

April 1985

# HP-71 HANDHELD COMPUTER



## Introduction

The HP-71 is one of the world's most powerful handheld BASIC language computers. Optimized for calculations, the HP-71 has been designed to provide maximum flexibility in meeting a variety of applications.

The HP-71 offers a 64K byte operating system, user--definable keyboard, and nondedicated I/O (input/out) ports. All this, in combination with built-in programming features, makes the HP-71 exceptionally easy to customize for unique applications. Additionally, the HP-71 may be used as the heart of an expandable computer system in scientific, engineering, business, and industrial applications. By adding peripherals, modules, software, and HP-IL (Hewlett-Packard Interface Loop) interfacing, this powerful handheld computer's capabilities can be expanded to those of low-cost computer systems and still retain the advantage of user friendly operation and portability.

Whether your application is in science, engineering, business, or industrial data collection or control, the HP-71 provides the power to perform complex arithmetic computational tasks efficiently and effectively in a small but powerful package.

## Overview

The HP-71 Handheld Computer is a portable 12 ounce package that provides a powerful calculation mode, BASIC language, and versatile expansion potential. The HP-71 offers a built-in operating system larger than many desktop computers and may be used alone or configured as part of an HP-IL (Hewlett-Packard Interface Loop) system for expanded calculating capability.

## HP-71 Features

**-CALC MODE** - A powerful, nonprogrammable operating mode. CALC mode is optimized for performing the most complex computations. Expressions are entered from left to right in a true algebraic format and intermediate results are displayed as the computation progresses. Precise answers are assured with 12 decimal digits of accuracy. In addition, CALC mode interacts with BASIC. For example, a variable assigned a value in BASIC retains that value in CALC mode, and vice versa. All of the built-in numeric functions of the HP-71 may be used in CALC mode in addition to user-defined single line functions. These functions include statistical capabilities that allow computation on up to 15 independent variables as well as a complete set of trigonometric functions.

- BASIC programming language - Over 240 functions, statements, and operators complement a language powerful enough to handle a variety of programming needs. Subprograms may be created to increase programming versatility and flexibility. Parameters may be passed from main programs to the subprograms. The enhanced HP-71 BASIC supports the IEEE Radix Independent Floating-Point Math Standard to more control and accuracy to computations.
- Built-in operating system - The powerful, calculation-oriented 64K byte operating system allows for high-level programming in addition to repetitive calculations.
- Five-level command stack - The last five commands used are stored in the HP-71 stack for easy access, modification, and reuse.
- Expandable - The HP-IL interfacing option opens the door to a broad array of accessories, peripherals, instruments, and other computers. The HP-71 system solution provides the ability to print, store, retrieve, display information, transmit, and receive data from larger computers or other HP-71s.
- Four RAM/ROM ports - The HP-71 has four plug-in ports for the addition of either additional RAM memory or ROM software modules or both. Up to four 4K byte RAM modules (82420A) may be used with the HP-71 adding an additional 16K of user available memory. This would provide a maximum of 33.5K bytes of user accessible memory. The direct address space for the HP-71 is 512K bytes allowing plenty of room for the addition of plug-in software (ROM) modules for specific solutions. Custom applications are possible with custom plug-in ROM modules to add unique problem-solving capabilities and a means of permanent private storage. Any of the external or internal RAM can be partitioned for quick location of data files and protection from inadvertent memory reset. Memory modules also may be removed without disturbing the rest of memory contents.
- Typing aids - Often used keywords or instructions can be displayed by pressing a shifted key. Program and data entry times can be greatly reduced using these built-in typing aids.
- Redefinable Keyboard - Each key on the keyboard may be redefined (except the blue and gold shift keys) to increase calculating efficiency. Typing aids may be assigned to any convenient key for immediate execution of any particular statement or program from the keyboard.
- Multiple file structure - The number of files in HP-71 memory is limited only by the amount of available RAM. Seven different file types are supported: BASIC, BIN, LEX, DATA, TEXT, KEY, and SDATA.

