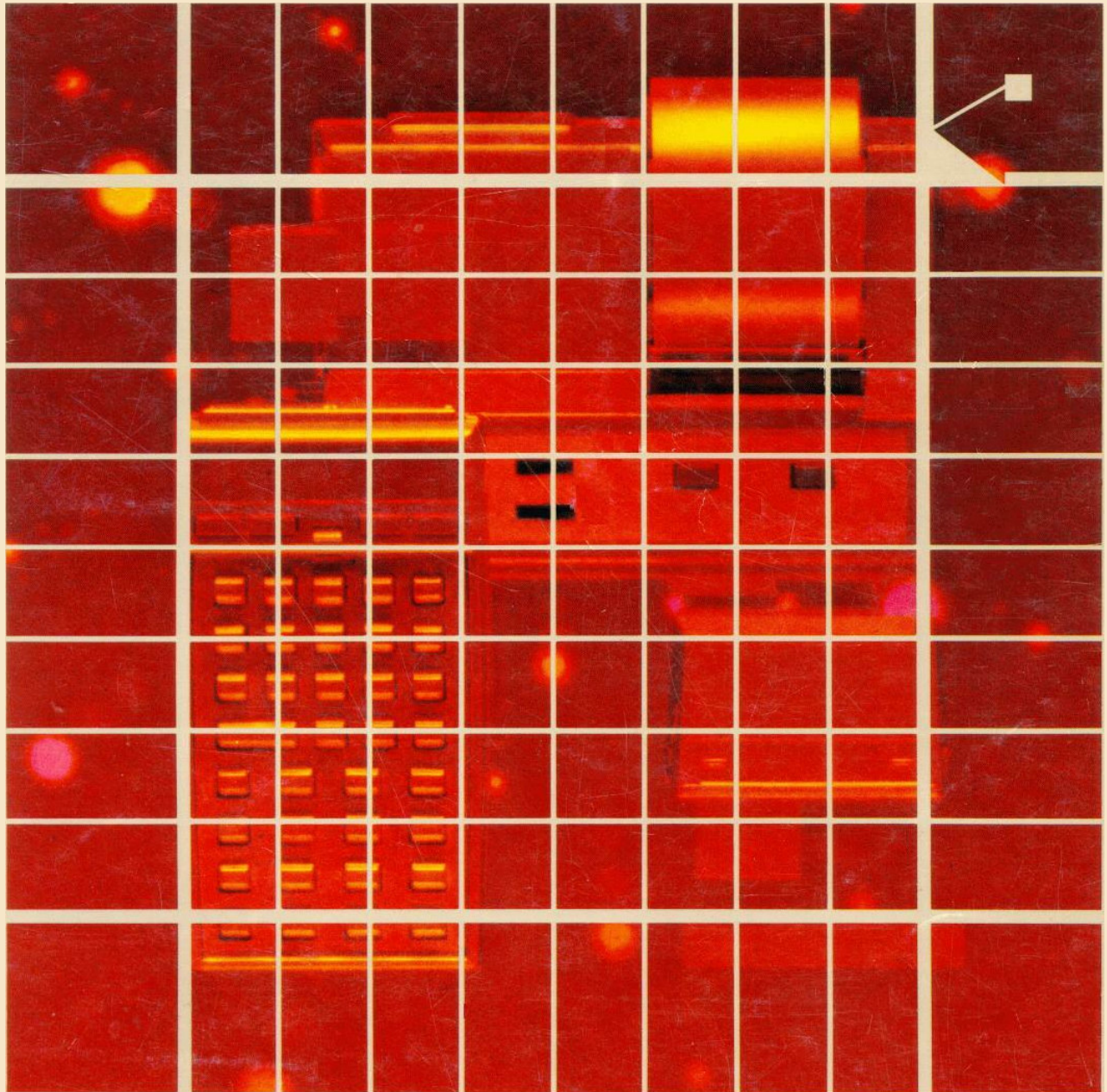


HEWLETT-PACKARD

HP 82160A

HP-IL Module

OWNER'S MANUAL



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Pierre Hardy.

Mail to: pierre.hardy@swing.be

Web site: <http://users.swing.be/id-phy/>

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HP 82160A
HP-IL Module
Owner's Manual

February 1981

82160-90001

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Connecting the Interface Loop

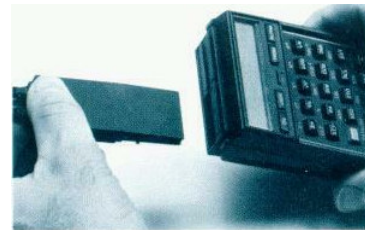
The interface loop consists of your calculator, the HP 82160A HP-IL Module, and up to 30 peripheral devices. These should be connected according to the instructions below.

