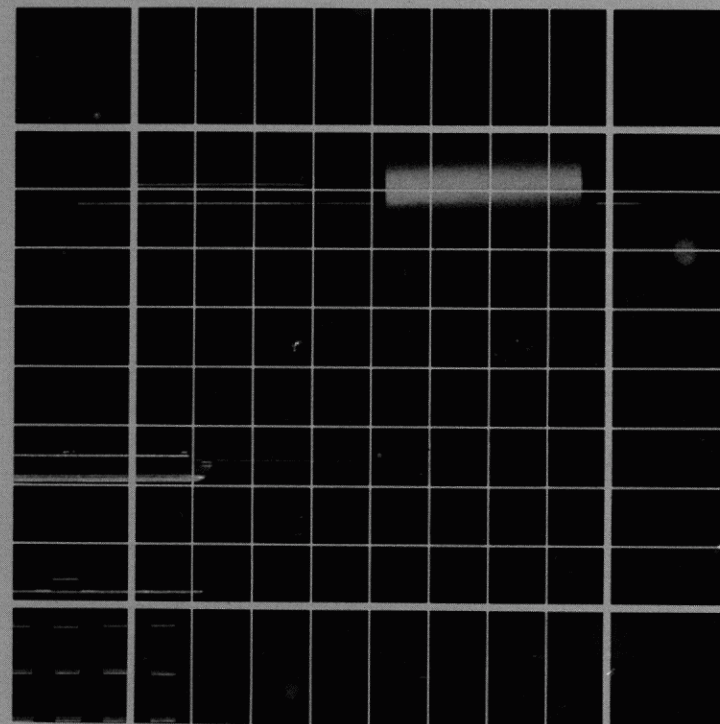HEWLETT-PACKARD

82143A
PRINTER
OWNER'S HANDBOOK

hp HEWLETT PACKARD

1000 N.E. Circle Blvd., Corvallis, OR 97330

"The success and prosperity of our company will be assured only if we offer our customers superior products that fill real needs and provide lasting value, and that are supported by a wide variety of useful services, both before and after sale."

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When Messrs. Hewlett and Packard founded our company in 1939, we offered one superior product, an audio oscillator. Today, we offer over 3500 quality products, designed and built for some of the world's most discerning customers.

Since we introduced our first scientific calculator in 1967, we've sold millions worldwide, both pocket and desktop models. Their owners include Nobel laureates, astronauts, mountain climbers, businessmen, doctors, students, and homemakers.

Each of our calculators is precision crafted and designed to solve the problems its owner can expect to encounter throughout a working lifetime.

HP calculators fill real needs. And they provide lasting value.

HEWLETT PACKARD

HP 82143A
Printer Owner's Handbook

November 1979

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Contents

Using the HP 82143A Printer

The HP 82143A Printer was designed specially for the HP-41C calculator system, adding powerful printing, plotting, graphics and special character capability. When you plug the printer into one of the ports on the HP-41C, an impressive set of printing functions becomes active.

This handbook takes you through the detailed operation of each of the functions as well as the general operation of the printer. So that you can become familiar with the capabilities of the calculator/printer system, you should read through this handbook.

Printer Controls

OFF ▐▊▌ ON **Switch.** This switch controls the power to the printer. In order for the printer to operate in the system, the power must be on. Procedures for ac line operation and charging the batteries are given later in this section.

MAN ▐▊▌ NORM **Print Mode Switch.** The printer has three modes of operation, which are controlled by the position of this switch. This switch controls what and how information is printed.

- In the MAN *(manual)* position, the printer is idle and does not print unless you or a program executes a print function. Listings of programs are printed left-justified when the printer is set to MAN.

- In the NORM *(normal)* position, the printer prints numbers and ALPHAs that are keyed in, function names as they are executed from the keyboard, and output from print functions. Running programs print only output from print functions and PROMPT output. Listings of programs are printed right-justified when the printer is set to NORM.

- In the TRACE position, the printer prints numbers and ALPHAs that are keyed in, function names, intermediate and final answers, and output from print functions. Program listings are printed in a special "packed" or condensed form when the printer is in TRACE.

5

Above each example printer listing in this handbook, the position of the

print mode switch is shown like this: Printer: MAN▐▓▓▓▌▬ .   This lets
you know how you should set the print mode switch to obtain the printed
output shown in the example.

Print Intensity Switch. This is a five-position switch that controls the
intensity of the characters being printed.

Print Key. When the HP-41C is in normal mode (with no program
running), you can print the contents of the X-register by simply pressing
[PRINT] . In ALPHA mode, when you press [PRINT] , the contents of the
ALPHA register are printed. Pressing [PRINT] while the HP-41C is set to
PRGM mode inserts a [PRX] *(print X)* as a line in the program, or while
the HP-41C is also in ALPHA mode, inserts a [PRA] *(print ALPHA)*
into the program.

Paper Advance Key. The paper advance key, [ADV], on the printer is
used to advance the paper in the printer. When the HP-41C is in normal
mode, pressing the paper advance key simply advances the paper one
line. Holding the key down produces multiple advances. When the
HP-41C is in PRGM mode and you are keying in a program, pressing the
paper advance key inserts an [ADV] *(advance)* into the program. (If you
hold the paper advance key down for longer than a second, the [ADV] is
not inserted into the program and the paper is immediately advanced.)
When the calculator executes the [ADV] in the program, the paper is
advanced one line.

Power Light. This light is on when the power to the printer is turned on.
If the battery power is not sufficient to run the printer, the power light is
off.

Bat Light. The bat light tells you the status of the rechargeable batteries
in the printer. When the bat light is on, battery power is low. This means
that the printer has about 10 to 15 minutes of power remaining. To con-
tinue operation you should immediately turn the printer OFF and insert a
fully charged battery pack or connect the AC adapter/recharger and
recharge the batteries for a few minutes before you resume printing.

CAUTION

Continued printing with the bat light on may damage the
rechargeable batteries.

The AC Adapter/Recharger and Rechargeable Battery Pack

The complete AC adapter/recharger and rechargeable battery pack are
important parts of your printer system. The rechargeable battery pack
supplies the printer with sufficient power for sustained portable printing
for 4000 to 5000 printed lines. When plugged in, the AC adapter/
recharger supplies operating power for the printer and recharges the
battery pack.

AC Line Operation

To operate the printer using the ac adapter/recharger, simply turn the
printer off, plug the ac adapter/recharger into the proper power source
and then into the printer, and turn the printer on. It is normal for the
underside of the printer and the ac adapter/recharger to be warm when
connected.

CAUTION

The battery pack must be in the printer while the AC adapter/
recharger is connected. Failure to do so could damage the
printer.

Battery Operation

When not being used, the rechargeable batteries have a self-discharge
rate of approximately one percent of available charge per day. If you
have not used the printer for an extended period of time, connect the ac
adapter/recharger and charge the battery pack. The rechargeable batter-
ies are being charged while you operate the printer from the ac adapter/
recharger. The battery pack will charge with the printer on or off.
Normal charging time from fully discharged battery pack to full charge is
(time depends on ac line voltage value):

Printer ON or OFF: 14 to 16 hours

Shorter charging periods will reduce the operating time you can expect
from a single battery charge. Whether the printer is off or on, the bat-
tery pack is never in danger of becoming overcharged.

Do not attempt to incinerate, puncture or disassemble the battery pack—
it may burst or release toxic materials. Do not connect together or other-

wise short-circuit the battery pack terminals—the pack may melt or cause serious burns.

Battery Pack Replacement

1. Turn the printer OFF and disconnect the ac adapter/ recharger.

2. Slide the two battery door latches inward.

3. Let the battery door and battery pack fall into your hand.

4. Insert the new battery pack so that its contacts face the printer and line up with the connector springs.
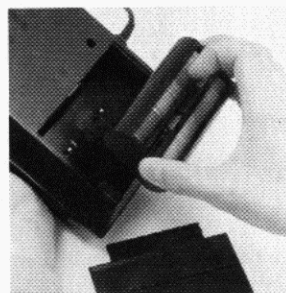
5. Insert the end of the battery door that is opposite the latches behind the retaining groove, and close the door.
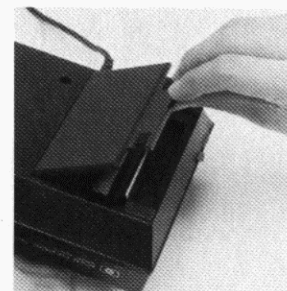
6. Secure the door by pressing it gently while sliding the two battery door latches outward.

Connecting the AC Adapter/Recharger

1. Turn the printer and calculator off.

2. Plug the ac adapter into the proper power source.

3. Plug the female recharger plug into the back of the printer as shown. The batteries will charge and the printer can be operated normally.
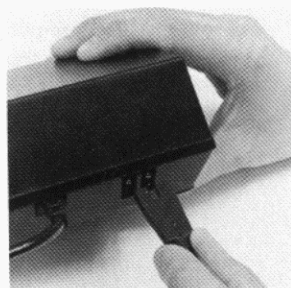
Plugging the Printer Into the HP-41C

1. Make sure the calculator and printer are turned off.

2. Remove the port cap that is in the highest numbered unused port. If you must remove a memory module, always remove one from the highest numbered port. (If you re-move a memory module, make sure the HP-41C has enough memory allocated to data storage registers— executing [SIZE] 064 will ensure this.)

3. Insert the printer interface module into the empty port as shown. Push it into the calcu-lator until it snaps firmly into place.

Your HP-41C system is now ready to use!

Removing the Printer From the HP-41C

1. Turn the HP-41C and the printer off!

2. Pull the printer interface module straight back until it is free from the port. Do not pull on the cord.

3. Replace the port cap on the empty port.

Loading Paper Into the HP 82143A Printer

The HP 82143A Printer is a thermal printer and it requires a special heat-sensitive paper. You should use only the Hewlett-Packard thermal paper available in 80-foot rolls from your nearest HP distributor or sales office or by mail from:

Hewlett-Packard
Corvallis Division
P.O. Box 3499
Corvallis, Oregon 97330

CAUTION

To prevent damage to your HP 82143A Printer use only Hewlett-Packard thermal paper.

To load paper into the printer:

1. Turn the printer ON and open the paper roll cover. Remove the empty core from the paper well.
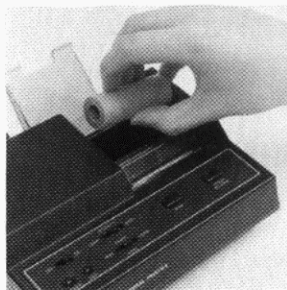
2. Before inserting the new roll of paper into the printer, discard the first two turns to ensure that no glue, tape or other foreign matter is on the paper. Make sure that the leading edge of the paper is straight, not crooked or jagged. A short, sharp crease on the leading edge may aid in the loading of the paper.

3. Temporarily place the paper roll in the paper roll cover. With your finger, push the leading edge of paper into the slot near the bottom of the paper well. Continue pushing until the paper can be pushed no further into the print mechanism.
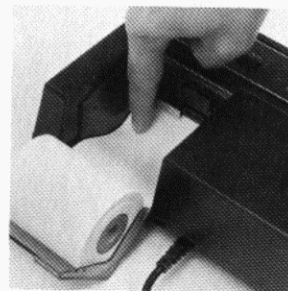
4. Press the paper advance key and hold it down until the paper passes the top of the plastic tear bar.
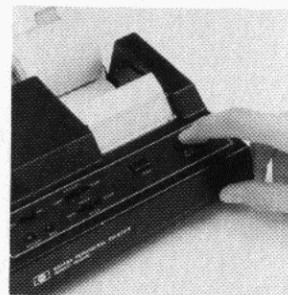
5. Drop the roll of paper into the paper well, close the cover, and press [PRINT] two or three times. (If you ran out of paper during the execution of a program, press [R/S].) If the paper is feeding properly but no printing appears when you print, the paper may be inserted backwards. The paper is chemically treated and will print on only one side.
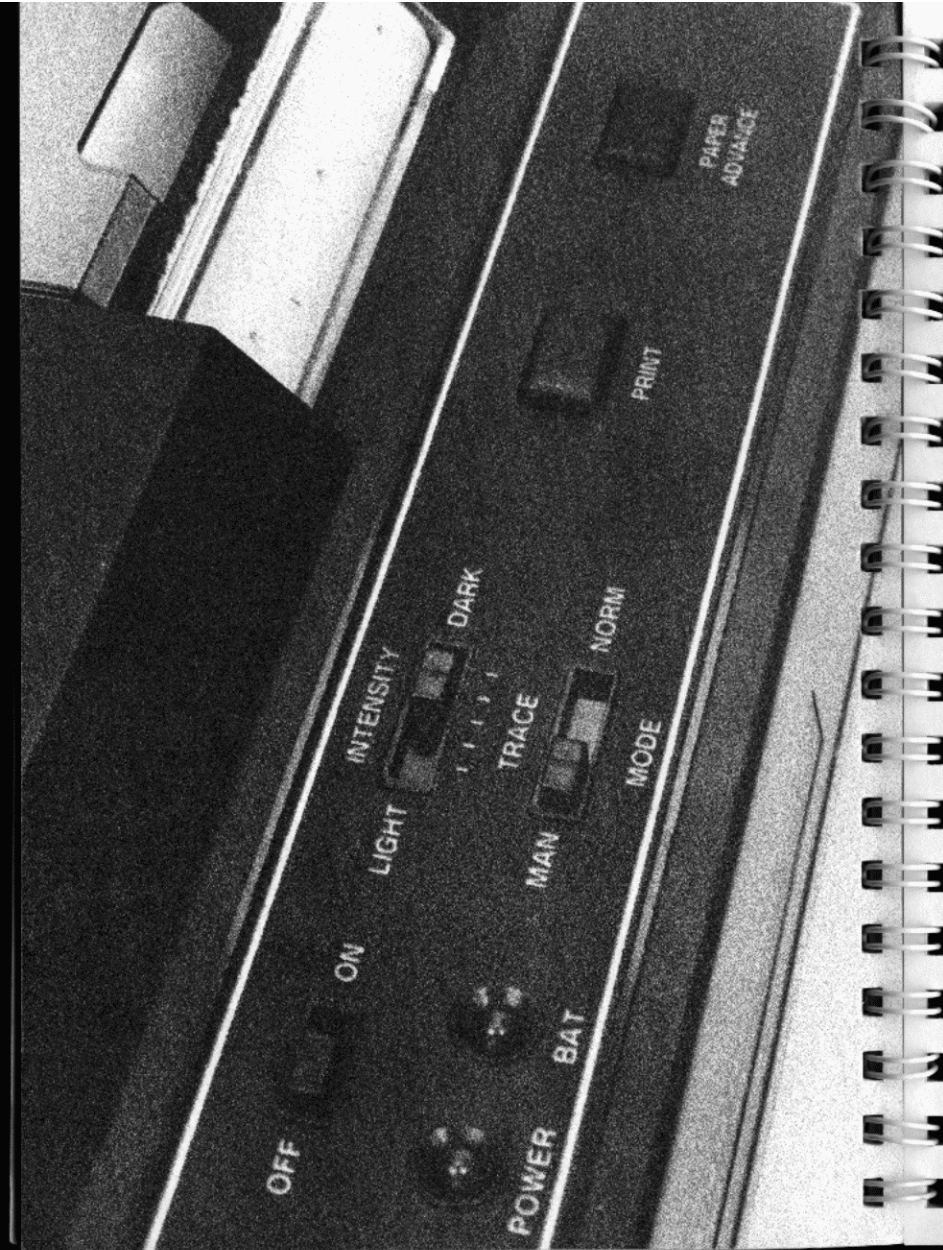
Printer Operations

The HP 82143A Printer is an easy to use but very capable addition to the HP-41C. To use the printer all you do is follow the directions given in section 1 for plugging in the printer and then turn the printer on. The system is instantly integrated and ready to use. This section and the following three sections show you how to use the printer from its most simple operations to the more specialized applications in plotting, special character output and graphics.