**HP Computer Museum**  
**[www.hpmuseum.net](http://www.hpmuseum.net)**

**For research and education purposes only.**

-Clock/calendar - A built-in quartz crystal clock can be set with an accuracy of one second per month or better. Clock/calendar dependent programs may be created that begin and run unattended. Three independent timers are built-in for time dependent programming flexibility.

-Display - The HP-71 incorporates a liquid crystal display that provides a 22 character window on a 96 character line. Both upper and lower case characters are available and true descenders are used. The display contrast is programmable to suit the user's needs.

### POSITIONING

The HP-71B is the most powerful advanced programmable BASIC language handheld computer optimized for calculations.

As a stand-alone product:

- \* Portable
- \* High value
- \* Powerful language
- \* Customizable by user
- \* Popular plug-in solutions
- \* Optimized for calculations

As part of a system (through HP-IL):

- \* Interfaces with numerous peripherals and instruments
- \* Communicates with other computers
- \* Customizable solutions

The HP-71 provides these key benefits.

- \* Size
  - Has a tremendous amount of capability in a handheld
- \* Expandability
  - Enhances long-term investment
- \* Power
  - Extended BASIC
  - Advanced calculator functions
  - Combination of both BASIC and CALC modes in one product

## Features

## Benefits

- \* **CALCmode**  
Fast, accurate solutions to complex calculations. Easy to use and edit. Increase computational flexibility by sharing variables with BASIC.
- \* **Built-in 64K byte ROM BASIC operating system**  
Powerful file management system. simple to program using over 240 keywords. Efficient, accurate computation with results to 12-digit precision.
- \* **User-definable keyboard**  
Reduce program and data entry time by assigning specific functions to specific keys. More efficient use of operating time.
- \* **Four RAM/ROM parts**  
Increase memory and storage capacity. Add to problem-solving versatility by combining plug-in ROM and RAM modules.
- \* **Software**  
Pre-tested solutions assure fast, accurate results. Choice of media: plug-in modules, magnetic cards, and cassettes.
- \* **Optional HP-IL interface**  
Tap the resources of larger computers. Control instruments without being present. Print, store, and expand display capabilities by adding peripherals and accessories.
- \* **Optional Card Reader**  
Convenient and inexpensive off-line storage of data and programs. Easy program loading.

## The HP-71 System Solution

HP 82400A Card Reader - The HP 8200A magnetic card reader offers an inexpensive means of storage for programs and data. A specially designated slot, internal to the HP-71, accepts the card reader as a plug-in accessory. Addition of the card reader does not change the external dimensions of the HP-71.

Cards may be encoded as a private file so that they may be copied and executed, but viewed or edited. Automatic verification assures accuracy of information. Additionally, encoding prevents cards from being overwritten. Each card hold 1.3K bytes of program or data.

HP 82401A HP-IL Interface - The Hewlett-Packard Interface Loop (HP-IL) is a bit-serial interface designed for low cost, battery operable systems. HP-IL lets the HP-71 be used as a system controller, capable of transmitting and receiving data, and performing a wide variety of information management and instrument control functions. In this system, devices are connected by two-wire cables leading from the output port of one device to the input port of the next device, until all devices form a closed loop. This loop structure provides a unique capability through auto addressing, device capability identification, power on/off control, and error checking. Additionally, several HP-IL peripherals support a "standby" mode allowing power to be switched on and off under program control thereby conserving battery power.

The HP-71 HP-IL interface, with a data transfer rate of 5000 bytes/second, plugs into a specially designed port at the upper left corner of the HP-71. This interface allows connection to any HP-IL product and to HP-IB, GPIO, and RS-232 interfaces using converters.

The HP-IL Interface gives the HP-71 simultaneous control of up to 30 devices on the loop, and through secondary addressing, up to 930 devices. The 16K bytes of ROM in the interface provides for printer, display, mass storage, and general I/O (input/output) operations. A total of 46 separate commands are integrated into the HP-71 HP-IL interface providing tremendous I/O control capability.