CAUTION

Be sure the calculator is turned off before connecting or disconnecting the module and cable connectors. If this is not done, the calculator may be damaged or the system's operation may be disrupted.

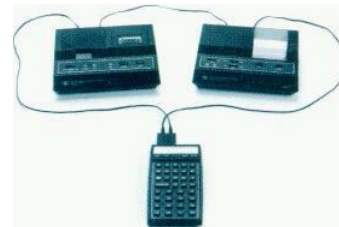
Installing the Interface Module

The HP 82160A HP-IL Module plugs into any of the calculator's ports. (If any HP 82106A Memory Modules are also plugged in, the interface module must be in a higher-numbered port than the memory modules.) Push in the module until it snaps into place. The module's switch should face down.



Connecting Peripheral Devices

The peripheral devices in the interface loop may be connected to the interface module in any order—but all of the interface cables must form a continuous loop. All connections are designed to ensure proper orientation.



To connect a peripheral device, first turn off the calculator. Then merely disconnect the loop in one place and connect the new device into the loop at that place. *All devices must be turned on for the interface to operate properly.*



Note: If a plug-in HP 82143A Printer is connected to the calculator system, the Print Function Switch on the interface module must be set to DISABLE. Otherwise, the operation of the calculator could be disrupted. With this setting, primer operations will be executed by the plug-in printer only. If you want to print using the HP-IL print functions and an HP-IL printer, the Print Function Switch on the interface module must be set to ENABLE and a plug-in HP 82143A Printer must not be connected.

Printer Operations

The HP 82160A HP-IL Module permits the calculator to generate printed output by connecting a printer to the interface loop. The interface module adds powerful printing, graphics, special character, and plotting capabilities to your system. To use the printer, all you do is follow the directions given in section 1 for installing the interface module and connecting the HP-IL printer to the loop. Be sure the Print Function Switch (located on the bottom of the interface module) is set to ENABLE and a plug-in HP 82143A Printer is not connected. Refer to the owner's manual for the printer to determine any additional preparations required for that device. The system is then ready to perform the operations described in this section.*

The printer functions described in thin section include all of the functions available on the HP82143A Printer, an earlier, plug-in accessory. Throughout this section, printer operations are illustrated using the HP 82162A Thermal Printer, an HP-IL peripheral. The operation of the interface module and the HP 82162A Thermal Printer is almost identical to the operation of the HP 82143A Printer. In fad, programs written to use the HP 82143A Printer will operate normally using the HP 82162A Thermal Printer.†

Flags and the Printer

When you start using the printer operations discussed in thia section, you will find it helpful to know how the calculator flags influence the operations.

The calculator uses up to six flags to control a printer-type device. Five of these flags (flags 12, 13,15,16, and 21) are user flags—that is, you can set, clear, and test them. The other flag (flag 55) is a system flag—it can only be tested. The effects of these flags are summarized below.

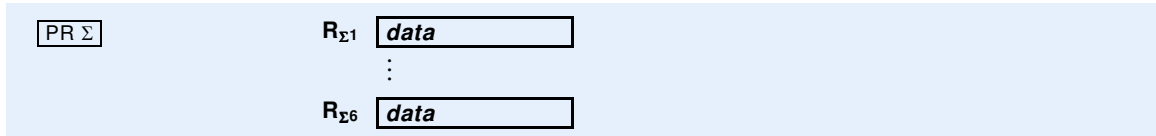
FLAG	SET	CLEAR	
Flag 55: Printer Existence	Indicates a printer is connected to system.	Indicates no primer is connected to system.	
Flag 21: Printer Enable	Performs printer operations normally.	Ignores printer operations in programs only.	
Flag 12: Double Wide	Prints and accumulates characters double width.	Prints and accumulates characters normal width.	
Flag 13: Lowercase	Prints and accumulates letters in lowercase.	Prints and accumulates letters in uppercase (except [a] through [z]).	
Flags 15 and 16: Print Mode (not used for HP82162A Thermal Printer)	Flag 15 clear clear set set	Flag 16 clear set clear set	Print Mode MAN (manual) NORM (normal) TRACE TRACE with stack option

* Refer to the owner's manual for the printer to determine which types of operations, if any, cannot be performed by your printer. Other printer-type (output) devices, such as video displays, may generate output using the printer operations described in this section.