To begin using your new printer, press the following keys to print a list of all of the functions in the printer.

Keystrokes

CATALOG 2

Printer:
```
                           CAT 2
-PRINTER-
ACA
ACCHR
ACCOL
ACSPEC
ACX
BLDSPEC
LIST
PRA
'PRAXIS
PRBUF
PRFLAGS
PRKEYS
PRP
'PRPLOT
'PRPLOTP
PRREG
PRREGX
PRΣ
PRSTK
PRX
REGPLOT
SKPCHR
SKPCOL
STKPLOT
```

All of these functions can be executed or assigned to keys for execution just as any other HP-41C function. These functions are available only while the printer is plugged in. Refer to section 4 in the *HP-41C Owner's Handbook and Programming Guide* for information about executing and assigning functions.

Standard HP-41C Printing Functions

There are four standard HP-41C functions that will automatically print as well as perform their normal functions while the printer is attached and set to the proper print mode. These functions are [VIEW], [AVIEW], [PROMPT] and [ADV]. They perform their normal functions as well as the printing functions regardless of whether they are executed from the keyboard or in a program.

View Register Contents [VIEW]

The [VIEW] *(view register contents)* function causes the contents of the specified register to be displayed. With the printer attached, [VIEW] causes the contents of the specified register to be printed as well as displayed. The example below stores a number into a register then uses [VIEW] to display and print it.

Keystrokes	Printer: MAN▯▮
27.9380 [STO] 01	27.9380
▮ [VIEW] 01	

ALPHA View [AVIEW]

The [AVIEW] *(ALPHA view)* function displays the contents of the ALPHA register. When the printer is attached, [AVIEW] displays and prints the contents of the ALPHA register. In the example, an ALPHA string is placed into the ALPHA register and then displayed and printed using [AVIEW].

Keystrokes	Display	Printer: MAN▯▮
[ALPHA]		PRINT IT
PRINT IT_	*PRINT IT_*	
▮ [AVIEW]	*PRINT IT*	
[ALPHA]		

Prompting [PROMPT]

When this standard HP-41C function is executed in a program, it displays the contents of the ALPHA register and halts program execution. While the printer is attached and the print mode switch is set to NORM or TRACE, the execution of [PROMPT] displays and prints the message in the ALPHA register, and then halts program execution. While the print mode switch is set to MAN, execution of [PROMPT] *displays* the ALPHA register and halts program execution but does not print.

Executed from the keyboard, [PROMPT] simply displays the contents of the ALPHA register while the printer is set to NORM or TRACE. The example here shows how [PROMPT] prints when executed from the keyboard (the example assumes that the contents of the ALPHA register are intact from the previous example).

Keystrokes	Display	Printer: ▮▮▯NORM
[XEQ] [ALPHA]		PROMPT
PROMPT	*PRINT IT*	PRINT IT
[ALPHA]		

Paper Advance [ADV]

To advance the printer paper, press the Paper Advance key, [ADV], on the printer. Pressing this key once advances the paper a single line. Holding the key down continues advancing the paper until you release the key.

Another way to advance the paper in normal and USER modes is to execute the [ADV] functions from the keyboard. Each execution of [ADV], either in a program or from the keyboard, advances the paper a single line. Pressing the advance key on the printer while the HP-41C is set to PRGM mode inserts an [ADV] function into program memory.

HP 82143A Printer Functions

All of the rest of the functions covered in this section are available only while the printer is plugged into the HP-41C. Two of these functions are available by pressing the [PRINT] key on the printer.

The [PRINT] Key

The [PRINT] key on the printer provides a method for printing the contents of the display at any time, in any print mode.

While the HP-41C is not in ALPHA mode, pressing [PRINT] prints the contents of the X-register (in PRGM mode, pressing [PRINT] inserts a [PRX] into the program). While the HP-41C is set to ALPHA mode, pressing [PRINT] prints the contents of the ALPHA register (in PRGM/ALPHA mode, pressing [PRINT] inserts a [PRA] into the program).

Keystrokes   **Printer:** MAN ▐▌▐▌▐ ▐

123,456,789   123,456,789.0   ***
[PRINT]
[ALPHA]
ABCDE   ABCDE
[PRINT]
[ALPHA]

Print X-Register [PRX]

[PRX] *(print X)* prints the contents of the X-register regardless of the print mode setting. It performs the same function as pressing the [PRINT] key on the printer when the calculator is not set to ALPHA mode. Remember, you can insert a [PRX] into a program by pressing [PRINT] on the printer while the HP-41C is set to PRGM mode.

Keystrokes   **Printer:** MAN ▐▌▐▌▐

123,456,789   123,456,789.0   ***
[XEQ] [ALPHA] PRX
[ALPHA]

Print ALPHA-Register [PRA]

[PRA] *(print ALPHA)* prints the contents of the ALPHA register, regardless of the print mode setting. [PRA] performs the same function as pressing the [PRINT] key on the printer with the calculator set to ALPHA mode. You can insert a [PRA] into a program by pressing the [PRINT] key on the printer while the HP-41C is set to ALPHA and PRGM modes.

Keystrokes   **Printer:** MAN ▐▌▐▌▐

[ALPHA]
ABCDEFGH   ABCDEFGH
[ALPHA]
[XEQ] [ALPHA] PRA
[ALPHA]

Printing Registers [PRREG] [PRREGX] [PRΣ] [PRSTK]

There are three printer functions that allow you to print the contents of data storage registers: [PRREG] , [PRREGX] , and [PRΣ] . The fourth register printing function prints the contents of the automatic memory stack registers ([PRSTK]). All of these functions are programmable, that is, they can be keyed in as lines in programs that you store in program memory.

Using [PRREG] *(print registers).* When you execute [PRREG], the contents of all currently allocated data storage registers beginning with R_{00} are printed. Each printed register is labeled with the register number on the left (*Rnnn=*) and the contents of the register (up to 15 characters) on the right. When a register contains ALPHA characters, its contents are enclosed in quotes when printed, like this *R01 = "ABC"*. The listing can be terminated at any time by pressing [R/S] .

For use in a program, key in the [PRREG] function just as you would any other function. Allocation of registers in example below is [SIZE] 017.

Keystrokes   **Printer:** ▐▐▌▐▌ NORM

[XEQ] [ALPHA] PRREG   R00= 0.0000
[ALPHA]   R01= 27.9380
                                         R02= 0.0000
                                         R03= 0.0000
                                         R04= 0.0000
                                         R05= 0.0000

```
R06=  0.0000
R07=  0.0000
R08=  0.0000
R09=  0.0000
R10=  0.0000
R11=  0.0000
R12=  0.0000
R13=  0.0000
R14=  0.0000
R15=  0.0000
R16=  0.0000
```

Using PRREGX *(print registers as directed by X).* This function provides you with complete control over which registers you are printing. PRREGX uses a number in the X-register to control the printing operation. Here is a procedure for using PRREGX:

1. Using the following format, place a data control number in the X-register:

    bbb.eee

    where **bbb** is the beginning data storage register address and **eee** is the ending data storage register address.

The calculator uses the absolute value of this number to control which data storage registers are to be printed. The **bbb** portion instructs the printer to begin at that data storage register address and the **eee** portion is the last data storage register to be printed. The **bbb** portion can be one to three digits and the **eee** portion must be three digits. The sign of the control number in X is not used or altered, it is ignored.

For example, when using PRREGX, 10.020 would instruct the printer to print the contents of registers R_{10} through R_{20}. The number 120.254 would instruct the printer to print $R_{(120)}$ through $R_{(254)}$. If the **eee** portion is less than or equal to **bbb**, the printer prints only the register specified by **bbb**. So, the number 20.000 would print just R_{20}. If **eee** is larger than the number of currently existing registers, the calculator prints from **bbb** to the first non-existent register encountered (*NONEXISTENT*). If **bbb** is larger than the number of currently allocated registers, the display will show *NONEXISTENT*.

2. Execute PRREGX. In a program, key the control number into the X-register (as a line in the program), and follow it with the PRREGX function. The control number can also be calculated by the program.

3. The printer now uses the control number to determine which registers to print. You can terminate the print session at any time by pressing R/S.

Here is an example showing how PRREGX can be used to print the contents of registers R_{01} through R_{05}. The control number is 1.005.

Keystrokes	Printer: ▐▐▐▐▐ NORM
1.005	1.0050
XEQ	PRREGX
ALPHA PRREGX	
ALPHA	R01= 27.9380
	R02= 0.0000
	R03= 0.0000
	R04= 0.0000
	R05= 0.0000

Using PRΣ *(print statistics registers).* The PRΣ function enables you to print the contents of the currently defined statistics registers (refer to section 6 in the *HP-41C Owner's Handbook and Programming Guide* for information about ΣREG and how statistics registers are defined). Executed in a program or from the keyboard, PRΣ prints the contents of all six statistics registers.

Keystrokes

XEQ
ALPHA PRΣ ALPHA

Printer: ▮▮▯▯ NORM

```
                      PRΣ
ΣX  = 0.0000
ΣX↑2= 0.0000
ΣY  = 0.0000
ΣY↑2= 0.0000
ΣXY = 0.0000
N   = 0.0000
```

Using PRSTK *(print stack).* When executed in a program or from the keyboard, the PRSTK function prints the contents of the automatic memory stack registers in T, Z, Y, X order.

Keystrokes

XEQ
ALPHA PRSTK
ALPHA

Printer: ▮▮▯▯ NORM

```
                      PRSTK
T= 0.0000
Z= 0.0000
Y= 0.0000
X= 0.0000
```

Printing Programs PRP LIST

There are two printer functions that print programs that you store in program memory: PRP *(print program)* and LIST *(list program).* Both of these functions are non-programmable (cannot be keyed in as part of program).

Using PRP *(print program).* To print a specific program that is presently stored in program memory, follow this procedure:

1. Execute PRP.
2. The calculator prompts you for the name of the program you wish to print. Simply key in the name of the program (press 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.

You can terminate the printing operation at any time by pressing R/S. LIST and PRP format program lines depending upon the position of the print mode switch. Following is a listing of a program printed using PRP showing the three formatting options. The program name is CHARS. (You may wish to key in and run this program—it produces a list of all printer characters. You will learn more about the printer functions used in this program later.)

Keystrokes

XEQ
ALPHA PRP ALPHA
ALPHA CHARS ALPHA

MAN ▮▮▮▯

```
01♦LBL "CHARS"
02 1.127
03 STO 00
04 FIX 0
05♦LBL 00
06 RCL 00
07 ACX
08 ACCHR
09 ADV
10 ISG 00
11 GTO 00
12 FIX 4
13 END
```

TRACE ▮▮▮▯

```
              PRP "CHARS"

01♦LBL "CHARS"
1.127  STO 00  FIX 0

05♦LBL 00
RCL 00  ACX  ACCHR  ADV
ISG 00  GTO 00  FIX 4
END
```

▮▮▮▯ NORM

```
PRP "CHARS"

01♦LBL "CHARS"
02 1.127
03 STO 00
04 FIX 0

05♦LBL 00
06 RCL 00
07 ACX
08 ACCHR
09 ADV
10 ISG 00
11 GTO 00
12 FIX 4
13 END
```

Using LIST. Using LIST, you can specify a number of lines of a program to print. Here is the LIST procedure:

1. Position the calculator to the desired program and then to the line where you wish printing to begin.
2. Execute LIST.
3. The calculator prompts you for a three-digit number of lines. After you key in the number, printing begins. You can terminate the printing operation at any time by pressing R/S.

Here is an example showing how to print only lines 5 through 10 of the CHARS program (printed in the example under `PRP`). The listing is shown printed in NORM print mode, (right justified).

Keystrokes

Printer: ▓▓▓▓ NORM

`■` `GTO`
`ALPHA` CHARS
`ALPHA`
`■` `GTO` `·` 005
`XEQ`
`ALPHA` LIST
`ALPHA` 006

```
       GTO "CHARS"
          GTO .005
          LIST 006

        05+LBL 00
        06 RCL 00
        07 ACX
        08 ACCHR
        09 ADV
        10 ISG 00
```

Printing Status and Key Assignments `PRFLAGS` `PRKEYS`

Since the HP-41C system has many flags and a reassignable keyboard, you may wish to review this information. Using `PRFLAGS` and `PRKEYS`, you can print this information at any time.

Using `PRFLAGS` *(print flags).* When executed from the keyboard or in a program, `PRFLAGS` begins printing the following information:

> Number of data storage registers (*SIZE* = nnn).
> Location of first statistics registers (Σ = nnn).
> Trigonometric mode (*DEG*, *RAD*, or *GRAD*).
> Display format (*FIX*, *SCI*, or *ENG* and number of digits).
> Status of all flags (*F nn SET* or *CLEAR*).

You can terminate the printing operation at any time by pressing `R/S`.

