

HP BASIC Porting and Globalization



HP Part No. 98616-90206
Printed in USA

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Printing History

First Edition — January 1994

Product Compatibility

This manual supports:

- HP BASIC/WS 300 (Version 6.2)
- HP BASIC/UX 300/400 (Version 6.3)
- HP BASIC/UX 700 (Version 7.0)
- HP BASIC/DOS (Version 6.2)

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Porting to 3.0

This chapter describes the differences between BASIC 2.0/2.1 extensions and BASIC 3.0.

Note If you are porting a program from a “pre-3.0” version of the BASIC system to a 4.0 or 5.0 system, then you should also read the subsequent porting chapters. Anytime you see 3.0 mentioned in this chapter it also refers to all subsequent system versions.

Porting Topics Covered

The following areas require consideration when transporting programs from BASIC 2.0/2.1 to BASIC 3.0. They are listed in the order in which they're discussed in this chapter.

- Compatibility with previous versions
- Configuring BASIC
- Statement changes
- CSUBs
- PHYREC
- Knob
- Graphics
 - Default plotter
 - Implicit GCLEAR
 - Input device viewport
 - Graphics Tablet DIGITIZE
 - The VIEWPORT Statement
 - The PIVOT Statement

- Display functions
- Prerun on LOADSUB
- Special case of I/O transfers

Compatibility with Preceding Versions

If you have programs which were written on previous Series 200 BASIC systems, you can use these same programs with little or no changes. The major task you have to perform is to configure the BASIC 3.0 system with the necessary BIN files.

Configuring BASIC

This section contains procedures that help you ensure you have loaded all the required language extensions and drivers. It also tells you where to find related information in your BASIC manual set.

Missing Language Extensions BIN Files

Follow this procedure to make sure that you have all the language extensions BIN files that a program needs. The procedure ensures that each program unit is not prerun and then preruns all program units. Prerun reports the first missing BIN file that it finds. Editing a program unit ensures that it is not in the prerun state. Stepping a stopped program preruns it.

Load the program and the BIN files PDEV and ERR. Enter the first line of the program to ensure that the main program is not in a prerun state. Find every SUB statement (using the FIND command enabled by the PDEV BIN file) and enter it. Find every DEF FN statement and enter it. Now no program unit is in a prerun state. Stepping preruns every subprogram. If prerun finds a statement or option that requires a missing BIN file, error 1 is given along with the name (if the ERR BIN file is loaded) of the missing BIN file. After loading the missing BIN file, step again to prerun the program. If a BIN file is missing, error 1 and its name are given. Repeat this process until stepping gives no

errors. At that point, all language extensions BIN files needed by the program are present. If the program loads subprograms or other programs, repeat this process for each of them.

This process does not work for a secured program. The best approach in this case is to ask the author or vendor for a list of the BIN files required. If this is not possible, load the ERR BIN file and run the program. Whenever a statement is executed that requires a missing BIN file, an error 1 and the name of the BIN file are given. After loading the BIN file, the program can be continued. However, it may be difficult to force the execution of all paths in the program. This can be a serious problem if a real-time control program is surprised by a missing BIN file at a critical moment.

Remember, if you have enough memory, you can load all the BIN files. However, only load KNB2_0 if you want KNOBX to function as it does in BASIC 2.0/2.1 and KNOBY to always return a zero. Refer to the Knob section later in this chapter for more information.

Missing Driver BIN Files

To ensure that all required driver BIN files are loaded, load the appropriate BIN file for each interface card and I/O port used (including the built-in HP-IB and RS-232 serial interface, if present). Also load the appropriate disk driver BIN file for each disk drive used.

If an operation is attempted to a device but the card driver BIN file is missing, the message "ERROR 163 I/O interface/driver not present" is usually provided. Examples of this are: CAT":,700" or PRINTER IS 701 with the HPIB BIN file missing.

If the card BIN file is present but the disk driver BIN file is missing, an attempt to access the disk causes error 1. If the ERR BIN file is loaded, the message "ERROR 1 Configuration error" is provided.

If both the card driver and disk driver BIN files are missing, error 163 is usually given but error 1 can also occur.

Statement Changes

There are several statements added with BASIC 3.0. These are listed below.

