition to the standard built-in HP-IB interface, there is an optional external 98624A HP-IB Interface Card. Both interfaces implement the IEEE 488-1978 Standard Digital Interface for Programmable Instrumentation. Both interfaces can communicate with as many as 14 HP-IB compatible instruments, connected with a maximum of 20 meters (65.6 ft.) of cable.

### Data Input/Output

Eight bi-directional data lines provide data input/output.

### Control Lines

DAV  
NRFD provide handshake  
NDAC

### Interface Management

IFC  
ATN  
SRQ provide control of the interface system  
REN  
EOI

### Interface Functions

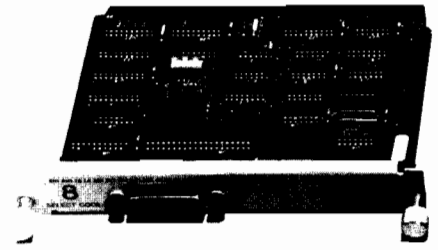
The chart below specifies the level of implementation in terms of IEEE 488-1978 mnemonics. The Device Trigger, Device Clear and Remote/Local state responses are achieved by programming the Series 200 computer for end-of-line interrupts on those conditions.

Source Handshake	SH1
Acceptor Handshake	AH1
Talker	T6
Listener	L4
Service Request	SR1
Remote/Local	RL1
Parallel Poll	PP1
Device Clear	DC1
Device Trigger	DT1
Controller	
System control	C1
IFC & Take charge	C2
REN	C3
Respond SRQ	C4
Miscellaneous control	C5
Drivers	E2

### Interrupt Capability

The internal and 98624A HP-IB interface are capable of generating interrupts under the following conditions in BASIC: (Pascal has no built-in interrupt capability).

- Controller addressed
- Talker addressed
- Listener addressed
- Service Request (SRQ) detected
- Parallel Poll configuration change
- EOI received
- Serial Poll active
- Remote/Local configuration change
- MY Address mode change
- Group Execute Trigger received
- Source handshake error
- Unrecognized universal command
- Unrecognized addressed command
- Secondary command received
- Device Clear received
- Interface Clear detected



98624A HP-IB Interface

### DMA Capability

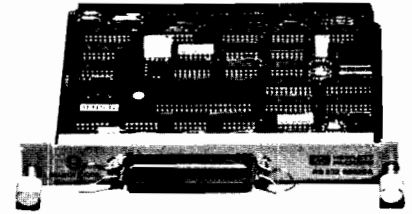
The internal and 98624A HP-IB interfaces are capable of carrying out DMA transfers via the optional two-channel 98260A DMA Controller Card. The following DMA capabilities are supported:

- Byte Mode DMA
- Regular DMA transfer (no burst DMA)

### Switch Configuration

The following switches can be configured on the interface card:

- Select Code – the factory select code setting for the 98624A card is 8 (select code is fixed at 7 for the internal HP-IB); select codes available for plug-in interface cards are language dependent.
- Interrupt Level – the factory interrupt priority level setting for the 98624A card is 3 (internal HP-IB level is fixed at 3); the 98624A card can have an interrupt level setting from 3 to 6.
- Interface Bus Address – 5-bit talker/listener address. The factory-set bus address for the 98624A is 21 decimal (21 for internal HP-IB; if the computer is not system controller the internal HP-IB default bus address will become 20); the 98624A card can have a bus address setting from 0 to 30.
- System Controller – 1-bit switch allows the 98624A interface to act as a system controller or non-system controller. The factory setting is system controller. Internal HP-IB has a jumper or a switch.



98626A RS-232 Interface

## Serial Interface

In addition to the built-in Serial Interface, there is an optional external 98626A Serial Interface card. Both interfaces provide bit-serial communication between the Model 16 computer and asynchronous EIA RS-232-C (CCITT V.28/V.24) devices. Data rates range from 50 to 19 200 baud (bits/sec). A variety of cabling options allow for current loop and terminal connections. Series 200 terminal emulation software takes advantage of this card for connecting to other computers.

### Transfer Rates

The maximum data rates for the Serial Interface are as follows:

	Input	Output
Handshake	19 200 baud	19 200 baud

### Data Rates and Formats

All signals present at the Serial Interface card's connector conform electrically to EIA RS-232-C and CCITT V.28 specifications. Data formats include 5,6,7 or 8 bits/character and 1, 1.5 or 2 stop bits. Odd, even or no parity is selectable and fixing the parity bit to 0 or 1 is also selectable.