Here is an example of the output from `PRFLAGS`:

Keystrokes

Printer: ▓▓▓▓ NORM

`XEQ`
`ALPHA` PRFLAGS `ALPHA`

```
                    PRFLAGS

        STATUS:
        SIZE= 017
        Σ= 11
        DEG
        FIX 4

        FLAGS:
        F 00  CLEAR
        F 01  CLEAR
        F 02  CLEAR
        F 03  CLEAR
        ⌐ 0/   ⌐
              CLEAR
        F 49  CLEAR
        F 50  CLEAR
        F 51  CLEAR
        F 52  CLEAR
        F 53  CLEAR
        F 54  CLEAR
        F 55  SET
```

Using `PRKEYS` *(print key assignments).* When executed from the keyboard or in a program, `PRKEYS` prints the keycode of the reassigned key followed by the name of the program or function assigned to that key. Keycodes are a row-column identification of a key location. The keycodes for shifted key locations are prefixed with a − (minus sign). This example assumes that no key assignments have been made.

Keystrokes

Printer: ▓▓▓▓ NORM

`XEQ`
`ALPHA` PRKEYS
`ALPHA`

```
                    PRKEYS

        USER KEYS:NONE
```

You can terminate the printing operation at any time by pressing `R/S`.

Printing the Catalogs

The information in any of the function catalogs can be printed by simply setting the print mode switch to TRACE, pressing ▆ CATALOG and the number of the catalog you wish to print (1, 2, or 3). As the display and printing of CATALOG 1 progresses, the calculator is automatically positioned to the program in program memory that is currently displayed. In addition, when you print CATALOG 1, the number of "bytes" (refer to appendix D in the *HP-41C Owner's Handbook and Programming Guide* for an explanation of "bytes") that each program occupies in program memory is printed next to the END of each program printed. Refer to the example below.

The CATALOG function is not programmable (cannot be recorded as a line in program memory).

Print the contents of CATALOG 1:

Keystrokes

▆ CATALOG 1

Printer:
TRACE

```
                           CAT 1
LBL'CHARS
END           33 BYTES
.END.         09 BYTES
```

Programming and the Printer

Using the Printer During Program Entry

While you are keying in a program in PRGM mode, you can use the printer to print a record of each line you key in. With the print mode switch set to TRACE or NORM, each completed line you key in is printed.

If there is not enough room left in program memory for the line you just keyed in, it is printed and then *PACKING* and *TRY AGAIN* are printed below the line just printed. This gives you a record of the line you just keyed in, even though it did not fit into program memory.

Printer Operation During a Running Program

If you set the print mode switch to TRACE during the execution of a program that you have stored in program memory, the printer will print the operation on that line along with any intermediate and final results calculated. While you are executing a program with the printer in this

mode, you will notice that program execution slows significantly to allow the printer to keep up with the execution. TRACE mode execution is a good way to debug your programs.

Programs will obviously execute faster while the print mode switch is set to NORM or MAN. And in these print modes, the printing functions in the executing program control what is printed, and when.* Later you will learn how flag 21 can be used to control printing by print functions in a running program.

Executing Programs Containing Print Functions With No Printer Present

Remember from the beginning of this section that the printer functions only become available while the printer is plugged in and turned on. So if you have programs stored in program memory that contain specific printing functions, and the printer is not attached, those print functions are *NONEXISTENT* and that program will not execute properly (when a print function is encountered, the display will show *NONEXISTENT*). However, when you plug the printer back in, turn it on and execute that program, it will execute properly. Here is how the HP-41C keeps track of these printer functions:

1. While the printer is in place, the function name appears normally in the program like this: *04 PRX*, or *55 PRREG*

2. When the printer is removed, these functions are displayed as a function called XROM. An XROM function tells the HP-41C that the function belongs to some plug-in accessory. Next to the XROM function name are two numbers. These numbers indicate which accessory the function belongs to as well as an indicator of the function. So, the program line *04 PRX* (with the printer plugged in) would change to *04 XROM 29,20* when the printer was removed. The *XROM* tells the system that the function belongs to a plug-in accessory, and the *29,20* tells the system that that accessory is number *29* (the printer) and the function number is *20* (PRX).

---

* The HP-41C interacts with the printer during program execution, even if the program does not contain printing operations. When the printer is turned on, program execution will be slightly slower than if the printer is turned off or removed.

Programs containing these functions have the following XROM numbers when the printer is removed.

Function	XROM Number
ACA	XROM 29, 01
ACCHR	XROM 29,02
ACCOL	XROM 29,03
ACSPEC	XROM 29,04
ACX	XROM 29,05
BLDSPEC	XROM 29,06
LIST	Not programmable
PRA	XROM 29,08
PRAXIS	XROM 29,09
PRBUF	XROM 29,10
PRFLAGS	XROM 29,11
PRKEYS	XROM 29,12
PRP	Not programmable
PRPLOT	XROM 29,14
PRPLOTP	XROM 29,15
PRREG	XROM 29,16
PRREGX	XROM 29,17
PRΣ	XROM 29,18
PRSTK	XROM 29,19
PRX	XROM 29,20
REGPLOT	XROM 29,21
SKPCHR	XROM 29,22
SKPCOL	XROM 29,23
STKPLOT	XROM 29,24

Flags and The Printer

There are five HP-41C flags that are used in controlling the printer. Four of these (flags 12, 13, 21, 25) are user flags; that is, you can set, test and clear them. The fifth (flag 55) is a system flag and it can only be tested.

Printer Existence Flag (Flag 55). This flag is used to indicate if the printer is attached to the HP-41C (power on or off). Each time the HP-41C is turned on, the calculator checks to see if the printer is plugged in. If it is, the calculator automatically sets flag 55. If the printer is not plugged in, the flag is cleared. Since flag 55 is a system flag, you can only test it.

Printer Enable Flag (Flag 21). This user flag is used to control printing in *programs* that contain specific print functions. While flag 21 is set,

printing functions in a running program will print normally. While flag 21 is clear, printing is suppressed. Each time the HP-41C is turned on flag 21 is set to match the status of flag 55. If the printer is plugged in when you turn the calculator on, flags 55 and 21 are both automatically set. If it is not plugged in, when you turn the HP-41C on, flags 55 and 21 are cleared. Flag 21 has no effect on print functions executed from the keyboard.

Here is a table that shows how flags 55 and 21 work together to control printing in executing programs.

Flag 55 Printer Existence Flag

		SET	CLEAR
Flag 21 Printer Enable Flag	SET	This is the initial condition when the printer is connected. 1. If printer is ON, print functions print normally. 2. If printer is OFF, print functions result in PRINTER OFF display. VIEW and AVIEW perform their normal functions and halt execution. ADV is ignored.	Printer is not connected but flag 21 has been set. 1. No printing occurs. 2. VIEW and AVIEW perform their normal functions and halt execution. ADV is ignored. 3. Execution of any printer function results in NONEXISTENT display.
	CLEAR	Printer is connected but flag 21 has been cleared. 1. Running programs will not print output generated by print functions, even if printer is connected and turned ON. VIEW and AVIEW operate normally in programs but do not print. 2. If printer is ON, print functions executed from the keyboard print normally. 3. If printer is OFF, print functions executed from the keyboard result in PRINTER OFF display.	This is the initial condition when the printer is not connected. 1. VIEW and AVIEW perform their normal functions and will "not" halt execution. ADV is ignored. 2. Print functions are displayed as XROM nn,nn in programs and result in NONEXISTENT display when executed by running program. 3. Print functions executed from keyboard result in NONEXISTENT display.

Double Wide Flag (Flag 12). Flag 12 is a special purpose user flag that is used to control how characters are printed on the printer paper. While flag 12 is set, all characters are printed double width.

Keystrokes		Printer: MAN
ALPHA DOUBLE WIDE	Type in these letters in ALPHA mode.	DOUBLE WIDE **DOUBLE WIDE**
PRINT	Press the PRINT key on the printer.	
ALPHA ■ SF 12	Set flag 12—the double wide flag.	
ALPHA PRINT	Press PRINT .	
ALPHA ■ CF 12	Return to normal print width.	

The maximum number of characters in one line of single-wide print is 24, and the maximum number of characters in one line of double-wide print is 12. If you print more than 12 double-wide characters, the additional characters will be printed on the next line.

Remember that all special purpose user flags (flags 11 through 20) are cleared each time the HP-41C is turned on.

Lower Case Flag (Flag 13). Flag 13 is another special purpose user flag that is used to control the way characters are printed. While flag 13 is set, all letters printed appear in a lower case format. All other characters other than alphabetic letters are not affected by flag 13.

Try this example to see how the printer and this flag work.

Keystrokes		Printer: MAN
ALPHA LOWER CASE PRINT	Key in the letters in ALPHA mode.	LOWER CASE lower case
ALPHA ■ SF 13	Set the lower case flag.	
ALPHA PRINT	Press PRINT	
ALPHA ■ CF 13	Return to normal printing.	
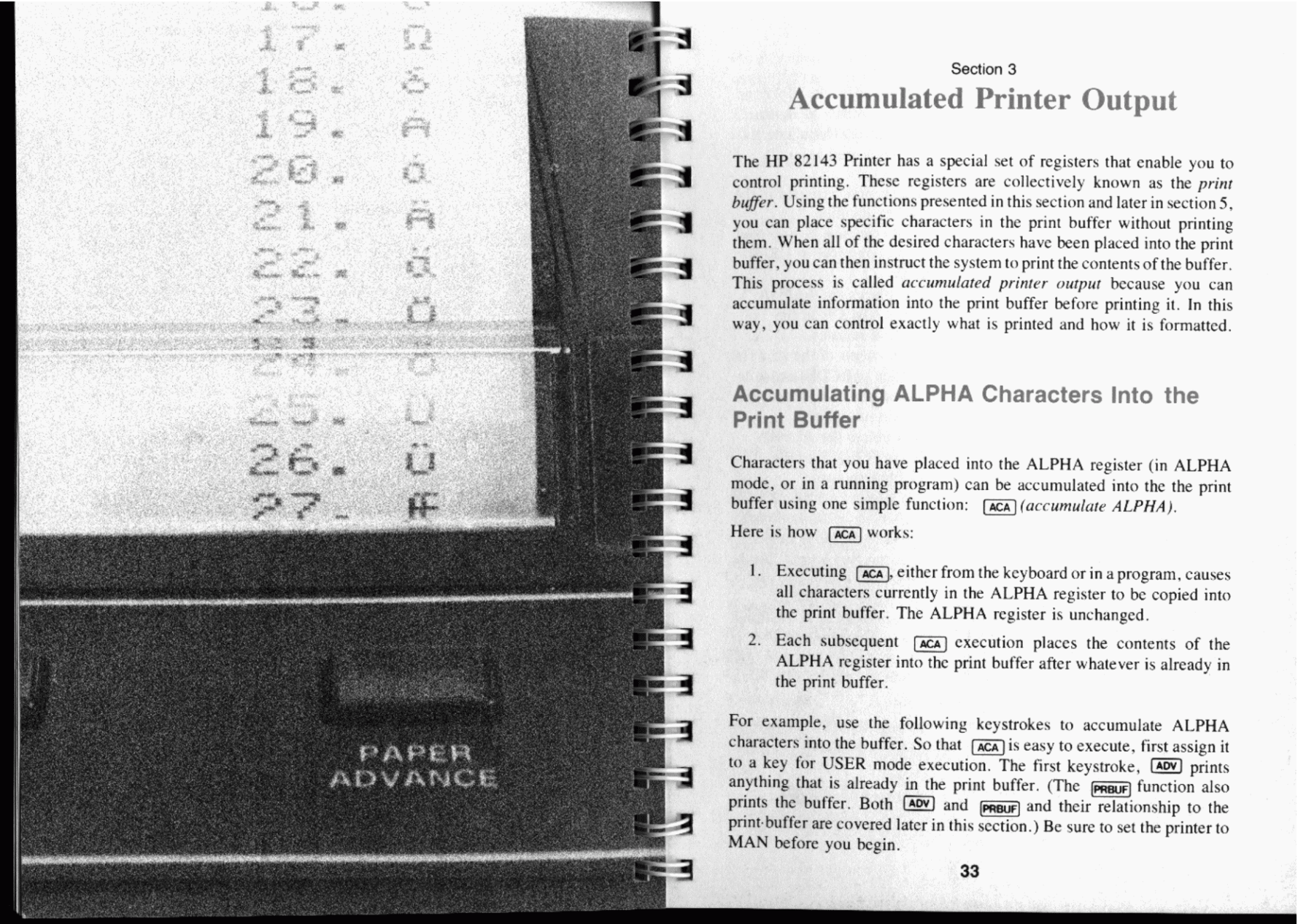
Notice that the display shows the letters in upper case. The lower case flag only changes the way letters are printed, not displayed.

The printer will continue to print all letters in lower case as long as flag 13 is set. The flag is cleared each time the HP-41C is turned on, resulting in upper case printing until the flag is again set.

Error Ignore Flag (Flag 25). This flag can be used in programs to control how the calculator reacts to errors. While set, the HP-41C will ignore the first error it encounters. The error automatically clears the flag. A list of all errors and messages is given in appendix B.

For more information about flag 25 and errors, refer to section 14 in the *HP-41C Owner's Handbook and Programming Guide*.

Accumulated Printer Output

The HP 82143 Printer has a special set of registers that enable you to control printing. These registers are collectively known as the *print buffer*. Using the functions presented in this section and later in section 5, you can place specific characters in the print buffer without printing them. When all of the desired characters have been placed into the print buffer, you can then instruct the system to print the contents of the buffer. This process is called *accumulated printer output* because you can accumulate information into the print buffer before printing it. In this way, you can control exactly what is printed and how it is formatted.

Accumulating ALPHA Characters Into the Print Buffer

Characters that you have placed into the ALPHA register (in ALPHA mode, or in a running program) can be accumulated into the the print buffer using one simple function: [ACA] *(accumulate ALPHA)*.

Here is how [ACA] works:

1. Executing [ACA], either from the keyboard or in a program, causes all characters currently in the ALPHA register to be copied into the print buffer. The ALPHA register is unchanged.

2. Each subsequent [ACA] execution places the contents of the ALPHA register into the print buffer after whatever is already in the print buffer.