The growing list of available HP-IL peripherals includes:

HP 82161A  
Digital Cassette Drive

HP 9114A  
Disc Drive

HP 82162A  
Thermal Printer/Plotter

HP 7470A Opt. 003  
Graphics Plotter

HP 82905B Opt. 248  
Impact Printer

HP 2225B  
Thinkjet Printer

92198A Mountain Computer  
80-Column Video Interface  
(Monitor or Video required)

HP 82168A  
Acoustic Coupler

HP 3468A  
Digital Multimeter

HP 5383A  
Frequency Counter

HP 3421A  
Data Acquisition/Control Unit

HP 5384A  
Frequency Counter

HP 82164A  
HP-IL/RS-232C Interfaces

HP 82165A  
HP-IL/GPIO Interfaces

HP 82169A  
HP-IL/HP-IB Interfaces

#### SOFTWARE

Software solutions for the HP-71 include a variety of application pacs including:

AC STEADY STATE CIRCUIT ANALYSIS	82481A
CURVE FITTING	82484A
FINANCE	82482A
MATH	82480A
SURVEYING	82483A
TEXT EDITOR	82485A
FORTH/ASSEMBLER	82441A
SOFTWARE DEVELOPMENT UTILITY (WITH MINI-CASSETTE)	82440A
DATAKOM	82488A
AMPI STATISTICS	82489A
TRANSLATOR	82490A

Additionally, HP-71 Solution Books provide complete step-by-step keystroke listings in the following areas:

GAMES	00071-90065
GENERAL UTILITIES	00071-90066
MATH	00071-90064

#### CUSTOM PRODUCTS

Hewlett-Packard's Custom Products program combines customer generated software with the power of the HP-71. Applications that dictate that many people have access to the same unique

program or data are candidates for custom products. There are several options from which to choose, and all are designed to tailor a problem-solving system to meet special demands.

Custom software modules may be developed that contain from 16K bytes to 64K bytes of program or data. Up to four of these modules may be used separately or together in the HP-71. Custom magnetic cards provide an alternative media option. Lastly, custom keyboard overlays provide a friendly user interface for special or unique applications.

#### HP-71 DEVELOPMENT SYSTEM

To enhance the problem solving versatility of the HP-71, Hewlett-Packard provides the tools to simplify the program development process. For the HP-71 this means a choice of languages as well as the capability to move between languages.

Software Development Utility - This utility allows for development of BASIC, FORTH, or Assembly language source files using a personal computer word processing program. Files may be transferred back and forth to the HP-71. These transfer programs are provided on magnetic cards and associated listings of typical programs for the host personal computer are included. File transfer options include: HP-IL, HP-IB, or RS-232. Appropriate interfaces are required.

FORTH/Assembler - The FORTH/Assembler ROM provides an extended software development environment for the HP-71. This operating system allows development of application programs in FORTH that execute faster than programs written in BASIC. HP-71 FORTH enhances FORTH 1983 Standard word capability set with string manipulation words, floating point words, and HP-IL words. The FORTH operating system is compatible with the HP-71 BASIC operating system. This allows switching between FORTH and BASIC environments without programs, data loss, or reconfiguring the HP-71. Programs written in one language can execute routines written in the other language. FORTH also provides calculator capability.

An Assembler, written in FORTH, provides the same command set as the assembler used to develop the HP-71 operating system. This assembler may be used to create FORTH primitives, HP-71 binary files, or language extension (LEX) files to extend the BASIC language.

The text editor can create and edit text files for use as source files for BASIC, FORTH, or Assembly language programs, as well as nonprogramming related purposes.

A BASIC keyword, <KEYBOARD IS>, turns any terminal device connected to the HP-71 through an interface into an external keyboard and display.



## Documentation

To support development of HP-71 applications the internal specifications of the HP-71 have been documented and are available. The information includes details on the internal operation, entry points into the operating system, source code listings, and HP-IL interface description, and hardware bus specifications.

### The Internal Design Specifications (IDS) Documents

Different aspects of HP-71 internal operation are covered in each specification document.