Standard switch selectable data rates available are:

50	75	110	134.5
150	200	300	600
1200	1800	2400	3600
4800	7200	9600	19200

### Interrupt Capability

The Serial Interface is capable of generating interrupts under the following conditions in BASIC. (Pascal has no built-in interrupt capability).

- Receiver buffer full
- Transmitter buffer empty
- Receiver buffer overrun error
- Received character parity error
- Received character framing error
- Received break indication
- Carrier detect line change
- Clear-to-send line change
- Data-set-ready line change
- Ring indicator change from on to off.

This interrupt capability allows the interface to operate in a full duplex fashion when information is input under interrupt control while information is output by standard write commands.

### Switch Configuration

The following switches can be configured on the interface card:

Select Code – the factory select code setting for the 98626A card is nine (Internal Serial Interface is fixed at 9); select codes available for plug-in interface cards are language dependent.

Interrupt Level – the factory interrupt priority level setting for the 98626A card is three (Internal Serial Interface interrupt level is fixed at 4); the 98626A card can have an interrupt level setting from three to six.

Parity – a 3-bit switch to enable or disable parity, even or odd parity, or fixed '1' or fixed '0' parity bit.

Character Length – a 2-bit switch selects between five, six, seven or eight bits per character length.

Stop Bits – a 1-bit switch selects between one stop bit per character or 1.5 stop bits per character if the character length is five bits per character. If the number of bits per character is six, seven, or eight then the stop bits switch selects between one stop bit per character or two stop bits per character.

Modem Status Line Disconnect – a 4-bit switch allowing the Ring Indicator, Data Set Ready, Clear To Send and/or Carrier Detect lines to be disconnected and tied high. Not available on the internal Serial Interface.

Baud Rate Select – allows power up/reset selection for the baud rate. Refer above to the baud rates available for switch selection.

Remote/local jumper – allows an external device to be used as a remote keyboard and CRT during boot-up (Model 16S only).

## Color Video Interface

The 98627A Color Video Interface provides the interconnection to an external color monitor. This interface connects to a high-performance, high-resolution color monitor via three outputs – Red, Green/sync and Blue (RGB). The capabilities provided by this interface make it appear as a “soft plotter”.

This interface, when connected to an external monitor, does NOT replace the internal CRT for all applications (e.g., program editing). It provides an enhanced soft graphics output capability.

Colors: Eight – magenta, blue, cyan, green, yellow, red, white, black.

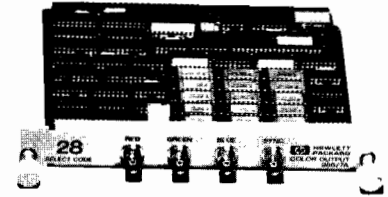
Resolution: Selectable to allow a wide variety of monitors to be used in worldwide applications.

U.S. preferred: (No flicker) – 512 x 390 at 60Hz non-interlaced vertical scan rate.

European preferred: (No flicker) – 512 x 390 at 50Hz non-interlaced vertical scan rate.

High resolution: (Some flicker) – 512 x 512 at 46.5Hz non-interlaced vertical scan rate.

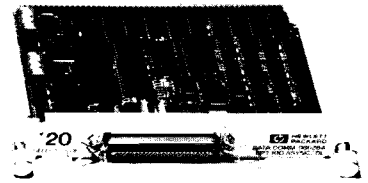
Cables: Four 5-ft. (1.52m) cables supplied with BNC termination.



98627A Color Output

Cable type: 75 ohm, coaxial RG-59/U – similar to Belden 9259. Note: Longer cables may not meet environmental requirements.

Tested monitors: Barco CDCT 3/51 – 20 in. with cabinet. Conrac 7211, C19 – 19 in. with cabinet. Mitsubishi – C39-19, available through distributors. These monitors are electrically compatible with the 98627A interface; however, they may not, in all cases, pass applicable government regulations for emitted RFI.



98628A Datacomm Interface

## Data Communications Interface

The 98628A Data Communications Interface provides both protocol management and electrical levels for asynchronous serial communications. This card also supports the Distributed System Network/Data Link (DSN/DL) protocol for communications to an HP 1000 series minicomputer. A terminal emulation program, which takes advantage of this card for communication to other computers, is also available.

### Data Rates and Formats

All signals present at the 98628A interface card's connector conform electrically to EIA RS-232-C and CCITT V.28/V.24 specifications. Data formats include 5, 6, 7 or 8 bits/character and 1, 1.5 or 2 stop bits. Odd, even or no parity is selectable and fixing the parity bit to 0 or 1 is also selectable.