For example, use the following keystrokes to accumulate ALPHA characters into the buffer. So that [ACA] is easy to execute, first assign it to a key for USER mode execution. The first keystroke, [ADV] prints anything that is already in the print buffer. (The [PRBUF] function also prints the buffer. Both [ADV] and [PRBUF] and their relationship to the print·buffer are covered later in this section.) Be sure to set the printer to MAN before you begin.

Keystrokes	Display	
[ADV]	0.0000	This advances the paper and prints whatever is in the print buffer. (X-register is shown cleared.)
■ [ASN] [ALPHA] ACA [ALPHA] [LN]	ASN ACA_ 0.0000	[ACA] is now assigned to the [LN] key location ...
[USER]	0.0000	... and can now be executed by pressing [LN] in USER mode.
[ALPHA] ABCDE [ALPHA]	0.0000	This places the ALPHA letters ABCDE in the ALPHA register.
[ACA] ([LN])	0.0000	The contents of the ALPHA register (ABCDE) are now copied into the print buffer but are not printed.
[ALPHA] FGHIJ [ALPHA]	0.0000	This places the ALPHA letters FGHIJ into the ALPHA register.
[ACA] ([LN])	0.0000	The contents of the ALPHA register (FGHIJ) are now added to the print buffer after the first letters. So the print buffer now has the letters ABCDEFGHIJ accumulated in it. Nothing has been printed yet.

Print the contents of the print buffer by pressing the [ADV] key on the printer. You will learn more about printing the buffer later.

Keystrokes

[ADV]

Printer: MAN▐▊▊▊

ABCDEFGHIJ

Here is what happened when you accumulated the ALPHA characters with [ACA] and then pressed [ADV].

Contents of the ALPHA Register	The Print Buffer	Printer: MAN▐▊▊▊

ABCDE ──── [ACA] ────▶ A
                      B
                      C
                      D
                      E

FGHIJ ──── [ACA] ────▶ A
                      B
                      C
                      D
                      E
                      F } [ADV]   ABCDEFGHIJ
                      G
                      H
                      I
                      J

Accumulating Numbers in the X-Register into the Print Buffer

The [ACX] *(accumulate X-register)* function does the same operation that [ACA] performs except that [ACX] accumulates the information in the X-register into the print buffer. When you execute [ACX], a copy of the characters in the X-register is accumulated into the print buffer.

To see how [ACX] works, do the following example. Assign [ACX] to the [LOG] key location for USER mode execution. (The HP-41C is still in USER mode from the last example.)

Keystrokes	Display	
■ [ASN] [ALPHA] ACX [ALPHA] [LOG]	ASN ACX_ 0.0000	[ACX] is now ready for USER mode execution. All you do is press [LOG] in USER mode to execute [ACX].

Keystrokes	Display	Description
123 CHS	−123	Places the number −123 in X.
ACX (LOG)	−123.0000	This accumulates the contents of the X-register into the print buffer. The print buffer now contains: −123.0000.

Now print the buffer by pressing ADV .

Keystrokes	Display	Printer: MAN
ADV	−123.0000	-123.0000

Notice that the character position for the sign of the number ("blank" for positive numbers and "−" for negative numbers) and the decimal point are also accumulated.

Here is what happened to the print buffer:

Contents of X-Register		The Print Buffer	Printer: MAN
−123.0000	ACX	− 1 2 3 . 0 0 0 0	ADV → -123.0000

Character-by-Character Accumulations

There are a total of 127 standard characters that can be printed on the HP 82143 Printer. Fifty-nine of these characters are on the ALPHA mode keyboard and can be accumulated into the print buffer using ACA . Using ACCHR *(accumulate character)* you can accumulate any of the 127 characters, one at a time, into the print buffer.

Each of the 127 characters is assigned a number from 1 through 127. To accumulate a character, you specify the number that corresponds to the desired character and execute ACCHR . Here is a listing of each character and its corresponding number. (The program in the example on page 23 produces this list of characters and numbers.)

1. x	34. "	67. C	100. d
2. x̄	35. #	68. D	101. e
3. ←	36. $	69. E	102. f
4. α	37. %	70. F	103. g
5. β	38. &	71. G	104. h
6. Γ	39. '	72. H	105. i
7. ↓	40. (	73. I	106. j
8. Δ	41.)	74. J	107. k
9. σ	42. *	75. K	108. l
10. ◆	43. +	76. L	109. m
11. λ	44. ,	77. M	110. n
12. μ	45. -	78. N	111. o
13. ∠	46. .	79. O	112. p
14. τ	47. /	80. P	113. q
15. Φ	48. 0	81. Q	114. r
16. Θ	49. 1	82. R	115. s
17. Ω	50. 2	83. S	116. t
18. δ	51. 3	84. T	117. u
19. Å	52. 4	85. U	118. v
20. å	53. 5	86. V	119. w
21. Ä	54. 6	87. W	120. x
22. ä	55. 7	88. X	121. y
23. Ö	56. 8	89. Y	122. z
24. ö	57. 9	90. Z	123. ▪
25. Ü	58. :	91. [	124. ⏐
26. ü	59. ;	92. \	125. →
27. Æ	60. <	93.]	126. Σ
28. æ	61. =	94. ↑	127. ⊦
29. ≠	62. >	95. _	
30. £	63. ?	96. ̄	
31. ▪	64. @	97. a	
32. .	65. A	98. b	
33. !	66. B	99. c	

For example, accumulate Φ into the print buffer and print it. Specify the number 15 (for Φ) and execute `ACCHR` . (For use in a program, place the number of the desired character into the X-register and follow that with `ACCHR` as a line in the program.)

Keystrokes   **Printer:** MAN ▮▮▮▮
15
`XEQ` `ALPHA`
ACCHR `ALPHA`
`ADV`

`ACCHR` uses the absolute value of the integer portion of the number in the X-register, and does not alter the sign or the number.

Printing the Contents of the Print Buffer

Once you have the desired characters accumulated into the print buffer you can then instruct the printer to print the contents of the buffer. The buffer is printed left to right—the first character you place in the buffer is printed on the left and the last character you place in the buffer is printed on the right. There are two ways to print the contents of the buffer and further control the format of how the print buffer is printed.

The two functions that cause the print buffer to be printed are `PRBUF` *(print buffer)* and `ADV` *(advance)*. `PRBUF` prints the contents of the print buffer *left justified*, that is, the information will be printed beginning at the left margin of the print tape. `ADV` on the other hand, prints the contents of the print buffer *right justified*, where the information is lined up to the right margin.

Once any information in the print buffer is printed, that information is no longer in the print buffer.

The other functions that will cause the contents of the print buffer to be printed are, in general, any functions that normally cause printing (e.g., `PRX`, `PRA`, `VIEW`, `AVIEW` , etc.). However, you should remember that these functions may also change the contents of the buffer in the course of their normal function execution. `AVIEW` , for example, normally causes the contents of the ALPHA register to be printed and displayed. If the print buffer contains accumulated characters and you execute `AVIEW` , the print buffer will be printed on one line and then the contents of the ALPHA register will be printed on the next line.

When the buffer is completely filled,* the printer *automatically* prints one line of the buffer to provide additional buffer space.

You can clear the contents of the print buffer *without printing* by turning the power to the printer off then back on. All information in the print buffer will be lost.

To see how the `PRBUF` works with the accumulating functions, try this example. Begin by assigning `PRBUF` to the `TAN` key location for execution in USER mode. Check the USER display annunciator to ensure that the HP-41C is in USER mode.

Keystrokes   **Display**

▮ `ASN`
`ALPHA` PRBUF   *ASN PRBUF_*
`ALPHA`
`TAN`   *15.0000*   `PRBUF` is now assigned to the `TAN` key location for USER mode execution. The displayed number remains from the previous example.

---

* The print buffer is 44 registers long. Depending upon the characters printed and operations performed during the buffer filling process, the buffer will hold fewer actual printing characters.

Now accumulate characters using [ACA], [ACX], and [ACCHR] to print this output: ＋ 25.4 MM/IN¹ . (This example assumes that [ACA] is assigned to the [LN] location, [ACX] is assigned to [LOG], and [PRBUF] is assigned to [TAN] for USER mode execution.)

Keystrokes   Printer: MAN �

[USER]

125

[XEQ] [ALPHA]

ACCHR [ALPHA]

■ [FIX] 1

25.4   ＋ 25.4 MM/IN!

[ACX] ([LOG])

[ALPHA] [SPACE] MM

■ IN [ALPHA]

[ACA] ([LN])

33

[XEQ] [ALPHA]

ACCHR [ALPHA]

[PRBUF] ([TAN])

The contents of the print buffer are printed left-justified and the buffer is now empty. To see how [ADV] prints the print buffer, repeat the above keystrokes and press [ADV] rather than [PRBUF] when you print the buffer.

Keystrokes   Printer: MAN ▮

125

[XEQ] [ALPHA]

ACCHR [ALPHA]

25.4   ＋ 25.4 MM/IN!

[ACX] ([LOG])

[ALPHA] [SPACE] MM

■ IN [ALPHA]

[ACA] ([LN])

33

[XEQ] [ALPHA]

ACCHR [ALPHA]

[ADV]

Accumulating Formatted and Unformatted Numbers

The [ACX] function causes the entire formatted number to be accumulated into the print buffer; this includes the number, formatted to the current display format specification, and the space for the minus sign in front of the number. If you wish to accumulate just the number and not the initial space, use [ARCL] to recall the contents of the X-register (press ■ [ARCL] [•] X in ALPHA mode) into the ALPHA register. [ARCL] copies only the number and its sign to the ALPHA register, not the initial space for positive numbers. For example:
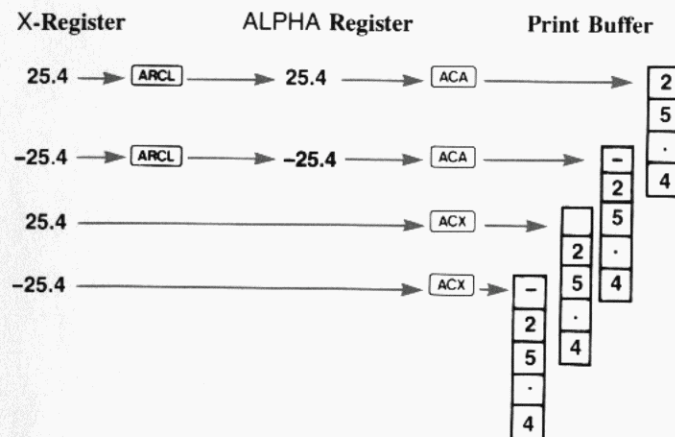
Skipping Characters in the Print Buffer

One additional function [SKPCHR] *(skip character)*, enables you to skip a number of character positions on the printed line. The number of characters to skip is specified by a number in the X-register. This function allows you to easily control the format of information you accumulate and then print.

To use [SKPCHR], place the number of spaces you wish to skip into the X-register and then execute [SKPCHR]. Here is a simple example showing how [SKPCHR] can be used to control formats. Assign [SKPCHR] to the [COS] key location for USER mode execution. This example assumes that [ACA] is still assigned to the [LN] location, that [ACX] is still assigned to the [LOG] location, and that [PRBUF] is still assigned to the [TAN] location. Make sure the HP-41C is in USER mode.

Keystrokes	Display	
■ [FIX] 4	33.0000	Return to [FIX] 4.
■ [ASN]		
[ALPHA] SKPCHR	ASN SKPCHR_	
[ALPHA]		
[COS]	33.0000	[SKPCHR] is now assigned to the [COS] location and is ready for execution in USER mode.

Now, accumulate the following into the print buffer:

Keystrokes	Display	
[ALPHA] TIME:	TIME:_	
[ALPHA]		
[ACA] ([LN])	33.0000	The ALPHA string TIME: is now in the print buffer.

Using [SKPCHR] (assigned to the [COS] location), accumulate 12 spaces into the print buffer.

Keystrokes	Display	
12	12.0000	The number of spaces to be skipped is placed in the X-register.
[SKPCHR] ([COS])	12.0000	The print buffer now contains the string TIME: followed by 12 spaces.

To complete the line, accumulate the string 4:35 AM into the print buffer.

Keystrokes	Display
[ALPHA]	
■ 4: ■ 3 ■ 5AM	4:35AM_
[ALPHA]	12.0000
[ACA] ([LN])	12.0000

Print the buffer using [PRBUF] (assigned to the [TAN] location).

Keystrokes   Printer: MAN �\|||||▮

[PRBUF] ([TAN])

TIME: 4:35AM

The buffer was printed and is now empty. Note that [SKPCHR] uses the absolute value of the integer portion of the number in X to define the skip value.

Accumulating Lower-Case and Double-Wide Settings

HP-41C flags 12 and 13 control how the actual characters are printed. (A complete description of these flags is given on pages 28 through 31.) Flag 12, which is the double wide flag, controls the width of the characters printed. When set, flag 12 instructs the printer to print all characters double their normal width. Flag 13 is the lower-case flag, and when it is set, all alphabetic characters are printed lower case. When flags 12 and 13 are clear, printing is normal width (24 characters per line) and upper-case (except in the case of the actual lower-case characters on the ALPHA keyboard, a through e).

By setting and clearing these two flags, you can accumulate different width characters and upper/lower-case letters into the print buffer for later printing. Here is a simple example: (This example assumes that [ACA] and [PRBUF] are still assigned to the [LN] and [TAN] key locations, respectively, and that the HP-41C is in USER mode.)

Keystrokes	Display

ALPHA
MY NAME IS   *MY NAME IS_*   This string is in the ALPHA
ALPHA   register, ready for accumu-
lation into the print buffer.
The number remains from a
previous example.

ACA (LN)   12.0000   The ALPHA register con-
tents are now in the print
buffer.

■ SF 12   12.0000   Sets the double-wide flag.
ALPHA SPACE R
ALPHA

ACA (LN)   12.0000   This next string is accumu-
lated in the buffer with the
double-wide flag set.

■ SF 13   12.0000   The lower-case flag is now
set.

ALPHA AY ALPHA   12.0000
ACA (LN)   12.0000   The lower-case string "ay"
is accumulated in the print
buffer.

Now, print the buffer with PRBUF:

Keystrokes	

PRBUF (TAN) The buffer is printed.   **Printer: MAN** ▉▒▉

                               MY NAME IS Ray

■ CF 12
■ CF 13   Return to normal print
USER   settings.

Programming With the Accumulation Functions

All of the accumulation functions covered in this section can be keyed in as instructions in programs that you write. Using these functions, you can construct special formats for your output and control all phases of the program print operations.