KNOBY	PRINTER IS file
LIST BIN	READ LABEL
MAXREAL	RES
MINREAL	SCRATCH BIN
MODULO	SECURE
PDIR	SET LOCATOR
PLOTTER IS file	STORE SYSTEM
PRINT LABEL	SYSBOOT

Two statements were deleted, STORE BIN and RE-STORE BIN.

CSUBs

If you used Pascal-compiled subprograms (CSUBs) in your BASIC 2.0/2.1 programs, you need to purchase a Pascal 3.0 system upgrade and a CSUB Utility upgrade to use those CSUBs with BASIC 3.0. You must recompile the Pascal routine on Pascal 3.0 and re-execute the CSUB utility to make the routine look like a BASIC subprogram. If you are using a CSUB supplied by a vendor, you must have the supplier update the CSUB for you.

PHYREC

The PHYREC routine that allowed you to read from and write to physical records on a disk was changed from a binary program to a CSUB with BASIC 3.0. The PHYREC CSUB is located on the *HP BASIC Utilities Disk*.

You must append the PHYREC CSUB to your program and change the PHYREAD/PHYWRITE statements. If the PHYREC binary is appended to a program, a warning message is displayed and the binary is ignored by BASIC.

Use the following steps to locate all the lines for an application that uses PHYREC and change them to call and append the PHYREC CSUB.

1-4 Porting to 3.0

1. Boot a BASIC 2.0/2.1 system.

2. Delete the PHYREC binary.

```
LOAD "program"
SAVE "program2"      This saves the program without the binary.
SCRATCH A           This deletes the program and binary from memory.
GET "program2"      Calls to PHYREC are commented. Write down
                   the line numbers.

RE-STORE "program"
PURGE "program2"
```

3. Attach the PHYREC CSUB.

```
LOADSUB ALL FROM "PHYREC"
```

This file is located on the HP BASIC Utilities Disk. Do not try to run your application until you have completed all steps.

4. Uncomment and change all the calls to PHYREC. These are the lines you noted in step 2 above.

```
PHYREAD Sector,Int_array(*) > Phyread(Sector,Int_array(*)
PHYWRITE Sector,Int_array(*) > Phywrite(Sector,Int_array(*)
```

5. If Sector is declared to be an INTEGER, you need to put it into parentheses so that PHYREC will interpret it as a REAL.

```
Phyread((Sector),Int_array(*)
```

6. The syntax for a conditional call must be changed from:

```
IF condition THEN PHYREAD Sector,Int_array(*)
```

to:

```
IF condition THEN
  Phyread(Sector,Int_array(*)
END IF
```

or to:

```
IF condition THEN CALL Phyread(Sector,Int_array(*)
```

7. RE-STORE "program" after you have completed the changes.
8. Boot BASIC 3.0 and run your application.

Knob

In BASIC 3.0, unshifted knob movement causes horizontal cursor movement, and shifted knob movement results in vertical movement. This allows for greater compatibility between the knob and the HP-HIL mouse. (In BASIC 2.0/2.1, horizontal and vertical modes are toggled and interlocked.)

The KNOBX Function

The BASIC 2.0/2.1 definition of KNOBX, which we will refer to as all-pulse mode, is as follows: When an ON KNOB statement is executed to trap knob movement, knob pulses are accumulated and accessed via the KNOBX statement. Since the KNOBX function returns information on X-axis movement, a method of tracking Y-axis movement is not directly available with BASIC 2.0/2.1. The common method used to track Y-axis movement, is to interrogate keyboard status register 10 for information on the state of the CTRL and SHIFT keys at the time of the last knob interrupt. Using this information, SHIFTeD and/or CTRLed knob movement could be interpreted differently; in fact, an example program showing this was included in the 2.0/2.1 manual set. Following is another sample 2.0/2.1 program with this type of knob interpretation.

```

      :
      :
30   ON KNOB .1 GOSUB Knobsvc
40   Loop: GOTO Loop
50   STOP
60 !
70   Knobsvc: !
80     STATUS KBD,10;State      ! was SHIFT or CTRL key pressed?
90     Shift=BIT(State,0)      ! bit 0 set = SHIFT key pressed
100    Ctrl=BIT(State,1)       ! bit 1 set = CTRL key pressed
110    SELECT Shift
120      CASE 0                ! if shift not pressed, X direction
130        IF Ctrl THEN        ! if ctrl pressed, give finer resolution
140          X=X+KNOBX/10
150        ELSE
160          X=X+KNOBX
170        ENDIF
180      CASE 1                ! if shift pressed, Y direction
190        IF Ctrl THEN        ! if ctrl pressed, give finer resolution
200          Y=Y+KNOBX/10
210        ELSE
220          Y=Y+KNOBX
230        ENDIF
240    END SELECT
      :
      :