Standard data rates available with internal clocking:

50	75	110	134.5
150	200	300	600
1200	1800	2400	3600
4800	7200	9600	19200

### Interrupt Capability

The 98628A Serial Interface Card is capable of generating interrupts to the computer. In BASIC, the interface can be programmed to interrupt on the following conditions. (Pascal has no built-in interrupt capability.)

#### ASYNC

- Data or control block available
- Prompt received
- Framing and/or parity error
- Modem line change (DSR, DCD, CTS, RI)
- No activity timeout
- Lost carrier or connection timeout
- End-of-line received
- Break received

#### DATA LINK

- Data block available
- Space available for new transmission block
- Receive or transmit error
- Modem line change (DSR, DCD, DTS, RI)
- No activity timeout
- Lost carrier or connection timeout

### Switch Configuration

The following switches can be configured on the interface cards:

#### ASYNC/DATA LINK

Select Code – the factory select code setting for the 98628A card is 20; valid select codes are 8 – 31.

Interrupt Level – the factory interrupt priority level setting for the 98628 card is 3; valid interrupt level settings are 3 – 6.

Async/Data Link – selects between Async or Data Link personality.

The settings listed below are not all switch selectable; however, all values are selectable through the CONTROL statement. Values selected through the CONTROL statement override the switch settings.

#### ASYNC

These settings are active when the ASYNC/DATA LINK switch is set to its ASYNC position.

Parity – Bits/Char – a two-bit switch which selects between the following Parity – Bits/Char combinations: None – 8, None – 7, Odd – 7, Even – 7.

Hardware Handshake – a 2-bit switch which selects Handshake Off, Non-modem connection; Full Duplex, Modem connection; Half Duplex, Modem connection; and Handshake On, Non-modem connection.

Baud Rate – Stop Bit – a 3-bit switch which selects between the following combinations of baud rates/stop bit settings: 110 – 2, 150 – 2, 300 – 1, 600 – 1, 1200 – 1, 2400 – 1, 4800 – 1, 9600 – 1.

### Data Link

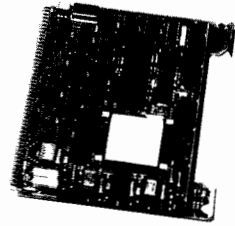
These settings are active when the ASYNC/DATA LINK switch is set to its DATA LINK position.

DID - a 3-bit switch which selects the following value for the 98628's device address: @, A, B, C, D, E, F or G. Baud Rate – a 2-bit switch which selects the following baud rates: 300, 1200, 9600 or 9200.

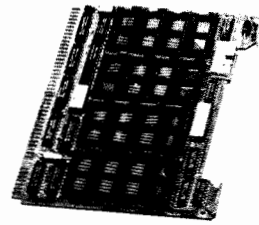
Hardware Handshake – a 2-bit switch which selects between Handshake Off, Non-modem connection; Full Duplex, Modem connection; Half Duplex, Modem connection; and Handshake On, Non-modem connection.

### Electrical Specifications

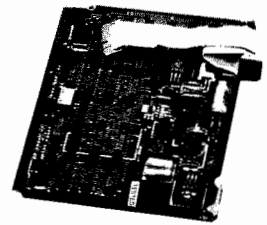
Card power consumption:	+ 5V at 715mA typical	+ 12V at 37mA typical	- 12V at 60mA typical
Pod power consumption (supplied by computer):	+5V typical	+12V typical	-12V typical
300 baud modem (13265A)	100mA	45mA	45mA
Data link adapter (13264A)	30mA	160mA	23mA
Electrical interface capabilities:	RS-232-C, V.24/V.28	RS-449	RS-423, V.10



98259A Magnetic Bubble Memory Card



98255A EPROM Card



98253A EPROM Development Kit

## 128K Byte Bubble Memory Card

The 98259A Magnetic Bubble Memory Card features 128K bytes of non-volatile mass storage. The 98259A provides increased reliability and durability over flexible disc storage.

**NOTE:** Due to power supply restrictions, only one bubble memory card is allowed in a Model 16.

### Access Times and Data Transfer Rates

Access time

Average . . . . . 42 milliseconds

Worst case . . . . . 90 milliseconds

Average transfer rate

Input . . . . . 8K bytes/sec.

Output . . . . . 8K bytes/sec.

## EPROM Card

The 98255A EPROM Card contains 16 sockets for EPROMs to allow up to 256K bytes of storage using Intel 27128A EPROMs or equivalent. 128K bytes of storage are available using Intel 2764 EPROMs or equivalent. EPROM integrated circuits must exhibit access times of 250 nanoseconds or less. EPROM integrated circuits must be used as pairs (2, 4, . . . 16). The EPROM card acts as a mass storage device.