Programs that contain accumulation functions should *not* be executed with the print mode switch set to TRACE or NORM. The TRACE and NORM printing operations use the same special buffer registers that are used for accumulating printed output. The results of executing a program with the print mode switch set to TRACE or NORM is that information that the program accumulates in the print buffer will print prematurely with the TRACE or NORM printing information.
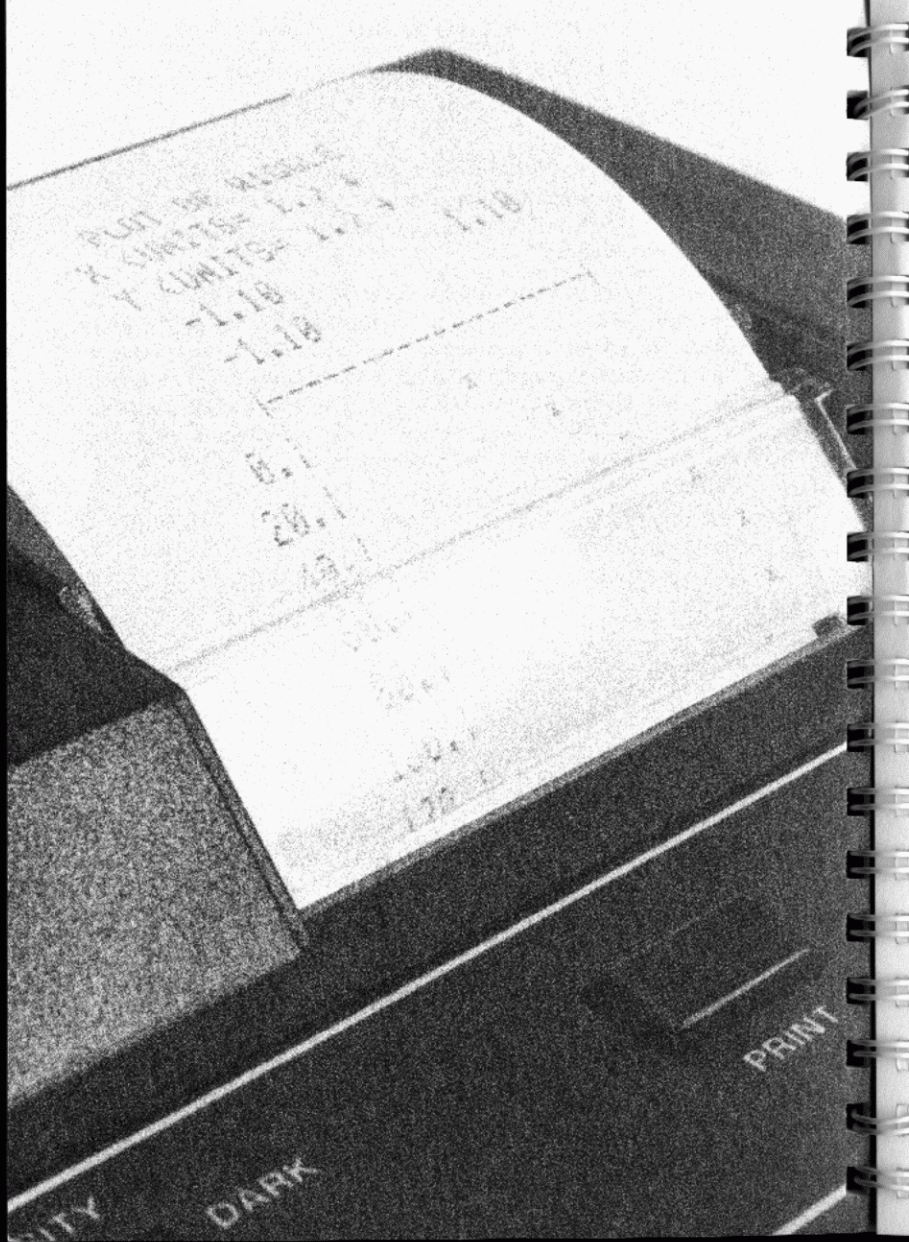
Plotting

The advanced capabilities of the HP-41C/HP 82143A system provide printing features never before offered by Hewlett-Packard in a portable calculator. While the printer is plugged into the HP-41C, five powerful plotting operations are available. Using these operations you can plot *any* valid single-value mathematical function. This section explains how each of the plotting operations are used and gives some examples of how each operation works.

Interactive Plotting of Functions

The interactive plotting operation, called [PRPLOT] *(print plot)*, requires a basic knowledge of how the HP-41C is programmed. If you are unsure as to how to key a program into the HP-41C, refer to part II of the *HP-41C Owner's Handbook and Programming Guide*.

[PRPLOT] prompts you for all of the information necessary to construct the axes of the plot and the values to be used to plot your function. Then, it uses a program that you have already stored in program memory to plot the actual values.

Before we get into the specifics of how [PRPLOT] works, try this simple example.

The function we will plot is:

$$y = SIN(x)$$

This example assumes that program memory is cleared and the allocation of data storage registers is [SIZE] 017. In addition, ensure that the HP-41C is set to degrees mode for this example and clear storage register R_{03} before you begin—you will learn how R_{03} is used in plotting later.

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Keystrokes	Display	
0 [STO] 03	0.0000	
[PRGM]		
■ [GTO] [·] [·]	00 REG 46	
■ [LBL]		
[ALPHA] WIGGLE	01 LBL WIGGLE	The name of the program.
[ALPHA]		
[SIN]	02 SIN	This computes the sine of the number in the X-register, or SIN(x). The result is placed back into the X-register.
■ [GTO] [·] [·]	00 REG 44	Ends the program.
[PRGM]	0.0000	

Now execute [PRPLOT]. Since the function you are plotting is $SIN(x)$, it would be useful to plot the values of x from 0 to 360, and the resultant values will be between −1.0000 and 1.0000. These values should be specified as YMIN = −1.1 and YMAX = 1.1 to provide room to adequately plot the values close to −1 and 1. For this example, the values of x should be in increments of 10. So x will be 0, 10, 20, ..., 360, and y will be SIN(0), SIN(10), SIN(20), ..., SIN(360). The x-axis should be set to zero.

Here are all of the values we have defined and the words that [PRPLOT] uses to prompt for those values.

Name of function:	NAME? **WIGGLE**
Minimum y value:	Y MIN? **−1.1**
Maximum y value:	Y MAX? **1.1**
X axis location:	AXIS? **0**
Minimum x value:	X MIN? **0**
Maximum x value:	X MAX? **360**
X increment value:	X INC? **10**

Note that [PRPLOT] uses registers R_{00} through R_{11} to construct the plot. Be sure that the function you are plotting does not use these registers. Any values stored in these registers prior to plotting will be lost. Refer to page 55 for additional information.

Keystrokes	Display
[XEQ]	
[ALPHA] PRPLOT	
[ALPHA]	NAME?
WIGGLE	WIGGLE
[R/S]	Y MIN?
1.1 [CHS]	−1.1
[R/S]	Y MAX?
1.1	1.1
[R/S]	AXIS?
0	0
[R/S]	X MIN?
0	0
[R/S]	X MAX?
360	360
[R/S]	X INC?
10	10
[R/S]	

Printer: MAN ▐▐▐▐▐█
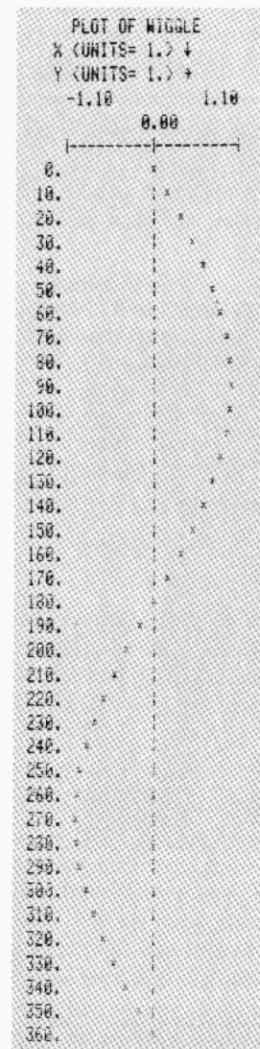
You can see how simple the PRPLOT operation is to use. You key a program into program memory, execute PRPLOT and supply the information requested by PRPLOT.

Now let's cover how PRPLOT works and how you can take advantage of its powerful plotting capabilities.

Programs for PRPLOT. The program or function that you wish to plot can be *any* program that takes a value in the X-register and returns a result to the X-register.* PRPLOT supplies the x-value to the program, runs the program, and then uses the result in the X-register to plot a point.

Printer	**X-Register**	**Program Memory**

```
PLOT OF WIGGLE
X (UNITS= 1.) ↓
Y (UNITS= 1.) ↓
   -1.10        1.10
        0.00
  |--------+--------|
  0.
 10.        | *
 20.        |  *
 30.        |    *
 40.
```

```
01 LBL WIGGLE
02 SIN
03 END
```

0.1736

20
0.3420

30
0.5000

```
320.     *    |
330.      *   |
340.       *  |
350.        * |
360.        *
```

360
0.0000

PRPLOT 0 0.0000

---

* When executed from a program, PRPLOT uses a minimum of three subroutine levels and up to two more than the number of subroutine levels in the function you are plotting.

In our example program WIGGLE, we specified the minimum x-value to be 0 and the maximum x-value to be 360. PRPLOT uses this specification to supply x-values to the program. The increment value (10 in the example) is used by PRPLOT to determine in what increments the x-values are to be supplied.

So, in the example, the x-values supplied by PRPLOT are 0 through 360 in increments of 10 (0, 10, 20, 30, 40, ... 350, 360). WIGGLE computes the sine of each of these values and places the answer back into X.

PRPLOT X-Values For Use By WIGGLE: (X-Coordinates)	Output From WIGGLE In X: (Y-Coordinates)
0	0.0000
10	0.1736
20	0.3420
30	0.5000
40	0.6428
⋮	⋮
360	0.0000

This input/output scheme allows you to plot even the most complicated of functions. All you do is key in the function as a program so that it uses the x-values (supplied by PRPLOT) in the X-register, and places each resultant back into the X-register. PRPLOT does the plotting and execution of the program automatically.
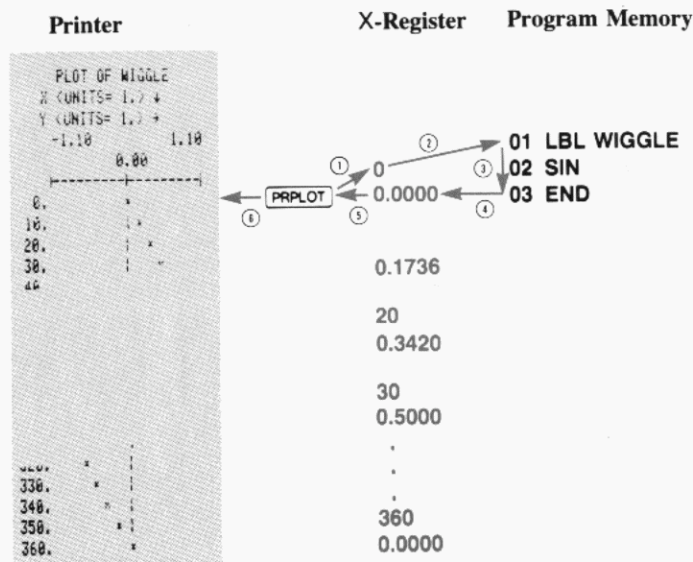
PRPLOT uses the Y, Z, and T stack registers for plotting. Any data placed in those registers will be destroyed by the execution of PRPLOT.

Specifying the X- and Y-Axes. When you run PRPLOT, it prompts you for all of the data it needs to construct a plot. Three of these values (X MIN, X MAX and X INC) determine what x-values are to be supplied to the function and how the x-axis is to be printed. The value specified for X MAX must be larger than X MIN. If incorrect values are entered, the calculator will continue to prompt for that value until a correct value is entered. The X INC will not plot x beyond X MAX.

Here are some examples of X MIN, X MAX and X INC values and their effects on the values supplied to our example function (SIN(x)):

PRPLOT Parameters	X-Values Supplied
X MIN 0 **X MAX** 360 **X INC** 10	0, 10, 20, 30, 40, 50, 60, ..., 360
X MIN 0 **X MAX** 360 **X INC** 1	0, 1, 2, 3, 4, 5, 6, 7, 8, ..., 360
X MIN 0 **X MAX** 360 **X INC** 19	0, 19, 38, 57, 76, 95, 114, ..., 342
X MIN 180 **X MAX** 360 **X INC** 30	180, 210, 240, 270, 300, 330, 360

An added feature of X INC is that by specifying a negative value, the value you specify tells the calculator that you want *that* number of x-increments. The calculator then determines the increment for you, automatically. For example, in the following example, if you specify X INC as −36, that means that you want the calculator to supply a starting value and 36 x-increments from 0 to 360.

X MIN 0 **X MAX** 360 **X INC** −36	0, 10, 20, 30, 40, 50, 60, ..., 360

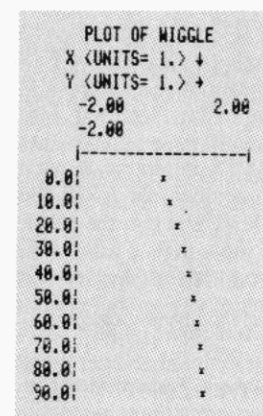If you specify X INC as −10, the calculator supplies a starting value and 10 increments from 0 to 360:

X MIN 0 **X MAX** 360 **X INC** −10	0, 36, 72, 108, 144, 180, 216, 252, 288, 324, 360

The y-axis is specified in the same way as the x-axis except that it does not affect the values supplied to the function you are plotting. Instead, it determines how the values will be plotted. In our first example, where the function $SIN(x)$ was plotted, the y-values were specified as − 1.1 for Y MIN and 1.1 for Y MAX. That is because all values of $SIN(x)$ fall between negative one and positive one, inclusive. By varying the y-axis values, you can further control how the plot is printed. If you specify the y-axis to be smaller than the range of the values to be plotted, the values that are larger than the range will be plotted at the corresponding maximum or minimums.

Here are some examples of how you can vary the y-values to change the plot. Notice that as the y-values are changed, the shape of the plot changes. In this way, you can specify the values to allow you to concentrate on a specific portion of a plot.