† The few operational differences between the HP 82162A Thermal Printer and the HP 82143A Printer will he noted throughout this section.

bbb.eee

where **bbb** is the beginning data storage register address and **eee** is the ending data storage register address. The **bbb** portion can be one to three digits; the calculator uses the first three digits of the **eee** portion, which follows the decimal point. For example, specify registers R₀₃ thru R₀₇ using 3.007 in the X-register.

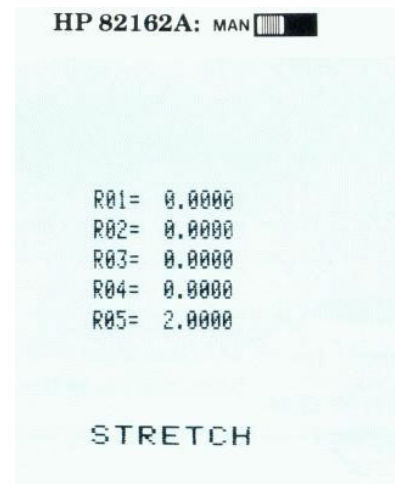


The **PR Σ** (*print statistics registers*) function enables you to print the contents of the currently defined statistics registers. (Refer to the owner's handbook for your calculator for information about **Σ REG** and how statistics registers are defined.) **PR Σ** prints the contents of all six statistics registers.

Example of printing registers:**Keystrokes**

SIZE 017	Allocates 17 storage registers.
CLRG	Clears all storage registers.
2 STO 5	Stores 2.0000 in R ₀₅ .
1.005	Specifies R ₀₁ through R ₀₅ .
PRREGX	Prints registers

SF 12	Sets double-wide flag.
ALPHA STRECTH	Enters ALPHA string.
ALPHA	
PRA	Prints ALPHA register.
CF 12	Specifies normal width

**Printing Programs**

Two functions print programs that are stored in program memory: **PRP** and **LIST**. The print mode determines the format in which program lines are printed. You can terminate the printing operation at any time by pressing **R/S**. These two functions are not programmable.

PRP *name*

The **PRP** (*print program*) function prints a specific program stored in program memory. When you execute **PRP**, the calculator prompts you for the name of the program you wish to print. Simply key in the name of the program (by pressing **ALPHA** *name* **ALPHA**) and printing will begin at the first line of the named program. If you press **ALPHA** **ALPHA** (do not specify a program name) in response to the prompt, the printer will print the program to which the calculator is presently positioned—beginning at its first line.

LIST *name*

The **LIST** function prints a specified number of lines of a program. First, position the calculator to the desired program and then to the line where you wish printing to begin. Then execute **LIST**. When prompted, key in a three-digit number specifying the number of lines you wish to print.

Mass Storage Operations

The mass storage operations available in the HP 82160A HP-IL Module permit you to store and retrieve information conveniently. By connecting a mass storage device to your Hewlett-Packard Interface Loop, you greatly expand the storage capacity of your calculator system. Follow the directions given in section 1 for installing the interface module and connecting the HP-IL mass storage device. Refer to the owner's manual for that device to determine any additional preparations that may be needed. The system is then ready to perform the operations described in this section.*

Throughout this section, mass storage operations are illustrated using the HP 82161A Digital Cassette Drive.

The Storage Medium

A mass storage device typically stores and retrieves information on a removable, interchangeable storage medium—such as a tape cassette. Each collection of information that is recorded on the storage medium is given an ALPHA name and is called a *file*. Because this information is generally transferred between the medium and registers in the calculator, the basic unit of information within a file is called a *register*. A *record* is a unit of storage capacity that is equal to from 32 to 37 registers, depending upon the type of information stored.

File names can be any string of up to seven ALPHA characters. If longer strings are used, only the first seven characters will be recognized and used by the calculator. No two files on a medium can have the same file name.

NEWM *nnn*

The **NEWM** (*new medium*) function initializes the storage medium. Each medium must be initialized at least once to establish on the medium a directory space and a format in which information will be recorded. When you execute **NEWM**, the calculator prompts you for the number of file entries you want to allocate to the directory space on the medium—any number up to 447. Each file that you record on the medium requires one entry in the directory. The directory space created by **NEWM** consists of an integral number of records, with each record containing eight entries. However, the last entry in the directory is reserved for the system and is not available. As a result, the directory always accommodates one less than a multiple of eight file entries—and at least as many entries as you specify. In addition, two records on the medium are reserved for system use. All remaining space on the medium is available for information storage.