EPROMs for the 98255A card are programmed with the 98253A EPROM Development Kit. However, this development kit must be used with a Series 200 Model 20, 26 or 36A/C computer.

The 98253A EPROM Development Kit consists of one EPROM programmer card and one 98255A EPROM Card. The EPROM Development Kit allows memory volumes to be created in EPROM. To program EPROMs, the programmer card is connected via a ribbon cable to the 98255A EPROM card. Both cards are inserted into adjacent slots of the Series 200 computer. The Programmer card can be set to program EPROMs at either 52.5 milliseconds or 13.1 milliseconds per word.

## Programmable Datacomm Interface

The Programmable Datacomm Interface product provides a spectrum of capabilities that can be tailored to meet special datacomm and/or serial interfacing needs. The product consists of two pieces – the Development Package (98690A) and the interface card (98691A). The 98690A Development Package contains the essential information and tools required by a sophisticated user to do firmware programming of the 98691A Programmable Datacomm Interface. The 98691A Programmable Serial Interface Card is a microprogrammable interface that is intended to be a foundation for designing application-oriented communications products. It is based on the Z-80 CPU, Counter Timer Chip and Serial I/O chip.

## Data Rates and Formats

The Z-80A Counter Timer Chip provides one system timer, and a programmable baud rate for the SIO channel. Speed available is as follows:

- Synchronous: max. 460K baud; min 50 baud
- Asynchronous: max. 57K baud; min. 50 baud
- The maximum speed with an external clock is 736K baud for synchronous communications.

Data formats provided by the Z-80A SIO chip are 5, 6, 7 or 8 bits/characters and 1, 1.5 or 2 stop bits, odd, even or no parity for asynchronous communications. The SIO chip supports CRC-16 or CCITT block frame check for synchronous operations.

## Interrupt Capability

The 98691A interrupt capability is determined by the capabilities programmed into the custom personality ROM.

## Electrical Specifications

Card power

consumption:	+ 5V	720mA typical
	+ 12V	37mA typical
	- 12V	60mA typical

Accessory power consumption (supplied by the Series 200 computer):

	+5V	+12V	-12V
	typical	typical	typical

HP 13264A Data Link Adapter	200mA	90mA	80mA
HP 13265A 300 Baud Modem	100mA	45mA	45mA
HP 13266A Current Loop Pod	30mA	160mA	23mA

(If these pods are used, care must be taken not to exceed the power specifications of the Series 200 I/O backplane.)

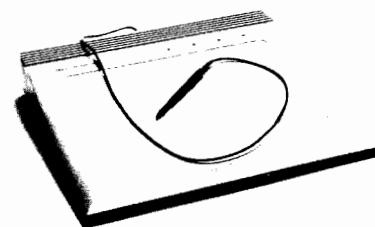
Electrical interface compatibility:

- RS-232C, V.24/V.28
- RS-449
- RS-423, V.10
- RS-422, V.11 (with user-built cable)

## Plotter Choices

	HP 7470A	HP 9872 Series*	HP 7580B*	HP 7585B*
Media Size	21.1 x 29.7 cm (8.5 x 11 in.)	Any sheet size to 29.7 x 42.0 cm (11 x 17 in.)	From 20.3 x 26.7 cm to 62.2 x 123.2 cm (8 x 10.5 in. to 24.5 x 48.5 in.)	From 20.3 x 26.7 cm to 92.7 x 119.0 cm (8 x 10.5 in. to 36.5 x 48.5 in.)
Media Type	Chart paper Transparency film	Chart paper Transparency film Roll paper (9872T only)	Chart paper Vellum Double matte polyester film	Chart paper Vellum Double matte polyester film
Pen Capability	Programmable 2-pen automatic plotting (up to 16-color plotting with manual changing) Fiber-tip pens	Programmable 8-pen plotting Fiber-tip pens	Programmable 8-pen plotting Liquid-ink, roller-ball and fiber-tip pens	Programmable 8-pen plotting Fiber-tip, liquid-ink and roller-ball pens
Addressable Resolution	.025 mm (.001 in.)	.025 mm (.001 in.)	.025 mm (.001 in.)	.025 mm (.001 in.)
Repeatability	.10 mm (.004 in.)	.10 mm (.004 in.)	.05 mm (.002 in.) paper vellum .10 mm (.004 in.) double matte polyester	.05 mm (.002 in.) paper vellum .10 mm (.004 in.) double matte polyester
Customer Support Services Available	HP Dealer Repair Center (check with dealer for availability), on-site service at your location, HP Field Repair Center, phone-in support, and user newsletter			
Ordering Information HP Part Numbers (when ordering, include appropriate opt. nos.)	HP 7470A Opt. 002	HP 9872C Opt. 026 HP 9872T Opt. 026	HP 7580B Opt. 016	HP 7585B Opt. 016
Product Includes	Each product includes an Interfacing and Programming Manual, pens, paper, and assorted accessories. The HP 7580B and HP 7585B also include an operator's manual.			