Y MIN −1.1 **Y MAX** 1.1 **AXIS** 0 **X MIN** 0 **X MAX** 90 **X INC** 10	**Y MIN** −2 **Y MAX** 2 **AXIS** −2 **X MIN** 0 **X MAX** 90 **X INC** 10

```
    PLOT OF WIGGLE
    X (UNITS= 1.) ↓
    Y (UNITS= 1.) →
     -1.10        1.10
          0.00
     +--------+--------+
 0.0 ¦        .
10.0 ¦        ¦ .
20.0 ¦        ¦  .
30.0 ¦        ¦   .
40.0 ¦        ¦    .
50.0 ¦        ¦     .
60.0 ¦        ¦      .
70.0 ¦        ¦       .
80.0 ¦        ¦        .
90.0 ¦        ¦        .
```

```
    PLOT OF WIGGLE
    X (UNITS= 1.) ↓
    Y (UNITS= 1.) →
     -2.00        2.00
          -2.00
     +------------------+
 0.0 ¦         .
10.0 ¦         .  .
20.0 ¦          .
30.0 ¦          .
40.0 ¦          .
50.0 ¦           .
60.0 ¦           .
70.0 ¦            .
80.0 ¦            .
90.0 ¦             .
```
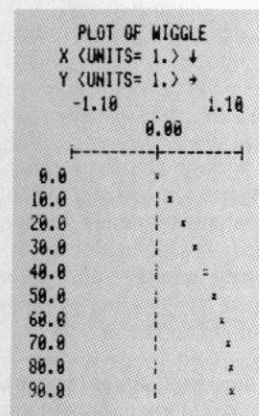
Y MIN	0
Y MAX	1.1
AXIS	.5
X MIN	0
X MAX	90
X INC	10

```
    PLOT OF WIGGLE
   X (UNITS= 1.) ↓
   Y (UNITS= 1.) →
      0.00         1.10
           0.50
   |--------|---------|
  0.0 ×       |
 10.0     ×   |
 20.0       × |
 30.0        ×
 40.0        | ×
 50.0        |   ×
 60.0        |     ×
 70.0        |       ×
 80.0        |        ×
 90.0        |        ×
```

Y MIN	.5
Y MAX	1.1
AXIS	1.1
X MIN	30
X MAX	90
X INC	10

```
    PLOT OF WIGGLE
   X (UNITS= 1.) ↓
   Y (UNITS= 1.) →
      0.50         1.10
                   1.10
   |-----------------|
 30.0 ×              |
 40.0      ×         |
 50.0           ×    |
 60.0              × |
 70.0                | ×
 80.0                |   ×
 90.0                | ×  |
```

The **AXIS?** prompt is asking where you wish to plot the x-axis. The value specified for AXIS should be between (inclusive) YMIN and YMAX. If it is not, the calculator will continue to prompt you for the AXIS value until a valid value is specified. Keying in NONE (or any other ALPHA characters) will suppress the printing of the X-axis.
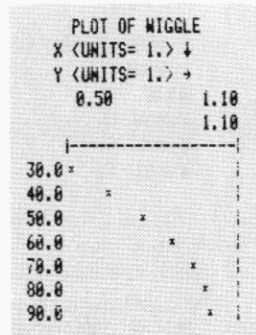
Look at the above examples to see how you can vary the position of the axis.

Plot Labels. Each printed plot is labeled with five lines of information. The first line is the name of the program you are plotting. The second and third lines are the x- and y-axis units. The last two lines are the actual y-axis labels.

Since the width of the printer tape is limited, many-digit labels on the axes are not possible to print. Instead, [PRPLOT] determines a unit value that will allow the labels to be printed in a shorter form. The format is:

```
   X (UNITS= 1.) ↓
   Y (UNITS= 1.) →
```

The arrow pointing down in the X-row is a reminder that the unit value applies to the labels on the x-axis down the left side of the plot. The arrow pointing to the right in the Y-row reminds you that the Y unit value applies to the numbers in the y-axis across the top of the plot.

For example, the unit values below indicate that the x-label units are 10^4, and the y-label units are 10^3.

```
    PLOT OF WIGGLE
   X (UNITS= E 4.) ↓
   Y (UNITS= E 3.) →
```

The next line in the plot label is the minimum and maximum Y-axis values. Directly under these numbers is the label for the vertical X-axis, which is positioned and labeled according to the value that you specified for the axis.

Registers Used By [PRPLOT]. [PRPLOT] uses registers R_{00} through R_{11} to hold the plotting information. Before [PRPLOT] will execute properly, the register allocation must be set to at least [SIZE] 012. In addition, [PRPLOT] uses the contents of R_{03} to specify the character to be used to plot the actual x, y values. Refer to Plotting With Special Characters on page 59 for more information. (Before you begin using [PRPLOT], it is a good idea to clear R_{03} so that the plot character is not some other unwanted character.)

The [PRPLOT] **Program.** [PRPLOT] is a program written using normal HP-41C functions. If you wish to look at the program, you can download it into program memory using [COPY]. The [PRPLOT] program requires a minimum of one additional plug-in memory module before it can be copied into program memory. Once the [PRPLOT] program is in program memory, you can add new lines, and delete existing lines. The changes that you make cannot, however, be recorded back into the printer. You must use the altered program as it is in memory, or record it on a card (using the HP 82104A Card Reader) for permanent storage. You can print the complete program on the printer. Appendix C contains an annotated listing of [PRPLOT].

If [PRPLOT] is allowed to execute to completion, the display format will be set to [FIX] 4, regardless of the display format that was in effect when [PRPLOT] began execution. In addition, flag 12 will be cleared.

Programmable Plotting

The [PRPLOT] operation is programmable and works in a program just as it does when executed from the keyboard. In addition, there is another programmable version of [PRPLOT] that is not interactive (does not prompt for the plotting parameters). It is called [PRPLOTP] *(print plot, programmable)*.

To execute [PRPLOTP] from the keyboard or in a program you must first store all of the plotting parameters into these registers:

R_{00}	YMIN
R_{01}	YMAX
R_{03}	Plotting Character
R_{04}	AXIS
R_{08}	XMIN
R_{09}	XMAX
R_{10}	XINC
R_{11}	NAME

When [PRPLOTP] is executed, it uses these values to construct a plot. Like [PRPLOT], [PRPLOTP] also uses the contents of R_{03} to specify the character to be used to plot the values. Refer to Plotting With Special Characters on page 59 for more information. The display format is set to [FIX] 4 when the plot is completed.

[PRPLOTP] is written using normal HP-41C functions and can be copied into program memory using [COPY] . It requires a minimum of one plug-in module before it can be copied into program memory. ([PRPLOTP] is the same program as [PRPLOT] except without the prompting operations.)

The *DATA ERROR* message will result if YMAX ≤ YMIN, XMAX ≤ XMIN, or AXIS is not between (inclusive) YMIN and YMAX. The *NONEXISTENT* display will result if the function to be plotted does not exist.

Plotting a Y-Axis

[PRAXIS] is the part of the [PRPLOT] program that determines what the Y-axis is to look like. It uses the values in the following registers to construct and label an axis, as well as determine the y unit value. [PRAXIS] is programmable, or it can be executed from the keyboard.

R_{00}	YMIN
R_{01}	YMAX
R_{02}	nnn*
R_{04}	AXIS

This operation can be used for your special applications where you wish to construct your own plotting routines. [PRAXIS] does the axis labeling and scaling computations for you. When you copy [PRPLOT] or [PRPLOTP] into program memory using [COPY], the [PRAXIS] subroutine is included with that program. A complete annotated listing of [PRPLOT], including [PRAXIS] is given in appendix C.

Sample Axis: (YMIN=−2, YMAX=5, nnn=140, AXIS=−0.75)

```
Y (UNITS= 1.) +
 -2.00           5.00
 -0.75
 |---|--------------|
```

The [PRAXIS] program uses two subroutine levels in its execution. If you wish to execute [PRAXIS] in a program or subroutine, be sure that the program has at least two subroutine levels available. When the top axis has been printed, you again have the full six subroutine levels available. [PRAXIS] clears flag 12 and leaves the display format set to [FIX] 4 when the plot is completed.

The *DATA ERROR* display will result if the absolute value of nnn (R_{02}) is greater than 168.

---

* The nnn parameter defines the width of the plotting field in columns. Each printed character is seven columns wide and there is a maximum of 24 characters on a line so the maximum width is 7 × 24 or 168 columns wide. In the execution of [PRAXIS], the nnn input is changed to a form that is suitable for use by [REGPLOT] and [STKPLOT]. This form, nnn.aaa is explained later in Single-Line Plotting. [PRAXIS] uses only the nnn portion of the number.

Single-Line Plotting

The [REGPLOT] operation *(register plot)* prints a vertical and one plot value. [REGPLOT] is used by [PRPLOT] and [PRPLOTP] for plotting. The plotting parameters for [REGPLOT] are:

X-Register	value to plot
R_{00}	*YMIN*
R_{01}	*YMAX*
R_{02}	**nnn.aaa**

where **nnn** is the column width of the plot (refer to footnote on page 57), and **aaa** is the column number of the x-axis. If **aaa**=0 the axis is automatically positioned on the column closest to Y=0. If **nnn.aaa** is negative, only the x-value is plotted, not the axis. You can execute the [PRAXIS] function covered on page 56 to automatically determine the **nnn.aaa** values.

[REGPLOT] uses R_{03} to specify the plotting character. Refer to Plotting With Special Characters on page 59 for more information. The [REGPLOT] program does not use any subroutine levels and does not change the display format or any of the values you store in the registers.

Here is a sample of [REGPLOT] input and output:

X-register	3
R_{00}	-2
R_{01}	5
R_{02}	*140.000*

An additional plot operation [STKPLOT] *(stack plot)* also enables you to do single-line plots just as you would with [REGPLOT] except that [STKPLOT] requires that the value and parameters be placed into the stack registers. The use of stack registers for plotting removes the possible conflicts that may arrise between your program's use of R_{00} and R_{01}. The [STKPLOT] operation always plots the x, y value with a small x.

T-register	value to plot
Z-register	*YMIN*
Y-register	*YMAX*
X-register	**nnn.aaa**

Here is an example of [STKPLOT] input and output:

T-register	5
Z-register	-10
Y-register	10
X-register	140.000

The [REGPLOT] and [STKPLOT] operations enable you to easily set up your own labeled plots. You first accumulate the X-label for a line of the plot with [ACX] and then execute [REGPLOT] or [STKPLOT]. The X-label will automatically be positioned in the correct column. This procedure can be repeated in a program for each line you wish to plot. Because the labels are positioned automatically, they can vary in length, providing they fall into the number of columns not used for plotting.

In both [REGPLOT] and [STKPLOT] the *DATA ERROR* message will result if YMIN $\geq$ YMAX, **nnn**=000, $|\text{nnn}| > 168$.
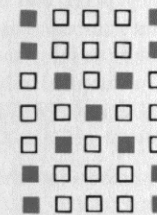
Plotting With Special Characters

The [PRPLOT], [PRPLOTP] and [REGPLOT] operations all use R_{03} to specify the character to be used for plotting. By using a special function ([BLDSPEC], covered in section 5) you can specify the plotting character that you wish to use in your plots. Each of these operations uses the data in R_{03} to determine which character to plot with. If the contents of R_{03} is numeric, the plot character used is the small x. But if the contents of R_{03} is output generated by [BLDSPEC], that information is used to determine the plot character. To ensure that the plot will be made using the small x, and not some unwanted character, clear R_{03} (press 0 [STO] 03).
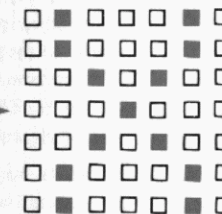
Graphics

The HP 82143A Printer has operations that allow you to control precisely what is printed, even the exact shape of what is printed. You can build your own character fonts, special characters, even print non-character graphics. Using the graphics operations discussed in this section, you can specify the plotting character used in [PRPLOT], [PRPLOTP], and [REGPLOT].

All standard characters printed by the HP 82143A Printer are composed of dots in a five-by-seven matrix. If you look very closely at a printed character, you will be able to see how the dots make up the characters. In order to provide spaces between characters, each character sits in a seven-by-seven matrix. To print a specific character, the printer prints the dots that make up that character.

The 5×7 character Matrix   **The Full 7×7 Matrix**   **Printed Character**

Using the graphics operations, you can actually tell the printer which dots are to be printed in each column of the seven-by-seven dot matrix.

Specifying a Column of Dots

Here is a simple way to specify which dots you wish to have printed in a particular column. Using the following illustration as a guide, fill in the dots you wish to print in a column. Each row is assigned a numeric value and the values for the dots you are printing are added together. The result is the *column print number* which is used in some of the graphics operations. The column print number can be 0 through 127.

Dots to Print	Sum of Values	Column Print Number		Dots to Print	Sum of Values	Column Print Number
1 ■ ——→ 1				1 ■ ——→ 1		
V 2 ■ ——→ 2				V 2 ■ ——→ 2		
a 4 ☐		99		a 4 ■ ——→ 4		127
l 8 ☐				l 8 ■ ——→ 8		
u 16 ☐				u 16 ■ ——→ 16		
e 32 ■ ——→ 32				e 32 ■ ——→ 32		
64 ■ ——→ 64				64 ■ ——→ 64		
		99				127

Accumulating Columns

A series of column print numbers can be accumulated together into the print buffer using [ACCOL] *(accumulate column)*. This allows you to print special graphics up to 43 columns wide.

To use [ACCOL], place a column print number into the X-register and execute [ACCOL]. The column print number is converted by [ACCOL] and is placed into the print buffer. Each converted column print number occupies one register in the print buffer. (Refer to section 3 for more information about the print buffer.) The [ACCOL] operation should be executed only while the print mode switch is set to MAN. The TRACE and NORM settings cause the print buffer to be printed prematurely.