Note: A smaller directory space permits faster access to files stored on the medium.

Any information previously stored on the medium will be erased when this command is executed. **NEWM** is not programmable.

* Refer to the owner's manual for the mass storage device to determine which types of operations, if any, cannot be performed by that device.

READSUB	ALPHA	filename
---------	-------	----------

The READSUB (*read subroutine*) function operates similarly to the READP function, except that the program is placed in program memory *after* the last program. This function is particularly useful in a program that copies a subroutine program from a mass storage device, executes that subroutine, and then continues the main program. READSUB does not change the position of the calculator in program memory.

Example of storing and retrieving a program: After entering a program into your calculator, store it on the medium, clear it from program memory, and then recall it from the medium.

Keystrokes	Display	
\blacksquare GTO \square . \square .	0.0000	Creates new program space. (Display assumed cleared.)
PRGM		
\blacksquare LBL		
ALPHA AREA ALPHA	01 LBLTAREA	} . Sample program AREA . . .
\blacksquare X ²	02 X \uparrow 2	
\blacksquare π	03 PI	
\square X	04 *X	
PRGM	0.0000.	X-register
ALPHA ,ML	,ML_	Specifies current program and filename ML.
ALPHA	0.0000	
WRTP	0.0000	Program AREA stored in file ML.
CLP ALPHA AREA	AREA_	Clears program AREA.
ALPHA	0.0000	
ALPHA ML	ML_	Specifies filename ML.
ALPHA	0.0000	
READSUB	0.0000	Copies program AREA at end of program memory.
\blacksquare GTO ALPHA AREA	GTO AREA_	Positions calculator to AREA.
ALPHA	0.0000	
PRGM	01 LBLTAREA	First line of retrieved program
PRGM	0.0000.	

Storing and Retrieving Data

A collection of data can conveniently be stored on the medium and recalled when needed. Using the functions described below, the entire collection—or any portion—can be stored or recalled.

CREATE	X	filesize	ALPHA	filename
--------	---	----------	-------	----------

The CREATE function allocates a portion of the medium for a data file and fills all registers with zero values. The number in the X-register specifies the number of registers to be allocated in the new data file. The contents of the ALPHA register specify the name of the file. (If a file with the specified name exists on the medium, DUP FL NAME is displayed and no new file is created.)

SEEKR	X	register	ALPHA	filename
-------	---	----------	-------	----------

The SEEKR (*seek register*) function positions the storage medium to a specific register within a data file. This permits data to be stored and retrieved from individual registers within a file using the WRTRX and

Interface Control Operations

You have seen that the HP 82160A HP-IL Module gives you the capability to perform printer and mass storage operations by using functions specifically designed for these applications. However, the Hewlett-Packard Interface Loop is a *general-purpose interface*. A third set of functions—the interface control functions—is designed to give you more complete control of interface activity—for any types of HP-IL devices connected in the loop.

It will be helpful to digress for a moment to give a brief explanation of the operation of the interface loop. This information should give you additional insight into how the devices interact and allow you to work with the loop more effectively—especially when you use the interface control operations described in this section.

Operation of the Hewlett-Packard Interface Loop

When you execute any of the functions described in this manual, the interface module translates the function into a sequence of HP-IL instructions. It then sends them around the interface loop to each device, one at a time. In the discussion that follows, you will learn how the calculator and peripherals communicate using the HP-IL instructions.

Roles of Devices

In order for the interface loop to operate in an orderly manner, the devices in the loop must operate according to their assigned roles. The role of each device is changed to suit the operation being performed. Three different roles are defined for HP-IL devices: controller, talker, and listener. Any device not assigned one of these roles is inactive.

The controller is the *one* device in the loop that can designate the roles of devices and control the loop's operation. The *system* controller (the calculator) is the device that controls and initializes the loop when it is first turned on. It can transfer control to another device, which then becomes the controller of the loop—the *active* controller. Similarly, an active controller can transfer control to another device. For all operations provided by the HP 82160A HP-IL Module, the calculator is always the system controller and the active controller.