```

With the introduction of the new HP-HIL keyboards (no built-in knob but optional mouse), the intent was to allow the mouse to emulate knob behavior in situations where a knob is no longer present. The all-pulse mode of interpretation, however, is unacceptable when using a mouse because the mouse is not a unidirectional device, yet movement information in only one direction is available. It is virtually impossible to move the mouse in one direction only. To be able to distinguish movement in each direction, the keyword **KNOBY** has been added to BASIC 3.0. **KNOBY** returns the net number of Y-direction knob pulses counted since the last time the **KNOBY** counter was zeroed.

Keyboards with Built-in Knob

To convert your programs which run on hardware with a built-in knob from 2.0/2.1 to 3.0, simply replace **KNOBX** with **KNOBX+KNOBY** in situations where total knob movement is being recorded. The major difference in 3.0 operation is that knob pulses in the X-direction are accessed via **KNOBX** and

knob pulses in the Y-direction are accessed via KNOBY. One way to modify the above program for 3.0 is:

```

      :
      :
30   ON KNOB .1 GOSUB Knobsvc
40   Loop: GOTO Loop
50   STOP
60 !
70   Knobsvc: !
80     STATUS KBD,10;State      ! was SHIFT or CTRL key pressed?
90     Shift=BIT(State,0)      ! bit 0 set = SHIFT key pressed
100    Ctrl=BIT(State,1)       ! bit 1 set = CTRL key pressed
110    SELECT Shift
120      CASE 0                ! if shift not pressed, X direction
130        IF Ctrl THEN        ! if ctrl pressed, give finer resolution
140          X=X+KNOBX/10
150        ELSE
160          X=X+KNOBX
170        ENDIF
180      CASE 1                ! if shift pressed, Y direction
190        IF Ctrl THEN        ! if ctrl pressed, give finer resolution
200          Y=Y+KNOBY/10
210        ELSE
220          Y=Y+KNOBY
230        ENDIF
240    END SELECT
      :
      :

```

However, this does not work with the HP-HIL mouse. A method that works with the HP-HIL mouse as well as with the built-in knob is:

```

      :
      :
30   ON KNOB .1 GOSUB Knobsvc
40   Loop: GOTO Loop
50   STOP
60 !
70   Knobsvc: !
80     X=X+KNOBX
90     Y=Y+KNOBY
      :
      :

```

HP-HIL Keyboards with Mouse

If your ON KNOB routine reads keyboard status register 10 for shift-knob or control-knob actions you will need to make some other changes to convert 2.0/2.1 programs to 3.0. On HP-HIL input devices (i.e. the mouse), keyboard status register 10 has a different interpretation: bit 0 (SHIFT key pressed) is set if last data processed at the last knob interrupt was Y-axis information (data accessed via KNOBY) and cleared if last data processed was X-axis data; bit 1 (CTRL key pressed) is never set. If unidirectional HP-HIL devices were to become available, a toggle switch would exist on the device to switch between X-axis and Y-axis directions and the shift bit on keyboard status register 10 would be set when in the Y-direction mode.

The previous program segment shows recommended servicing of the mouse.

Programming for Both Versions and Keyboards

In the most complicated case, you may wish to write code that runs on both BASIC 2.0/2.1 and BASIC 3.0 with either a built-in knob or HP-HIL mouse. Write knob service routines for the BASIC 2.0/2.1 program and the BASIC 3.0 program and LOADSUB the appropriate routine based on the current version of BASIC. The following program segments show one method of handling this situation.




```

      :
      :
30   GOSUB Whichversion
40   IF Version=3 THEN
50     LOADSUB ALL FROM "KNOBSVC3_0"
60   ELSE
70     LOADSUB ALL FROM "KNOBSVC2_0"
80   END IF
      :
      :
110  Whichversion:      ! running BASIC 2.0/2.1 or 3.0 ?
120  ON ERROR GOTO B2_0
130  STATUS 2,2;A      ! KBD register 2 does not exist for 2.0/2.1, error
140  Version=3         ! if line 130 didn't error out, must be 3.0
150  GOTO Versionfound
160  B2_0: !
170  Version=2
180  Versionfound: !
190  OFF ERROR
200  RETURN
      :
      :