\* Available from HP Sales Representatives only.



HP 9111A

## Graphics Tablet

The HP 9111A Graphics Tablet lets your Model 16 personal computer electronically create, display, and interact with pictorial information. As you move a pen-like stylus on the tablet's surface, the tablet translates your movements into X,Y coordinate points and transmits these points to the computer. Points are entered either each time the stylus is pressed or continuously as you draw.

## Customer Support

Services available:

- Dealer Repair Center (check with dealer for availability)

- On-site service at your location
- HP Field Repair Center
- Phone-in support
- User newsletter

## Ordering Information

HP part numbers:

- HP 9111A Opt. 026

Product includes:

- Graphics tablet
- One overlay
- Package of 20 menu blanks
- Package of stylus refills: 2 inkless, 3 ink
- User's manual
- Two spare fuses
- Power cord

### Features

- Hard, Durable Ceramic Platen
- User-definable Special Function Keys
- Slim-Lightweight Stylus
- Transparent Overlay
- Audible Feedback
- Self-tests

### Benefits

Ensures consistent tablet accuracy – resists scratches, expansion, and contraction.

Make program control easier – you can send a unique code to your computer program with the sixteen softkeys that are conveniently located across the top of the tablet.

Easy-to-use – fits comfortably in your hand and gives tactile feedback as you enter data.

Protects source documents from wear and tear – relieves you of concern by holding source documents on the platen and protecting them.

Gives you confidence – a beeper which is programmable in pitch, volume, and duration can let you know if you're using the tablet correctly.

Give you confidence – assure you that the tablet is operating properly.

## Specifications

### SYSTEM REQUIREMENTS

#### Computer

Model 16 with:

- BASIC 2.0 and BASIC Extensions 2.0 (or later versions), or
- Pascal 2.0 (or later version)

Resolution . . . . . 0.100 mm (0.004 in.)

Accuracy . . . . . ± 0.600 mm (0.0236 in.) at 20°C for each measuring point; change of 0.004 mm for each °C deviation from 20°C

Repeatability . . . . . ± resolution unit

Data rate . . . . . Programmable from 1 to 60 coordinate pairs/sec.; actual rate ± 0.2 Hz from programmed rate

Data format . . . . . ASCII or binary X,Y coordinate data

Active digitizing

area . . . . . 21.9 x 30.1 cm (8.6 x 11.8 in.); can be extended to include the area occupied by the 16 softkeys

Document

material . . . . . Single sheet, electrically nonconductive, homogenous, less than 0.5 mm thick

Interface . . . . . HP-IB

### OPERATING REQUIREMENTS

Line voltage . . . . . 100, 120, 220, 240 Vac, switch selectable

Frequency . . . . . 48 – 66 Hz

Power

consumption . . . . . 25 watts maximum

Operating

temperature . . . . . 0° to 55°C (32° to 131°F)

Humidity . . . . . 5% to 90% at 40°C, noncondensing

### SIZE AND WEIGHT

Height . . . . . 8.5 cm (3.35 in.)

Width . . . . . 44.0 cm (17.3 in.)

Depth . . . . . 44.0 cm (17.3 in.)

Weight

Net . . . . . 5.8 kg (12.8 lbs.)

Shipping . . . . . 10.8 kg (23.8 lbs.)



# Service and Support for the Model 16

You will discover an additional benefit to owning a Model 16 personal computer – Hewlett-Packard's commitment to ongoing support. At Hewlett-Packard, quality means long-term support to ensure you get the most from your investment.

Ongoing support means assistance in using your equipment most effectively as well as getting it fixed should a problem occur. For over 40 years, we have been helping our customers get maximum performance from their instruments and computers by providing a wide range of support services – from initial training courses to phone-in consulting and maintenance services. You can tailor a total support program to your particular needs.

## Boost Your Personal Productivity With HP Training

Whether you are a first-time user or an experienced programmer, comprehensive hands-on courses, taught at training centers close to you, can quickly bring you up to speed on your new personal computer. You can currently select from the following course offerings for Model 16 users.

### Series 200 Pascal Operating & Programming

*Length:* 5 days      *Course No:* 98511A

This 5-day course teaches the student the Pascal programming language and operating system and their most productive use on the HP Series 200 Model 16/26/36 Computer.