A talker is a device that *sends* information to the interface loop. It is designated and enabled by the controller. At any time, there can be no more than one talker. The controller may be a talker. Examples of talkers are a mass storage device sending data from a stored file and a voltmeter sending voltage measurements.

A listener is a device that *receives* information on the interface loop. There may be more than one listener in the loop at the same time. Listeners are designated by the controller. The controller may be a listener. (A device cannot be a listener and a talker at the same time, although it can have these roles at *different* times.) Examples of listeners are a mass storage device receiving and storing data in a file and a printer receiving and printing information.

Device Addresses

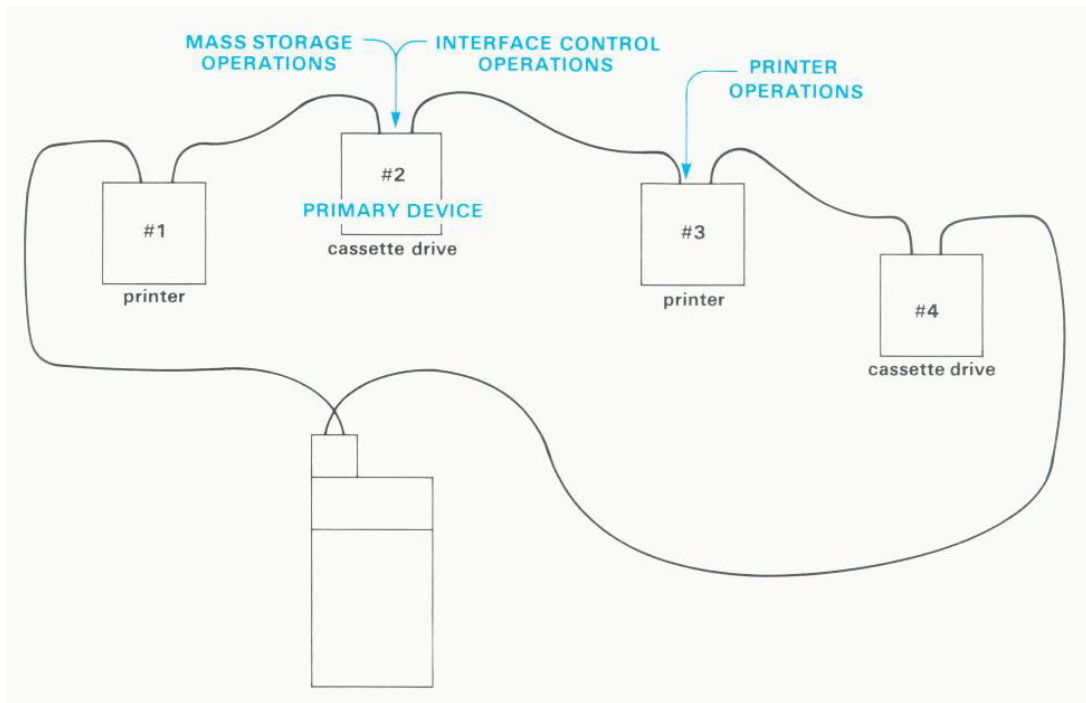
In order to distinguish between devices in the loop, each device must have an address—a number from 1 to 30. The controller uses the addresses to specify and control the devices.

In both Auto and Manual modes, the interface control functions are performed in the same way. Single-device operations are carried out by the primary device—except for the **LISTEN** function, which requires an address. Loop-control operations affect *all* devices, regardless of the interface mode.

The following table illustrates how Auto and Manual modes affect the operation of the interface loop:

Operation	Auto Mode	Manual Mode
Printer Operations	Performed by first printer-type device in loop starting with primary device.	Performed by primary device, if possible.
Mass Storage Operations	Performed by combination of all mass storage devices in loop starting with primary device.	Performed by primary device, if possible.
Interface Control Operations	Single-device operations performed by primary device, if possible.	Single-device operations performed by primary device, if possible.

As an example, device #2 is selected as the primary device in the interface loop shown below. The loop operates this way:



Auto Mode with Primary Device #2

Error Messages

This appendix contains a list of messages and errors that are related to interface operations. The messages and errors are grouped into printer, mass storage, and general interface control categories. Errors in the interface control category may occur during printer or mass storage operations. (Refer to the owner's handbook for your calculator for a list of all standard errors and messages.)

Note: For most error conditions, the function being attempted is not performed. However, for those conditions and functions indicated by * below, the operation may be partially performed.