```

KNB2_0

Because these modifications to the KNOB facilities may prevent your 2.0/2.1 programs from running on BASIC 3.0 without making a few changes, we have developed a way to return to the all-pulse mode of KNOB operation in which all knob pulses are accessed via KNOBX. *This mode is not recommended for the HP-HIL mouse.* To switch to this mode, execute CONTROL KBD,11;1.

Note If you select all-pulse mode, KNOBY always returns a zero.

Executing CONTROL KBD,11;0 returns you to the 3.0 mode of operation in which Y-direction pulses are accessed via KNOBY. To determine the mode, execute STATUS KBD,11;M. If M=0, KNOBX is in horizontal-pulse mode; if M=1, KNOBX is in all-pulse mode.

In some cases, it may be desirable to make this mode change implicitly. This can be accomplished by loading the BIN file KNB2_0 from the *Language Extensions* disk. A LIST BIN describes the new BIN file as 2.0 KNOBX Definition. The only effect of KNB2_0 being loaded is that it executes

1-10 Porting to 3.0

CONTROL KBD,11;1 for you automatically. When KNB2_0 is loaded, executing SCRATCH A also automatically executes CONTROL KBD,11;1. Note that if this binary is included in a stored system (e.g. created with the STORE SYSTEM statement), the effects are the same as loading it afterwards.

Note All-pulse mode (KNB2_0 loaded) is not recommended for the HP-HIL mouse. Also note that the KNB2_0 binary and the all-pulse mode are not supported by BASIC/UX.

Special Consideration

Since the KNB2_0 binary functionality is not supported by BASIC/UX, you will need to modify any program containing this functionality.

Graphics

Several graphics statements function differently with BASIC 3.0 than they did in BASIC 2.0/2.1. This section explains the differences.

Default Plotter

The initialization of graphics system variables and devices was changed slightly in BASIC 3.0. When GINIT is executed, several operations are performed automatically such as setting line type and character size. In addition to these operations, BASIC 2.0/2.1 also implicitly does a PLOTTER IS 3, "INTERNAL" to select the CRT as the default plotting device. In BASIC 3.0, the default plotting device is not selected until a statement is executed that affects it (e.g., DRAW, LABEL, GLOAD). At this time, the appropriate PLOTTER IS statement is executed along with GCLEAR, VIEWPORT and WINDOW statements. Refer to GINIT in the *HP BASIC Language Reference* manual for more information.

Implicit GCLEAR

In BASIC 2.0/2.1, any graphics statement following GINIT except PLOTTER IS, GINIT, and DUMP DEVICE causes the implicit execution of GCLEAR, VIEWPORT, and WINDOW. With BASIC 3.0, if a statement that requires a plotter is executed after GINIT, a PLOTTER IS CRT, "INTERNAL" is executed followed by GCLEAR, VIEWPORT, and WINDOW. Refer to GINIT in the *HP BASIC Language Reference* manual for more information.

Input Device Viewport

The GRAPHICS INPUT IS statement sets the hard clip limits of the input device to the largest space possible that has the same aspect ratio as the output device. Since this was not so in earlier versions, there were two potential problems. The first problem is that it is possible to move to positions on the input device that do not exist on the output device. The extent of this problem may be reduced with BASIC 3.0, but the problem is not eliminated. The second problem is that the aspect ratios of the input and output devices may differ causing pictures on the devices to appear different. BASIC 3.0 solves this problem by automatically setting the hard clip limits of the input device to the largest possible space that has the same aspect ratio as the output device.