It includes an in-depth look at the operating system; Pascal syntax, program structure, and control; data structures and I/O; and the creation and use of libraries. The course is 50% lab and 50% lecture.

*Note:* This course is taught using HP Models 26 and 36 computers on an earlier version of HP Pascal than the one supplied with the Model 16. However, the programming techniques can be applied to the Model 16.

*Prerequisites:* Experience in BASIC or FORTRAN and knowledge of program design.

### HP Series 200 BASIC Operating & Programming

*Length:* 5 days      *Course No:* 98510A

This course introduces experienced programmers to the operating and programming features of the BASIC language on the HP Series 200 Model 16/26/36.

The course begins with operating procedures and progresses through the mass storage, I/O, and graphics language extensions offered by the Series 200 BASIC language.

*Prerequisites:* Working knowledge of either BASIC, HPL, or FORTRAN programming.

## Free Help to Get You Going

Thoroughly-trained software engineers provide answers to your software questions through our Complimentary Phone-In Consulting Service. This service is available at no charge for 90 days to help you learn about your Model 16. You can receive assistance with your operating system, programming languages, and HP applications software.

When used in conjunction with your User Manuals and an appropriate training program, our Phone-In Consulting Service can provide answers to many of your operational questions.

## Stay Productive With Quick and Effective Software Assistance

In addition to our ninety-day Complimentary Phone-in Consulting Service, the following software support services are available.

**Systems Information Service (SIS):** includes Phone-in Consulting Service (beyond the complimentary ninety days), the Software Status Bulletin containing timely information on the reported operating status of HP software and documentation, the Communicator Magazine containing operating and programming tips, and software problem reporting by mail. Also for selected system software, SIS includes software updates. Simply specify a media option and HP will provide you with system software updates as they become available. (Those SIS products with no media options do not include software updates.)

**Software Notification Service (SNS):** includes the Software Status Bulletin and the Communicator Magazine.

**Software Subscription Service (SSS):** includes the Software Status Bulletin, the Communicator Magazine, manual and software updates, and software problem reporting by mail.

## Protect Your Investment With HP Maintenance Services

To realize the full long-term value of your computer investment, you need to plan for its maintenance. You can begin this planning before your purchase by selecting a service program matching your particular requirements for price and response time.

With all ongoing programs you get access to an HP Customer Engineer specially trained on the Model 16. And you get all the support you need, including all parts and labor for a known annual cost.

**On-Site Product Maintenance Service**

This service provides the quickest response for equipment in critical applications. You are assured of next-day service between the hours of 8 a.m. and 5 p.m. Monday through Friday if you are located within 100 miles of one of our service offices.

**Field Repair Center Maintenance Service**

This is our most economical hardware maintenance program for individual computers. You return the equipment to a Hewlett-Packard Field Repair Center where it will be repaired, tested, and sent back to you within three working days after it is received. This program provides savings of up to 50% over the cost of the On-site Product Service described above.

**Volume Repair Center Maintenance Service**

The same cost saving of the Field Repair Center program is available at your site. You receive weekly scheduled visits to your specified work area. To qualify for this service, you must have at least 25 eligible products (consisting of any combination of personal computers, plotters, terminals, etc. manufactured by Hewlett-Packard) and be located within 100 miles of one of our service offices. This is our most economical on-site maintenance program for your workstation products.

**Dealer Repair Center**

Authorized Hewlett-Packard Dealer Repair Centers provide a variety of maintenance services. They can also provide warranty services and may offer locally tailored services in addition to those described here. Your HP Personal Computer Dealer can help you determine which support service will best meet your needs.

**Tailor Your Personal Computer Support to Your Needs**

In addition to maintenance contracts, Hewlett-Packard also offers per-incident services, so you have even more flexibility in choosing a support program.

Take advantage of Hewlett-Packard's assortment of support offerings to construct an overall support plan to meet your specific requirements. Your HP dealer or sales representative can help you select the right combination of training, software assistance, and hardware maintenance to increase your productivity and enhance the long-term value of your personal computer investment.

For more information on HP support services, call toll-free (800) 835-HPHP in the United States. Elsewhere, contact your HP authorized dealer or local HP sales office.

**Service At a Glance**

	<b>On-Site Product Service</b>	<b>Volume Repair Service</b>	<b>Field Repair Service</b>	<b>Dealer Repair Center Service (min. service)</b>
Response time/frequency	Next day	Weekly	3-day turn-around	Weekly
Location	On-site	On-site	HP repair center	Dealer site
Coverage hours	8 am – 5 pm	8 am – 5 pm	8 am – 5 pm	Dealer hours
Relative price	1	.5	.5	*
Benefits	Convenience and quick response for equipment in critical applications	Economy through volume (25 unit minimum)	Most economical service for the individual owner	One local place for product and service needs

\* Authorized Hewlett-Packard Dealer Repair Centers provide similar services tailored to their customers' needs, at varying prices. Call 800-835-HPHP for the location of the Dealer Repair Center closest to you.