The following example accumulates nine column print numbers into the print buffer and then prints the buffer.

```
           1 2 3 4 5 6 7 8 9
        1  ☐ ■ ■ ■ ■ ■ ■ ■ ☐
        2  ☐ ■ ☐ ☐ ☐ ☐ ☐ ■ ☐
        4  ☐ ■ ☐ ■ ■ ■ ☐ ■ ☐
        8  ☐ ■ ☐ ■ ☐ ■ ☐ ■ ☐
       16  ☐ ■ ☐ ■ ■ ■ ☐ ■ ☐
       32  ☐ ■ ☐ ☐ ☐ ☐ ☐ ■ ☐
       64  ☐ ■ ■ ■ ■ ■ ■ ■ ☐
```
Column Print Numbers = 0 127 65 93 85 93 65 127 0

You may wish to assign [PRBUF] and [ACCOL] to the keyboard for USER mode execution. The example below assumes that these operations have been assigned to the keyboard for USER mode execution.

Keystrokes   **Printer: MAN ▐▌▌**

[CLX]	Clears the X-register.
[PRBUF]	Clears the print buffer.
0 [ACCOL]	The first column is accumulated.
127 [ACCOL]	The second column is accumulated.
65 [ACCOL]	
93 [ACCOL]	
85 [ACCOL]	
93 [ACCOL]	
65 [ACCOL]	
127 [ACCOL]	
0 [ACCOL]	The last column is accumulated.
[PRBUF]	The print buffer is printed and cleared.

[ACCOL] uses the absolute value of the integer portion of the number in the X-register for the column print number specification.

You can accumulate columns until the print buffer is filled. When filled, the print buffer is automatically printed.

Skipping Columns

As you are accumulating columns into the print buffer, you may find that you need to skip columns to obtain the desired output. The [SKPCOL] *(skip column)* operation allows you to do just that. To use [SKPCOL], simply place the number of columns that you wish to skip into the X-register and then execute [SKPCOL]. The skip value is accumulated into the print buffer. As with [ACCOL], [SKPCOL] should be executed with the print mode switch set to MAN.

The largest number of columns that you can specify is 167 (skipping 168 columns would be the same as a paper advance). The **DATA ERROR** message will result if the absolute value of the integer portion of the skip value is larger than 167. The smallest valid skip value is 0.

If you are skipping a large number of columns, you may wish to use [SKPCHR] rather than [SKPCOL]. For example, if you wish to skip 63 columns, that is the same as 9 characters (one character is seven columns wide). In programs, this technique will save program memory space by allowing smaller skip numbers.

Notice that the width of the printer paper is wider than the maximum-width printing. You can print up to 24 characters wide, or 168 columns wide on the printer.

Here is a simple example showing how [SKPCOL] can be used with [ACCOL]. The example assumes that [SKPCOL], [ACCOL] and [PRBUF] are all assigned to the keyboard for USER mode execution. The characters accumulated are two vertical lines, one is placed on the right margin, one on the left.

Keystrokes   Printer: MAN [img]

[PRBUF]	Clears the print buffer.
127 [ACCOL]	The first vertical line.
166 [SKPCOL]	Skips 166 columns.
127 [ACCOL]	The second vertical line.
[PRBUF]	Prints the buffer.

Building Special Characters

Whereas the [ACCOL] operation is used to accumulate special graphics up to 43 columns wide, the [BLDSPEC] *(build special)* is used to build special characters in the normal seven-by-seven matrix. Using the X- and Y-registers, [BLDSPEC] takes up to seven column print numbers, one at a time, and converts them into a seven-column character specification. This character is then accumulated into the print buffer using [ACSPEC] *(accumulate special)*, or stored into a register for later accumulation.

By using [BLDSPEC] and [ACSPEC] you can create your own special characters, new characters, and special symbols. Here is a procedure for using [BLDSPEC] and [ACSPEC].

1. Determine the seven column print numbers that make up the character.

2. Press 0 [ENTER+] to clear the X- and Y-registers.

3. Place the first column print number in the X-register and execute [BLDSPEC]. Repeat this procedure for each of the seven column print numbers. The characters displayed by the HP-41C are meaningless.

4. Execute [ACSPEC]. You can store the character into any storage register for later use. Even though the character is not displayed, it is in the X-register when you have completed the [BLDSPEC] operations.

5. Print the print buffer using [PRBUF] or [ADV].

Here is an example showing how the procedure is used to build and store a special character.

Column Numbers

		1	2	3	4	5	6	7
V	1	□	□	■	■	■	□	□
a	2	□	□	□	■	□	□	□
l	4	□	■	■	■	■	■	□
u	8	□	■	□	■	□	■	□
e	16	□	■	■	■	■	■	□
	32	□	□	□	■	□	□	□
	64	□	□	■	■	■	□	□

Column Print Numbers =   0 28 85 127 85 28 0

From left to right, the column print numbers are now "built" into a special character using [BLDSPEC].

Keystrokes

0 [ENTER+]	Clears the X- and Y-registers.
0 [BLDSPEC]	The first column print number.
28 [BLDSPEC]	The second.
85 [BLDSPEC]	The third.
127 [BLDSPEC]	The fourth.
85 [BLDSPEC]	The fifth.
28 [BLDSPEC]	The sixth.
0 [BLDSPEC]	The seventh.

Now that all of the column print numbers have been built into a special character you can accumulate and print it. The character can also be stored into a register and recalled for later accumulation.

Printer: MAN [IIII]██

|	
ACSPEC	The seven-column special character is accumulated into the print buffer.
PRBUF	The character is printed.
STO 01	The complete character is stored into register R_{01} and also remains in X.
RCL 01	The character is recalled,
ACSPEC	accumulated into the print
PRBUF	buffer, and printed.

The ACSPEC operation always accumulates seven columns. So if you specify fewer than seven column print numbers with BLDSPEC, the ACSPEC operation will automatically insert blank columns to right-justify the character in the matrix.

When you specify more than seven column print numbers with BLDSPEC, the first numbers specified will be lost as each excess number is specified.

Right- and Left-Justified Buffer Printing

You can control whether your accumulated output is right-justified (lined up to the right margin) or left-justified (lined up to the left margin) using the ADV and PRBUF operations.

To right-justify a buffer printing, press ADV on the printer or execute the ADV function.

To left-justify a buffer printing, execute PRBUF.

When the print buffer is automatically printed as a result of a buffer overflow or execution of other print functions, it is printed justified according to the last printed line.

With the contents of the stack intact from the previous example, print the print buffer right-justified.

Keystrokes   **Printer:** MAN [IIII]██

ACSPEC	Accumulates the character into the buffer.
ADV	Prints right-justified.

Now print the buffer left-justified.

Keystrokes   **Printer:** MAN [IIII]██

|	
ACSPEC	Accumulates the character into the print buffer.
PRBUF	Prints left-justified.

Programming the Special Character Operations

Any of the operations discussed above for using BLDSPEC and ACSPEC can be programmed. Just structure the program so that it builds and accumulates according to the procedure on page 64. Remember that you can store the special characters in any data storage register and then recall and accumulate them when you wish to print.

Special Plotting Characters

The PRPLOT, PRPLOTP, and REGPLOT operations discussed in section 4 all use a value in storage register R_{03} to specify the plotting character that is used in printed plots. Using BLDSPEC you can "build" any plotting character you desire, and then store it into register R_{03} prior to executing the plotting function.

1. Build a special plotting character.

2. Store it into R_{03}.

3. Execute the desired plotting operation.

Accessories, Maintenance and Service

Accessories

Standard Accessories

AC Adapter/Recharger
Rechargeable Battery Pack
HP 82143A Printer Owner's Handbook
Two Rolls of Paper

Optional Accessories for the HP 82143A Printer

Paper Rolls
Reserve Power Pack
Security Cable

Maintenance

The HP 82143A Printer has been designed with the utmost attention to detail and quality. After construction, each printer is thoroughly inspected for electrical, mechanical, and cosmetic flaws.

Temperature Specifications

- Operating: 0° to 45°C 32° to 113°F
- Storage: −40° to 55°C −40° to 131°F
- Charging: 15° to 40°C 59° to 104°F

Printer Maintenance

> **CAUTION**
>
> Always turn the HP-41C off before inserting or removing any plug-in extensions or accessories. Failure to turn the HP-41C off could damage both the calculator and the accessory.

1. Keep the contact area on the printer plug free of obstructions. Should the contacts become dirty, carefully brush or blow the dirt out of the contact area. Do not use any liquid to clean the contacts or the printer.

2. Store the printer in a clean dry place.

3. Always turn the HP-41C off before inserting or removing any plug-in extension. Failure to do so could damage both the calculator and the extension.

> **CAUTION**
>
> Do not insert your fingers or any other objects other than an HP module or plug-in accessory into any port. Doing so could alter the Continuous Memory or could even damage the port or the calculator. Always keep the port caps in place over any HP-41C ports that are not in use.

Improper Printer Operation

If your HP-41C system appears to be operating properly except for printing, check the following:

1. Make sure that the calculator is in the proper operating mode. Read the specific procedure for the print operation you are executing.

2. If a function executes from the keyboard but not from a program, make sure flag 21 is set. Refer to page 28.

3. Make sure that the printer interface cable is plugged into one of the I/O ports on the calculator and that both the calculator and printer are turned on.

4. Check the BAT and POWER indicators on the printer. If the rechargeable batteries do not have adequate power, the printer will not operate. Refer to section 1, pages 7–10 for more information about batteries and power.

5. Check the HP-41C display for the *OUT OF PAPER* message. If the printer is out of paper, it will not print.

6. Press [PRINT] then [ADV] on the printer. If the paper advances, the printer is operating properly.

7. If the paper is feeding properly but no printing appears on the paper, the paper roll may be inserted backwards. Pull the paper backwards out of the print mechanism, turn it over and reinsert the paper. Refer to section 1, pages 12–13 for more information. Use only Hewlett-Packard thermal paper.

8. If the paper is jammed, clear it by grasping the tape and pulling it forward or backward through the printer mechanism. Never insert tools into the printer or its mechanism.

9. If you still cannot determine the source of the problem, you may wish to take your HP-41C and the HP 82143A Printer to your nearest authorized HP retail outlet prior to sending the unit in for service. By temporarily exchanging printers, or calculators, you and the dealer may be able to determine which device is not functioning properly. Only the device that has been determined to be malfunctioning should be sent to HP for service. If you and the dealer are unable to determine the source of the malfunction, send the HP-41C and the printer to HP for service. Refer to Repair Policy.

Service

Repair Policy

Hewlett-Packard calculators and accessories are normally repaired and reshipped within five (5) working days of receipt at any repair center. This is an average time and could possibly vary depending upon the time of year and work load at the repair center.

Shipping Instructions

Should your printer require service, the unit including battery pack and ac adapter/recharger, should be returned with the following items:

1. A completed Service Card, including a description of the problem.

2. A sales slip or other proof of purchase (if the one-year warranty has not expired).

The printer, Service Card, and (if required) the proof of purchase should be packaged in its original shipping case or *other adequate packaging to prevent in-transit damage*. Such damage is not covered by the one-year limited warranty; Hewlett-Packard suggests that you insure the shipment to the repair center. The packaged printer should be shipped to the address shown on the Service Card.

Whether the unit is under warranty or not, it is your responsibility to pay shipping charges for delivery to the Hewlett-Packard repair center.

After warranty repairs are completed, the repair center returns the unit with postage prepaid. On out-of-warranty repairs, the unit is returned C.O.D. (covering shipping costs and the service charge).

Limited One-Year Warranty

What We Will Do. The HP 82143A and its accessories are warranted by Hewlett-Packard against defects in materials and workmanship for one year from the date of original purchase. If you sell your HP 82143A or give it as a gift, the warranty is automatically transferred to the new owner and remains in effect for the original one-year period. During the warranty period we will repair, or at our option, replace at no charge a product that proves to be defective provided that you return the product, shipped prepaid, to a Hewlett-Packard repair center.

How To Obtain Repair Service

Hewlett-Packard maintains repair centers in most major countries throughout the world. You may have your printer repaired at a Hewlett-Packard repair center any time it needs service, whether the unit is under warranty or not. There is a charge for repairs after the one-year warranty period. Please refer to Shipping Instructions.

The Hewlett-Packard United States Repair Center for handheld and portable calculators and accessories is located in Corvallis, Oregon. The mailing address is:

HEWLETT-PACKARD COMPANY
CORVALLIS DIVISION SERVICE DEPT.
P.O. BOX 999
CORVALLIS, OREGON 97330

Note: Not all Hewlett-Packard repair centers offer service for all models of HP calculators and accessories. However, if you bought your calculator or accessory from an authorized Hewlett-Packard dealer, you can be sure that service is available in the country where you bought your printer.

If you happen to be outside of the country where you bought your printer, you can contact the local Hewlett-Packard repair center to see if service is available for your model. If service is unavailable, please ship your printer to the following address:

HEWLETT-PACKARD COMPANY
1000 N.E. CIRCLE BOULEVARD
CORVALLIS, OREGON 97330
U.S.A.

All shipping and reimportation arrangements are your responsibility.

What Is Not Covered. This warranty does not apply if the product has been damaged by accident or misuse, or as a result of service or modification by other than an authorized Hewlett-Packard repair center.

No other express warranty is given. The repair or replacement of a product is your exclusive remedy. **ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS IS LIMITED TO THE ONE-YEAR DURATION OF THIS WRITTEN WARRANTY.** Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. **IN NO EVENT SHALL HEWLETT-PACKARD COMPANY BE LIABLE FOR CONSE-QUENTIAL DAMAGES.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Obligation to Make Changes. Products are sold on the basis of specifications applicable at the time of manufacture. Hewlett-Packard shall have no obligation to modify or update products once sold.

Warranty Information Toll-Free Number. If you have any questions concerning this warranty please call 800/648-4711. (In Nevada call 800/992-5710.)

Programming and Applications

Should you need technical assistance concerning programming, calculator applications, etc., call Hewlett-Packard Customer Support at 503/757-2000. This is not a toll-free number, and we regret that we cannot accept collect calls. As an alternative, you may write to:

HEWLETT-PACKARD
CORVALLIS DIVISION CUSTOMER SUPPORT
1000 N.E. CIRCLE BOULEVARD
CORVALLIS, OR 97330

A great number of our users submit program applications or unique program key sequences to share with other Hewlett-Packard owners. Hewlett-Packard will only consider using ideas given freely to us. Since it is the policy of Hewlett-Packard not to accept suggestions given in confidence, please include the following statement with your submittal:

"I am voluntarily submitting this information to Hewlett-Packard Company. The information is not confidential and Hewlett-Packard may do whatever it wishes with the information without obligation to me or anyone else."

Further Information

Service contracts are not available. Circuitry and design are proprietary to Hewlett-Packard. Service manuals are not available.