Graphics Tablet DIGITIZE

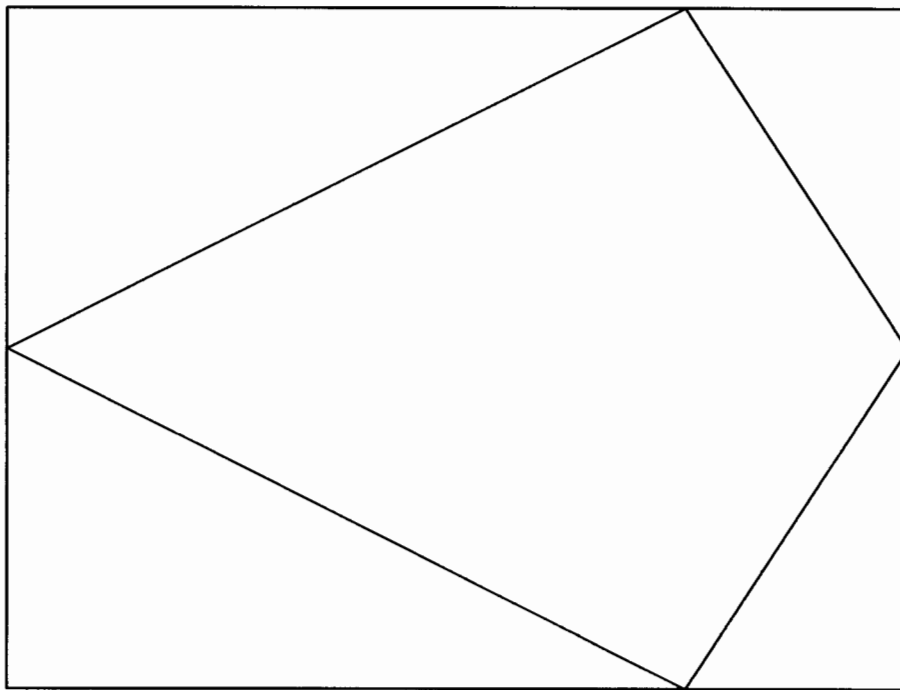
A stylus press on the HP 9111A Graphics Tablet prior to execution of a DIGITIZE statement does not satisfy the DIGITIZE with BASIC 3.0 as it does with BASIC 2.0/2.1. An output of the string "SG" to the graphics tablet after the GRAPHICS INPUT IS statement causes BASIC 3.0 to work like BASIC 2.0/2.1.

The VIEWPORT Statement

VIEWPORT was changed in BASIC 3.0 to make it compatible with the Series 500 and the industry standard. In BASIC 3.0, VIEWPORT rescales immediately. In BASIC 2.0/2.1, VIEWPORT does not rescale; only WINDOW and SHOW statements rescale.

An example helps demonstrate the difference. The following program behaves the same way in BASIC 2.0/2.1 and 3.0 because it does not have a VIEWPORT statement. It draws a large frame with a large quadrangle in it as shown in the following figure titled “BASIC 2.0/2.1 and 3.0 without VIEWPORT.”

```
10  GINIT
20  GRAPHICS ON
30  FRAME
40  CLIP OFF
50  MOVE 0,50
60  DRAW 100,100
70  DRAW RATIO*100,50
80  DRAW 100,0
90  DRAW 0,50
100 END
```