Printer Operations

Display	Function	Meaning
ALPHA DATA	<i>-all-</i>	ALPHA characters are in a register where a number is required—either a stack register or a data storage register.
DATA ERROR	<div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">ACCHR</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">ACCOL</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">BLDSPEC</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">PRAXIS</div> <div style="font-size: 2em; margin-left: 5px;">}</div> </div> * <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">PRAXIS</div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">PRREGX</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">REGPLOT</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">STKPLOT</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">SKPCHR</div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">SKPCOL</div> <div style="font-size: 2em; margin-left: 5px;">}</div> </div>	$ x \geq 128$. $YMAX \leq YMIN$, $AXIS > YMAX$, $AXIS < YMIN$, or $ nnn > 168$. $XMAX \leq XMIN$, $YMAX \leq YMIN$, $AXIS > YMAX$, or $AXIS < YMIN$ $ x > 999$. $YMAX \leq YMIN$, $nnn = 0$ or $ nnn > 168$. $ x \geq 24$. $ x \geq 128$.
NO PRINTER	<i>-all-</i>	A standard printer-type device is not in the interface loop. (Occurs in Auto mode only.)
NONEXISTENT	<i>-all-</i> * <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">PRP</div> * <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">PRPLOT</div> * <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">PRPLOT*P</div> * <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">PRREG</div> <div style="font-size: 2em; margin-left: 5px;">}</div>	Print Function Switch set to DISABLE. Set switch to ENABLE. Specified program or function program does not exist. Check program name Specified registers exceed highest numbered data storage register. Check bbb.eee format in X.
PRINTER ERR	* <i>-all-</i>	The printer is out of paper, jammed, or requires service. Reload paper (if required) or turn printer off and on, then check whether error recurs.
PRIVATE	<i>-all-</i>	An attempt was made to list, trace, edit, or view a private program.

Function Index

The operations listed below are active while the HP 82160A HP-IL Module is plugged into the calculator (and the Print Function Switch is set to ENABLE). These operations and programs containing these operations are executable only when appropriate peripherals are connected to the interface loop.

Printer Operations:

ACA	Accumulate ALPHA register into print buffer.	Page 15
ACCHR	Accumulate character into print buffer.	Page 17
ACCOL	Accumulate column into print buffer.	Page 20
ACSPEC	Accumulate special character into print buffer.	Page 22
ACX	Accumulate X-register into print buffer.	Page 16
ADV	Advance paper, print the print buffer right-justified.	Page 18
BLDSPEC	Build special character in X- and Y-registers.	Page 21
FMT	Accumulate format specifier into print buffer.	Page 19
LIST	List program lines. Not programmable.	Page 13
PRA	Print ALPHA register.	Page 12
PRAXIS	Print and label y-axis.	Page 26
PRBUF	Print the print buffer left-justified.	Page 18
PRFLAGS	Print flag status and other calculator information.	Page 15
PRKEYS	Print list of reassigned keys.	Page 14
PRP	Print program. Not programmable.	Page 13
PRPOLT	Plot function interactively.	Page 24
PRPLOT	Plot function noninteractively.	Page 26
PRREG	Print contents of all storage registers.	Page 12
PRREGX	Print contents of specified registers.	Page 12
PRΣ	Print contents of statistics registers.	Page 13
PRSTK	Print contents of X-, Y-, Z-, and T-registers.	Page 12
PRX	Print contents of X-register.	Page 12
REGPLOT	Plot single function value using storage registers.	Page 27
SKPCHR	Accumulate skipped characters into print buffer.	Page 18
SKPCOL	Accumulate skipped dot columns into print buffer.	Page 21
STKPLOT	Plot single function value using stack registers.	Page 27

Mass Storage Operations:

CREATE	Create new data file with zero values.	Page 34
DIR	Display or print a directory of stored files.	Page 32
NEWM	Prepare new medium for storing files. Not programmable.	Page 31
PURGE	Remove file from medium.	Page 38
READA	Read "write-all" file and set calculator.	Page 37
READK	Read key-assignment file and reassign keys.	Page 36
READP	Copy program file, replacing last program in memory.	Page 33
READR	Copy data file into calculator registers.	Page 35
READRX	Copy part of data file according to X-register.	Page 35
READS	Read status file and set calculator status.	Page 37
READSUB	Copy program file after last program in memory.	Page 34
RENAME	Rename stored file.	Page 38
SEC	Make a stored file secured.	Page 37