# Configuring a Model 16

Use the information below to easily configure the right Model 16 system for your application.

The Model 16 comes in two versions to suit your price/performance requirements: the Model 16S bundled system and the Model 16A minimum

configuration. Each has built-in RAM on its processor board, built-in HP-IB and Serial Interfaces, and two slots for further expansion. Differences are:

	Model 16A	Model 16S
Processor Board RAM	128K bytes	256K bytes
Additional 256K RAM Boards	0	1
Total RAM Included	128K bytes	512K bytes
Boot ROM	Boot-up from 3½-in. or 5¼-in. flexible disc drives only	Boot-up from all supported mass storage devices
Graphics	Standard, but can be deleted	Standard
RAM-based BASIC 2.0	Ordered separately	Included
Built-in HP-IB Interface (with 2-meter cable)	Yes	Yes
Built-in Serial Interface (cable not included)	Yes	Yes
Expansion Slots Built-in	2	2
Expansion Slots Available	2	1*

\* One of the Model 16S' expansion slots is used for the additional 256K byte RAM board that comes standard.

## Built-in Interfaces

To make a usable system, a mass storage device must be connected to the Model 16. One two-meter HP-IB interconnect cable (10833B) is shipped with the Model 16 for this purpose. Every additional device (e.g., printer, plotter, etc.) that is to be connected to the built-in HP-IB interface will also need an interconnect cable (10833A/B/C/D).

The built-in Serial Interface is not shipped with a cable, as there are two different cables available. Order separately the 5061-4215 cable with the DTE connector (male) or the 5061-4216 cable with the DCE connector (female).

## Expansion Slots

There are four uses for the Model 16's expansion slots: RAM memory, ROM languages, accessory cards or an I/O card. RAM, ROM, and accessory cards each use one expansion slot. An I/O card uses one slot, but covers the adjacent slot above it. The adjacent slot above it may still be used for RAM, ROM or accessory cards. Therefore, I/O cards may only be used in the bottom slot, while RAM, ROM and accessory cards may be used in either slot. (Only one DMA controller card or bubble memory card is allowed per machine, however.)