### **Volume I: Detailed Design Description (00071-90068)**

- \* System Start-up and Memory Configuration
- \* Memory Structure
- \* System Control
- \* The BASIC Interpreter
- \* Language Extension and Binary Files
- \* BASIC File Considerations
- \* Statement Parse, Decompile, and Execution
- \* Utilities
- \* Message Handling
- \* File System
- \* Table Formats
- \* Internal Data Representation
- \* Numeric Computation Algorithms
- \* Clock System
- \* HP-71 Assembler Instruction Set
- \* HP-71 Code Examples
- \* HP-71 Resource Allocation

## **Volume II: Entry Point and Poll Interfaces (00071-90069)**

- \* Documents entry and exit conditions of 25 categories of supported system entry points.
- \* Documents interfaces to operating system polls of LEX files.
- \* Index of entry point names and global symbol values.

## **Volume III: Operating System Source Listings (00071-90070)**

- \* Full assembly listings of the 76 modules that comprise the HP-71 operating system.

## **HP-IL (82401-90023)**

- \* Internal Design Notes
- \* Extended Command Syntax
- \* Examples of HP-IL Operation
- \* I/O Processor Firmware Specification
- \* HP-IL Poll Interfaces
- \* HP-IL ROM Utility Routines
- \* HP-IL LEX File Source Listings



## **Hardware Design Specification (0071-90071)**

- \* Describes each bus line and its purpose; specifications and schematic diagrams are included.
- \* Describes the CPU (from a hardware perspective).

## HP-71B Markets

### MARKET - TECHNICAL PROFESSIONALS

Typical customers and application areas:

Electrical Engineers	Mining/Petroleum Engineers
Mechanical Engineers	Mathematicians
Chemical Engineers	Physicists
Statisticians	Surveyors
Chemists	

Typical Needs:

Computational Power	Programming Capability
Software Solutions	Adaptability

How the HP-71B Fills the Bill:

CALC Mode	Surveying Pac
Extended BASIC	Math Pac
AC Circuit Analysis Pac	Curve Fitting Pac
Portability	Expandability
Communications	Text Editor

### MARKET - BUSINESS PROFESSIONALS

Typical customers and application areas:

Real Estate Salespeople	Financial Analysts
Securities Brokers	Insurance Adjusters
Economists	Actuaries

Typical Needs:

Software Solutions	Business & Personal Use
Convenience	Aesthetics
Current Applications	

How the HP-71B Fills the Bill:

Finance Pac	Portability
Expandability	CALC Mode
Extended BASIC	Text Editor

### MARKET - INSTRUMENT CONTROL

Typical customers and application areas:

Technical Individuals & Companies	Instrument Control
Process Control	Host to Portable Communication

Typical Needs:

Low Cost Portable

BASIC Computer

How the HP-71B Fills the Bill:

Extended BASIC  
Portability  
Customizable

FORTH/Assembly Pac  
HP-IL/IO

MARKET - OEM, VEU, SOFTWARE SUPPLIERS

Typical customers and application areas:

Individuals who make a  
business out of customizing  
solutions

MPN applications  
IPN applications  
Transportation

Typical Needs:

Low Cost Portable

BASIC Computer

How the HP-71B Fills the Bill:

"Open-Machine" Philosophy  
BASIC Development System  
HP-IL  
Large Addressability

FORTH/Assembly Pac  
Customizable  
Text Editor Pac

## Questions and Answers

Q. Where doe the HP-71 "Fit-In"?

A. The HP-71B is a leader in capability in the handheld computer market. Because of its power and expandability, it also competes in the advanced calculator, handheld terminal, and controller markets.

Q. Why CALC mode? Why not RPN? Does this mean HP is replacing RPN?

A. RPN is a useful language and will be for quite some time. The HP-41, with its thousands of programs, will keep RPN alive. No other advanced calculator can boast such a vast array of software. The fact that well over half a million HP-41s exist today is going to keep the interest in sharing resources and common systems active. RPN is an efficient and effective language preferred by many. It's also the basis of Series 10 which is extremely popular with technical and business professionals alike.