Should other problems or questions arise regarding repairs, please call your nearest Hewlett-Packard sales office or repair center.

Appendix B

Messages and Errors

Following is a listing of all printer messages and errors that you might see. For a list of all standard HP-41C messages and errors, refer to appendix E of the *HP-41C Owner's Handbook and Programming Guide*.

Display	Meaning
ALPHA DATA	ALPHA characters are in a register where a number was required. The following print functions may result in this display (refer to appendix E of the *HP-41C Owner's Handbook and Programming Guide* for more information):

REGPLOT, STKPLOT, PRREGX, SKPCHR, SKPCOL, ACCHR, ACCOL, BLDSPEC, PRPLOT, PRPLOTP, PRAXIS.

DATA ERROR　　The following abnormal conditions will result in this message (refer to appendix E of the *HP-41C Owner's Handbook and Programming Guide* for more error conditions):

SKPCOL	where $|x| \geqslant 168$.
SKPCHR	where $|x| \geqslant 24$.
REGPLOT and	
STKPLOT	where $YMIN \geqslant YMAX$, **nnn**$=0$, $|$**nnn**$|>168$.
PRREGX	where $|x|>999$.
ACCOL,	
ACCHR , and	
BLDSPEC	where $|x| \geqslant 128$.
PRPLOTP and	
PRAXIS	where $YMAX \leqslant YMIN$, or AXIS is not between (inclusive) YMIN and YMAX.
PRAXIS	where **nnn**>168.
PRPLOTP	where $XMAX \leqslant XMIN$.

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NONEXISTENT　　An attempt was made to print a nonexistent program, or a printer function that is not intended for listing.

PRREGX	where $|x| >$ address of highest numbered existing data storage register.
PRPLOT and	
PRPLOTP	where the named function is nonexistent.

OUT OF PAPER　　The printer is out of paper. Load a new roll of paper following the instructions given on page 12.

PRINT ERROR　　The printer has malfunctioned. Turn the printer OFF and ON, and press ⟵ . If repetition of this procedure several times continues to result in this message, the unit requires service. Refer to Service, page 70.

PRINTER OFF　　A printer function was executed while the printer was turned OFF. Turn the printer on. If you wish to continue execution of the program with the printer OFF, clear flag 21 and press R/S .

PRIVATE　　An attempt was made to list, trace, edit, or view a private program.

Appendix C

Annotated [PRPLOT] Program Listing

Following is a listing of the [PRPLOT] plotting program. This program can be downloaded into program memory using the [COPY] operation. Refer to page 260 of the *HP-41C Owner's Handbook and Programming Guide* for more information about [COPY]. The [PRPLOT] program requires a minimum of one additional plug-in memory module before it can be copied into program memory.

```
01♦LBL "PRPLOT"
02 AON
03 "NAME ?"
04 PROMPT
05 AOFF
06 ASTO 11
07♦LBL 11
08 "Y MIN ?"
09 PROMPT
10 STO 00
11 "Y MAX ?"
12 PROMPT
13 STO 01
14 X<=Y?
15 GTO 11
16♦LBL 12
17 "AXIS ?"
18 CF 23
19 PROMPT
20 STO 04
21 FS? 23
22 ASTO 04
23 RCL 01
24 X<Y?
25 GTO 12
26 CLX
27 RCL 00
```

Prompts for inputs, checks data, and stores the input values.

```
28 X>Y?
29 GTO 12
30♦LBL 13
31 "X MIN ?"
32 PROMPT
33 STO 06
34 "X MAX ?"
35 PROMPT
36 STO 09
37 X<=Y?
38 GTO 13
39 "X INC ?"
40 PROMPT
41 STO 10
```

```
42♦LBL "PRPLOTP"
43 CF 12
44 ADV
45 6
46 SKPCHR
47 "PLOT OF "
48 ARCL 11
49 ACA
50 PRBUF
```

Prints the name of the function being plotted.

```
51 RCL 08
52 RCL 09
53 "X"
54 XEQ 09
55 STO 07
56 7
57 ACCHR
58 PRBUF
```

Calculates and prints the X-units.

```
59 130
60 STO 02
```

Sets plot field width to 130 columns.

```
61 XROM "PRAXIS"
```

Calculates Y-units and completes the plot label.

Checks X INC for positive or
negative sign.

```
62 RCL 10
63 X>0?
64 GTO 00
```

Calculates X increment value if
X INC is negative (number of
increments).

```
65 RCL 09
66 RCL 08
67 -
68 RCL 10
69 ABS
70 /
71 STO 10
```

Determines print format for
X-labels.

```
72♦LBL 00
73 RCL 09
74 RCL 08
75 ABS
76 X<Y?
77 X<>Y
78 RCL 07
79 /
80 LOG
81 INT
82 2
83 -
84 STO 05
```

Sets first X-value equal to XMIN
(the initial value).

```
85 RCL 08
86 STO 06
```

Sets print format and accumulates
X-label.

```
87♦LBL 14
88 FIX IND 05
89 RCL 07
90 /
91 RND
92 ACX
93 3
94 SKPCOL
```

Calculates and prints one point.

```
95 RCL 06
96 XEQ IND 11
97 REGPLOT
```

Increments X-value and checks for
completion of plot.

```
98 RCL 10
99 ST+ 06
100 RCL 09
101 RCL 06
102 X<=Y?
103 GTO 14
```

Resets display mode.

```
104 FIX 4
```

Calculates and prints Y-units label.

```
105 RTN
106♦LBL "PRAXIS"
107 CF 12
108 RCL 00
109 RCL 01
110 "Y"
111 XEQ 09
112 STO 06
113 125
114 ACCHR
115 PRBUF
```

Converts **nnn.aaa** to **nnn** and checks
nnn.

```
116 RCL 02
117 INT
118 ABS
119 STO 02
120 168
121 X<Y?
122 GTO 10
```

Formats and accumulates YMIN
label.

```
123 RCL 00
124 RCL 06
125 /
126 RND
127 ACX
```

Calculates and skips number of
columns between the YMIN and
YMAX labels.

```
128 XEQ 05
129 R↑
130 RCL 01
131 XEQ 04
132 R↑
133 +
134 -
135 7
136 X≤Y?
137 RDN
138 SKPCOL
```

Accumulates the YMAX label and
prints the Y-labels.

```
139 RCL 01
140 RCL 06
141 /
142 RND
143 ACX
144 ADV
```

Calculates axis column location (if
printed).

```
145 RCL 04
146 SIGN
147 X=0?
148 GTO 03
149 LASTX
150 RCL 00
151 X>Y?
152 GTO 10
153 -
154 RCL 01
155 RCL 00
156 -
157 X<Y?
158 GTO 10
159 /
160 RCL 02
161 1
162 -
163 *
164 .5
165 +
166 INT
167 STO Y
```

Positions and prints axis label.

```
168 RCL 04
169 RCL 06
170 /
171 RND
172 ACX
173 XEQ 05
174 2
175 /
176 X>Y?
177 GTO 00
178 +
179 RCL 02
180 1
181 -
182 X<Y?
183 ENTER↑
184 -
185 GTO 01
186◆LBL 00
187 ENTER↑
188 +
189 RCL 02
190 -
191◆LBL 01
192 SKPCOL
193 ADV
```

Calculates position of axis mark and
prints Y axis.

```
194 XEQ 08
195 STO 05
196 X=0?
197 GTO 00
198 RCL 02
199 1
200 -
201 X=Y?
202 GTO 00
203 X<>Y
204 1
205 -
206 XEQ 06
207 RCL 05
208 1
209 +
210 GTO 01
211◆LBL 03
212 XEQ 06
213◆LBL 00
214 RCL 02
215 2
216◆LBL 01
217 -
218 XEQ 06
219 ADV
```

Puts **nnn.aaa** in R$_{02}$.

```
220 RCL 02
221 RCL 05
222 1
223 +
224 1 E3
225 /
226 +
227 ENTER↑
228 CHS
229 X<>Y
230 RCL 04
231 SIGN
232 X=0?
233 RDN
234 RDN
235 STO 02
```

Resets display format.

```
236 FIX 4
```

```
237 RTN
```

Formats label value into actual label.

```
238◆LBL 04
239 RCL 06
240 /
241 RND
```

Calculates number of columns
required for a label.

```
242◆LBL 05
243 ABS
244 INT
245 X≠0?
246 GTO 00
247 RDN
248 5
249◆LBL 00
250 LOG
251 INT
252 RCL 05
253 +
254 3
255 +
256 7
257 *
258 RTN
```

Fills in axis with dashes between
label marks.

```
259*LBL 06
260 ENTER↑
261 ENTER↑
262 7
263 MOD
264 2
265 /
266 INT
267 SKPCOL
268 -
269 "-"
270*LBL 07
271 7
272 X>Y?
273 GTO 00
274 -
275 ACA
276 GTO 07
277*LBL 00
278 RDN
279 SKPCOL
```

Accumulates a label mark.

```
280*LBL 08
281 127
282 ACCOL
283 R↑
284 RTN
```

```
285*LBL 09
286 "⊦ <UNITS="
287 X<=Y?
288 GTO 10
289 X<>Y
290 ABS
291 X<Y?
292 X<>Y
293 LOG
294 X<0?
295 GTO 00
296 INT
297 2
298 X<>Y
299 X>Y?
```

Calculates multiplier value and
places that value into X. Accumu-
lates "units" line.

```
300 GTO 01
301 -
302 STO 05
303 0
304 GTO 02
305*LBL 00
306 FRC
307 X≠0?
308 1
309 LASTX
310 INT
311 X<>Y
312 -
313*LBL 01
314 "⊦ E"
315*LBL 02
316 4
317 SKPCHR
318 ACA
319 FIX 0
320 RDN
321 X=0?
322 GTO 00
323 ACX
324 10↑X
325 2
326 STO 05
327 FIX 2
328 RDN
329 GTO 01
330*LBL 00
331 1
332 ACX
333 FIX IND 05
334*LBL 01
335 "> "
336 ACA
337 RTN
```

Generates *DATA ERROR* message for
bad inputs.

```
338*LBL 10
339 0
340 /
341 END
```

Appendix D

Reading and Keying in Programs From Printer Listings

Programs listed on the HP 82143A Printer are printed in a special format. The format shows all functions by name, without showing every keystroke. Here are some hints that will help you when you read and key in your programs from printed program listings.

1. When you see '' (quote marks) around a character or group of characters in the program listing, those characters are ALPHAs. To key them in, simply press [ALPHA], key in the characters, then press [ALPHA] again.

2. The diamond in front of each LBL instruction is a visual aid to help you locate labels in the program listings. When you key in a program from a listing, ignore the diamond.

3. The printer indication of the divide sign is / (the same as the display). When you see / in the program listing, press [÷].

4. The printer indication of the multiply sign is * (the same as the display). When you see * in the program listing, press [×].

5. The ⊢ character in the program listing is an indication of the [APPEND] function. When you see ⊢, press ■ [APPEND] in ALPHA mode (press ■ and the K key in ALPHA mode).

6. All operations requiring register addresses accept those addresses in these forms:

nn	a two-digit number.
IND nn	indirect (■) followed by a two-digit number.
X, Y, Z, T, or L	a stack address: [·] followed by X, Y, Z, T, or L.
IND X, Y, Z, T, or L	indirect stack: ■ [·] followed by X, Y, Z, T, or L.

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Indirect addresses are specified by pressing ■ and then the indirect address. Stack addresses are specified by pressing [·] followed by X, Y, Z, T, or L. Indirect stack addresses are specified by pressing ■ [·] and X, Y, Z, T, or L.

Here is a sample program listing that illustrates how you can key in programs.

Printer:	Keystrokes	Display
01◆LBL "SAMPLE"	■ [LBL]	
02 "THIS IS A"	[ALPHA] SAMPLE	
03 "⊢SAMPLE"	[ALPHA]	01 LBL^TSAMPLE
04 AVIEW	[ALPHA] THIS IS A	
05 6	[ALPHA]	02 ᵀ THIS IS A
06 ENTER↑	[ALPHA] ■ [APPEND]	
07 -2	SAMPLE	03 ᵀ SAMPLE
08 /	■ [AVIEW] [ALPHA]	04 AVIEW
09 ABS	6	05 5
10 STO IND L	[ENTER↑]	06 ENTER
11 "R3="	2 [CHS]	07 -2
12 ARCL 03	[÷]	08 /
13 AVIEW	[XEQ] [ALPHA] ABS	
14 END	[ALPHA]	09 ABS
	[STO] ■ [·] L	10 STO IND L
	[ALPHA] R ■ 3=	11ᵀR3=
	■ [ARCL] 03	12 ARCL 03
	■ [AVIEW] [ALPHA]	13 AVIEW
	■ [GTO] [·] [·]	14 END

HP 82143A Printer Function Index

While the HP 82143A Printer is plugged into the HP-41C, these operations become active in the system. These operations, and programs containing these operations are only executable while the printer is plugged in and turned on. You can print these functions as well as functions in other plug-in accessories by executing CATALOG 2 while the printer is set to TRACE, or only view them in the display by executing CATALOG 2 while the printer is set to MAN or NORM.

ACA	Accumulate ALPHA register (page 33) .
ACCHR	Accumulate character (page 36)
ACCOL	Accumulate column (page 62).
ACSPEC	Accumulate special character (page 64).
ACX	Accumulate X-register (page 35).
ADV	Advances paper and prints buffer right justified (page 38).
BLDSPEC	Build special character (page 64).
LIST	List program lines (page 23). Not programmable.
PRA	Print ALPHA register (page 19).
PRAXIS	Print axis (page 56).
PRBUF	Print buffer (page 39).
PRFLAGS	Print flags and other status information (page 24).
PRKEYS	Print reassigned keys (page 25).
PRP	Print program (page 22). Not programmable.
PRPLOT	Print plot, interactive plotting (page 47).
PRPLOTP	Print plot, noninteractive plotting (page 56).
PRREG	Print registers (page 19).
PRREGX	Print registers as directed by X (page 20).
PRΣ	Print statistics registers (page 21).
PRSTK	Print stack (page 22).
PRX	Print X register (page 18).
REGPLOT	Plot single line using data in registers (page 58).
SKPCHR	Skip characters, accumulate in print buffer (page 41).
SKPCOL	Skip columns, accumulate in print buffer (page 63).
STKPLOT	Plot single line using data in stack (page 58).