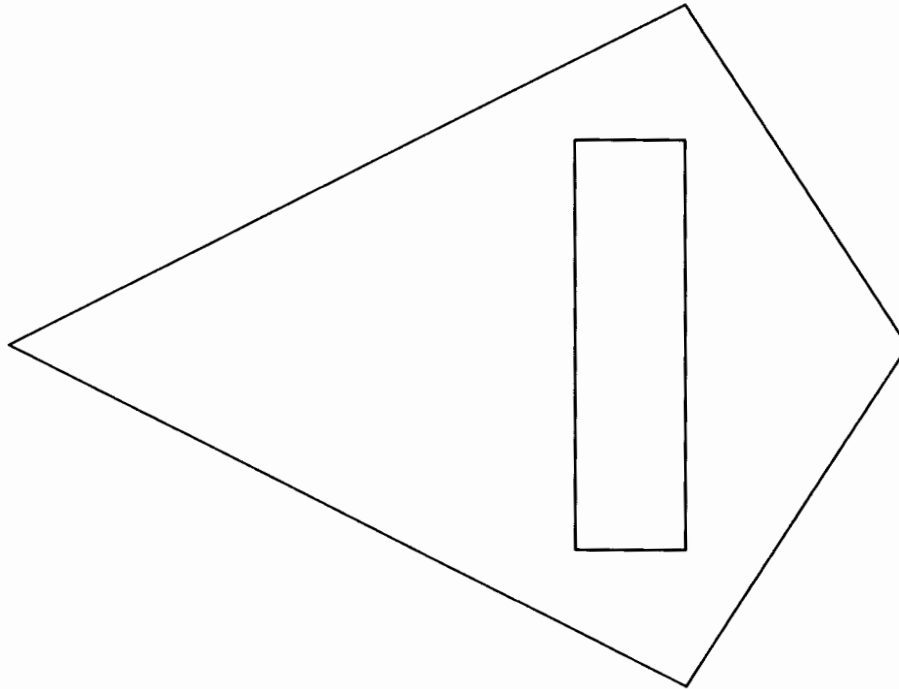


BASIC 2.0/2.1 and 3.0 without VIEWPORT

If a VIEWPORT statement is placed in the program, BASIC 2.0/2.1 and BASIC 3.0 give different results. The program becomes:

```
10  GINIT
20  GRAPHICS ON
30  VIEWPORT 80,100,20,80
40  FRAME
50  CLIP OFF
60  MOVE 0,50
70  DRAW 100,100
80  DRAW RATIO*100,50
90  DRAW 100,0
100 DRAW 0,50
110 END
```

With BASIC 2.0/2.1, the result is a small frame with a large quadrangle around it (see figure titled "BASIC 2.0/2.1 with VIEWPORT"). The frame is what one would expect from the VIEWPORT; it is tall and thin. The quadrangle is the same as the one drawn by the program without the VIEWPORT because the VIEWPORT has not caused the DRAW's to be rescaled.



BASIC 2.0/2.1 with VIEWPORT

With BASIC 3.0, the result is a small frame with a small quadrangle inside the frame (see figure titled “BASIC 3.0 with VIEWPORT”). The frame is the same frame as given by BASIC 2.0/2.1. The quadrangle fits inside the frame because the VIEWPORT in BASIC 3.0 causes all subsequent DRAW's to be rescaled.



BASIC 3.0 with VIEWPORT

The VIEWPORT change usually does not affect programs because most programs used a sequence such as:

```
VIEWPORT 20,100,20,80  
WINDOW Xmin,Xmax,Ymin,Ymax
```

The result of these two statements in order is the same in BASIC 2.0/2.1 and BASIC 3.0.

Some BASIC 2.0/2.1 programs used the following order:

```
VIEWPORT 20,100,20,80  
WINDOW Xmin,Xmax,Ymin,Ymax  
VIEWPORT 0,100*RATIO,0,100
```

The second VIEWPORT was used to change the soft clip limits. In BASIC 2.0/2.1, the second VIEWPORT did not rescale so that the scale defined by the WINDOW and the first VIEWPORT remains effective. When the above sequence is run in BASIC 3.0, the second VIEWPORT rescales all subsequent plotting.

The best solution to this problem is to change the sequence to:

```
VIEWPORT 20,100,20,80
WINDOW Xmin,Xmax,Ymin,Ymax
CLIP OFF
```

The PIVOT Statement

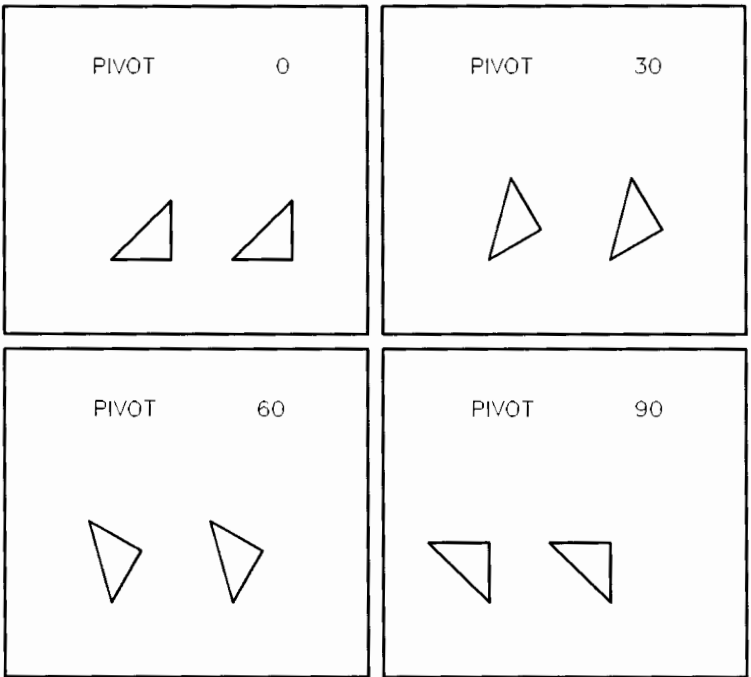
In BASIC 3.0, the local origin of RPLOT and LABEL is affected by the PIVOT statement. The best way to see the differences between BASIC 2.0/2.1 and BASIC 3.0 is by studying the following examples.