Basic was chosen for the HP-71B because developing programs in a high-level language is easier, and BASIC is a very common programming language. CALC mode is a natural extension of the BASIC language and allows for an interactive relationship between the two models. Because of this and its versatility, it was a logical choice for the advanced calculator mode of the HP-71B.

Q. What is the HP-71B's Speed?

A. The HP-71B has been optimized for numeric calculations. Its unique architecture, based on a 4-bit parallel bus, takes advantage of its increased precision. In benchmark tests against the HP-41, the HP-71B circuit analysis program ran ten times faster. The Finance Pac solutions are faster with the HP-71B than the same solutions are with the HP-12C.

Q. What is the HP-71B, an advanced calculator or a handheld computer?

A. The HP-71 is a handheld computer, optimized for calculation. It provides a single product for the individual who requires the power to do non-repetitive calculations (CALC mode) and the capability to perform routine computation (BASIC mode). BASIC language makes the product a handheld computer. Including the advanced computational capability makes a contribution to the marketplace, and the expandability of the HP-71B makes it a valuable tool for the customer.

Q. Is the HP-71B compatible with other HP computers?

A. The HP-71B has three types of mass storage data files:

Text (or LIF1)- This type of file has variable-length records that contain ASCII data. This type is compatible with HP-75 LIF1, HP-41 AS (ASCII), and LIF (type 1) files from other HP computers.

Data- This type of fixed-length file contains numeric and string values. It allows both sequential and random access. It is the same format as data files from Series 80 personal computers. Files are not interchangeable between machines.

SDATA-This type of file has fixed-length, eight-byte records that can contain numeric values. It is compatible with HP-41 DA (data) files. The HP-71B can also read six-character ASCII strings from an SDATA file, but it can't store them in an SDATA file.

HP-71B BASIC program files are not directly compatible with other computers because the HP-71B has unique coding for its operations. However, it is possible to share program files by using the TRANSFORM statement--transforming the program into TEXT files.

Appendix D of the HP 82401A HP-IL Interface Owner's Manual, part number 82401-90001, contains detailed information.

Q. What's next? What enhancements are planned for the HP-71B?

A. Without talking futures, you can imagine the direction we will take by looking at the way the product is designed. The operating system can address 512K bytes. Ports can serve multiple uses. HP recognizes that the HP-71B can contribute to other markets as well, and is developing solutions to fit these needs. Third-party vendors will continue to provide enhancements for the product.

Q. What's included in the HP-IL interface? What communication and interfacing capabilities exist?

A. Included in the HP-IL interface are convenient assignments for printer and display output; mass storage statements that are extensions of those on the HP-71B; five methods for specifying HP-IL devices; simple or extended addressing, and operation as an HP-IL controller or HP-IL device.

Q. Why not more memory or a larger display?

A. According to research, the main benefit of the HP-71B is its small size. Results of this research also show that the computational power in this product is extremely beneficial. At this time we are unable to maintain the small size and provide a larger display. However, many aids have been added to compensate for the small display, such as a 96 character line, line editing keys, command stack, typing aids, and user-defined keys.

At present our IC technology and available PC board space dictate the memory size. Technology must improve to the point that ICs can be made more dense before it will be possible to provide more RAM memory.

Q. What documentation exists for the "open machine" and how do I get my hands on it?

A. Three volumes of documentation are available. This highly technical material is designed to provide the sophisticated software or hardware developer with the tools to develop software, hardware, or interfaces for the HP-71B.

Volume I: Internal Design Specifications

Includes system overview, operating system functions, bus and hardware specifications, and instructions on how to develop LEX files.

Volume II: Internal Design Specifications

Includes entry and exit points for the operating system.

Volume III: Internal Design Specifications

Includes source code listings for the operating system and HP-IL.

Q. Can I use the HP-75 program cards?

A. Although the magnetic cards are the same, a program written for the HP-75 cannot be read directly into the HP-71B via the magnetic card due to differences in the BASIC languages.