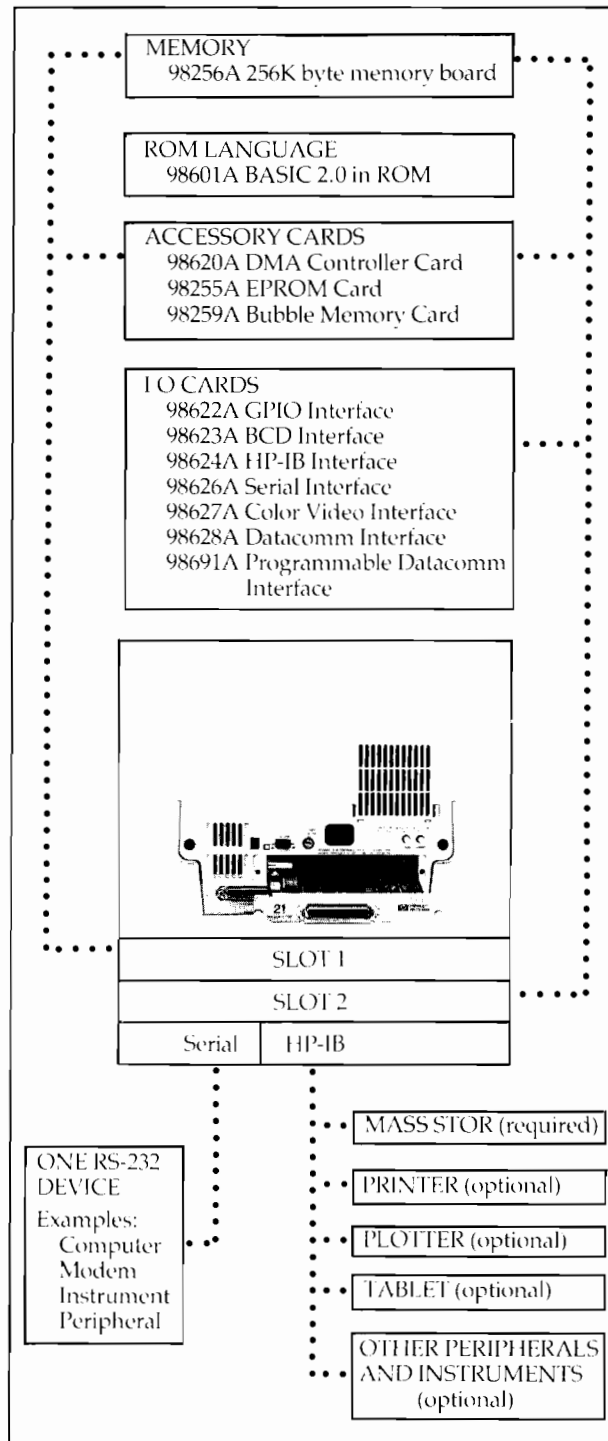
## Memory Requirements

Both RAM- and ROM-based language systems use some RAM. RAM-based systems load entirely into RAM, while ROM-based systems "steal" a small amount of RAM for workspace. In the case of BASIC, the system memory requirements must be subtracted from the total memory in the configuration to find maximum program size. These requirements are summarized in the Language System table on the next page.

Language System	Memory Required (Approx.)
RAM-based BASIC 2.0 (98611A)	277K bytes
ROM-based BASIC 2.0 (98601A)	21K bytes
RAM-based BASIC Extensions 2.1 (98612A)*	
Advanced Programming . . . . .	175K bytes
Shared Resource Management . . . . .	53K bytes
Graphics Enhancements . . . . .	45K bytes
XREF . . . . .	7K bytes
BCD . . . . .	3K bytes

\*BASIC Extensions 2.1 requires that ROM- or RAM-based BASIC 2.0 be present.

Pascal 2.1 (98615A) is a RAM-based system composed of a kernel and several modules that load on top of it. The different modules have different memory requirements, and the kernel itself is user-modifiable. To have enough room for loading the modules and creating a program, a minimum recommended Pascal program development environment is 512K bytes. In a run-only environment, however, the minimum memory needs may be reduced to as low as 130K bytes. This will vary depending on the particular requirements of the application.



## Series 200 Interface and Accessory Cards

Product No.	Description	Cable Part No. <sup>§</sup>
98622A	16-bit GPIO Interface	
Opt. 001	4.6M (15 ft.) unterminated cable . . . . .	5061-4209
Opt. 002	0.8M (2.5 ft.) terminated cable for 9885M Flexible Disc Drive . . . . .	5061-4211
Opt. 003	4.6M (15 ft.) terminated cable for 6940A/B Multiprogrammer . . . . .	5061-4210
Opt. 004	2.5M (8.3 ft.) terminated cable for 9866A/B Thermal Printer . . . . .	5061-4212
98623A	BCD Interface* <sup>†</sup>	
Opt. 001	4.6M (15 ft.) unterminated cable . . . . .	5061-4217
98624A	HP-IB Interface	
	1M (3.3 ft.) HP-IB cable . . . . .	10833A
	2M (6.6 ft.) HP-IB cable . . . . .	10833B
	4M (13.2 ft.) HP-IB cable . . . . .	10833C
	0.5M (1.6 ft.) HP-IB cable . . . . .	10833D
98626A	RS-232 (Serial) Interface	
Opt. 001	4.9M (16 ft.) RS-232 cable with DTE connector (male) . . . . .	5061-4215
Opt. 002	4.9M (16 ft.) RS-232 cable with DCE connector (female) . . . . .	5061-4216
13265A	300 Baud Modem	
98627A	Color Video Interface (includes cables) <sup>‡</sup>	
98628A	Datacomm Interface (Always order with one personality option and one or more cable options)	
	<i>Personality Options</i>	
Opt. 100	Async and Data Link ROM	
	<i>Cable Options</i>	
Opt. 001	4.9M (16 ft.) RS-232-C DTE (male) cable with test connector . . . . .	5061-4215
Opt. 002	4.9M (16 ft.) RS-232-C DCE (female) cable with test connector . . . . .	5061-4216
Opt. 003	4.9M (16 ft.) RS-449/423 DTE (male) cable with test connector . . . . .	5061-4250
Opt. 099	No cable (for use with 132XX adapters below)	
13264A	Data Link Adaptor	
13265A	300 Baud Modem	
98255A	EPROM Card* <sup>†</sup>	
98259A	Magnetic Bubble Memory* <sup>†</sup>	
98620A	2-channel DMA Controller <sup>†</sup>	

§ For ordering cables separately.

\* Not supported in Pascal.

† Requires BASIC Extensions.

‡ Requires Color Video Interface Binary or BASIC Extensions 2.0.

# Let us show you the Model 16

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