RPLOT with PIVOT

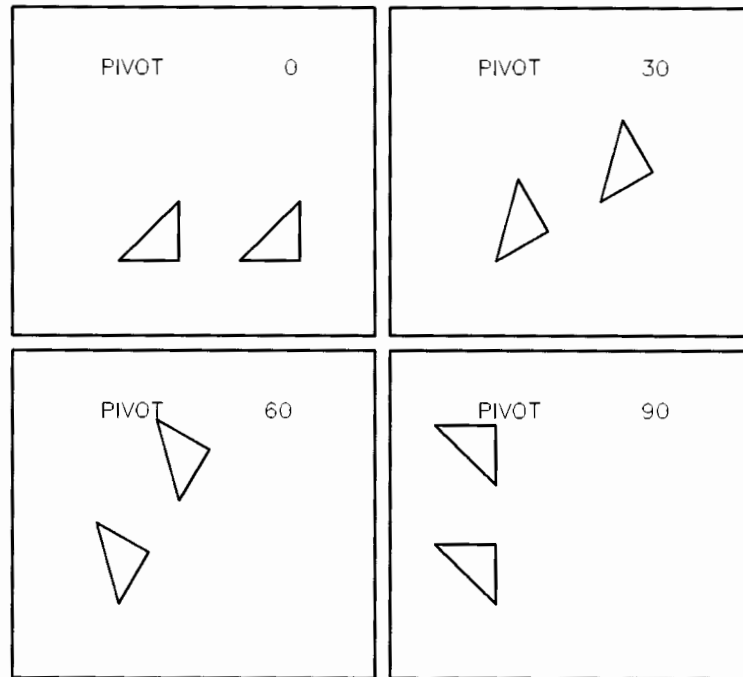
The following program illustrates the effects of PIVOT on RPLOT statements. Outputs of the program with BASIC 2.0/2.1 and 3.0 are shown after the program.

```
10   DEG
20   GINIT
30   GRAPHICS ON
40   VIEWPORT 0,64,51,100
50   Pivot(0)
60   VIEWPORT 66,130,51,100
70   Pivot(30)
80   VIEWPORT 0,64,0,49
90   Pivot(60)
100  VIEWPORT 66,130,0,49
110  Pivot(90)
120  END
130  SUB Pivot(P)
140  WINDOW 0,131,0,100
150  FRAME
160  MOVE 30,80
170  LABEL "PIVOT",P
180  MOVE 40,20
190  PIVOT P
200  Tri
210  MOVE 80,20
220  Tri
```

```
230 PIVOT 0
240 SUBEND
250 SUB Tri
260 RPLLOT 20,0,-1
270 RPLLOT 20,20
280 RPLLOT 0,0
290 SUBEND
```



BASIC 2.0/2.1 RPLLOT with PIVOT



BASIC 3.0 RPLLOT with PIVOT

LABEL with PIVOT

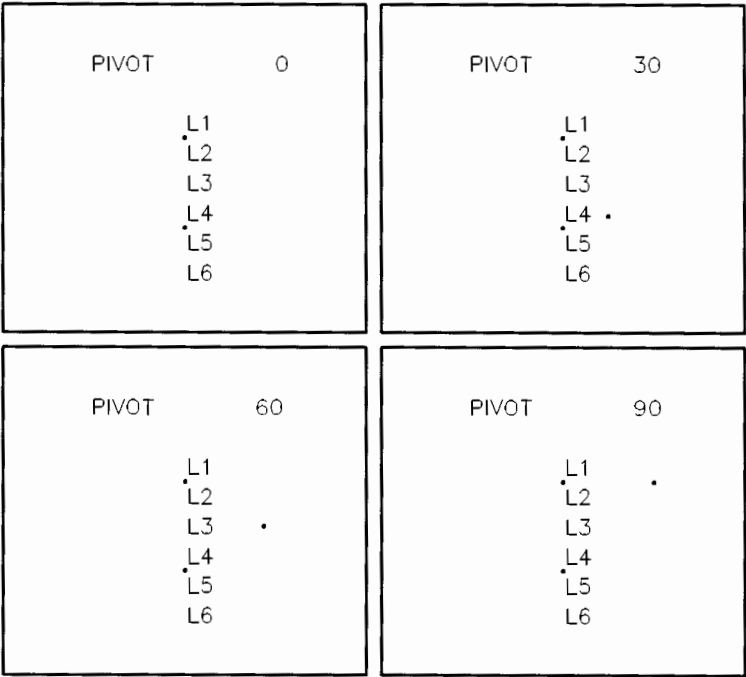
The following program illustrates the effects of PIVOT on LABEL statements. Outputs of the program with BASIC 2.0/2.1 and 3.0 are shown after the program.

```

10  DEG
20  GINIT
30  GRAPHICS ON
40  VIEWPORT 0,64,51,100
50  FRAME
60  Pivot(0)
70  VIEWPORT 66,130,51,100
80  FRAME
90  Pivot(30)
100 VIEWPORT 0,64,0,49
110 FRAME

```

```
120 Pivot(60)
130 VIEWPORT 66,130,0,49
140 FRAME
150 Pivot(90)
160 END
170 SUB Pivot(P)
180 WINDOW 0,131,0,100
190 MOVE 40,80
200 LABEL "PIVOT",P
210 MOVE 60,60
220 PIVOT P
230 IDRAW 0,0
240 LABEL "L1"
250 LABEL "L2"
260 LABEL "L3"
270 IDRAW 0,0
280 PIVOT 0
290 IDRAW 0,0
300 LABEL "L4"
310 LABEL "L5"
320 LABEL "L6"
330 SUBEND
```



BASIC 2.0/2.1 LABEL with PIVOT

PIVOT 0 L1 L2 L3 L4 L5 L6	PIVOT 30 L1 L2 L3 L4 L5 • L6
PIVOT 60 L1 L2 L3 L4 L5 L6 •	PIVOT 90 L4 L1 L5 L2 L6 L3 •

BASIC 3.0 LABEL with PIVOT

Display Functions

The effect of turning Display Functions mode on is to display special control characters on the screen. In BASIC 2.0/2.1, Display Functions has no effect on control characters 128 through 159. With BASIC 3.0, the appropriate character is displayed on the screen when control characters 128 through 159 are displayed and Display Functions is enabled. For example, on a Model 236 running BASIC 2.0/2.1, the following statement:

```
PRINT CHR$(129)&'HI THERE"&CHR$(128)
```

results in:

HI THERE *in inverse video*

With BASIC 3.0, the result is:

```

hP HI THERE hP CR
LF

```

The symbols are machine dependent; the actual characters displayed may vary with other models.

Prerun On LOADSUB

To speed the execution of the LOADSUB statement, BASIC 3.0 does not prerun each subprogram loaded by the execution of the LOADSUB statement if the subprogram has been stored in a “prerun state.” This differs from BASIC 2.0/2.1 in that BASIC 2.0/2.1 does prerun on the entire program every time LOADSUB is executed. The only effect seen by this change is improved performance when loading subprograms with the LOADSUB statement. For more information on prerun, refer to the “Program Structure and Flow” chapter in the *HP BASIC Programming Guide*.

Special Case of I/O Transfers

A special case of decreased I/O performance has occurred with BASIC 3.0 due to a missed interleave caused by the increased overhead for handling multiple processors. Outbound transfers without DMA to the 913xA/B/V/XV Winchester disk drives perform at 11.75 Kbytes/second in BASIC 3.0. In BASIC 2.0/2.1, those transfers perform at a rate of 50 Kbytes/second. This degradation occurs only if all the following conditions are met:

- 8 MHz processor board (no cache)
- Not using DMA
- Using outbound TRANSFER (not OUTPUT) to 913xA/B/V/XV drive

This performance degradation affects users who are logging test data onto their disks. Adding DMA can increase the outbound transfer rate to 50 Kbytes/second. (Inbound transfers without DMA from those drives perform at 11.75 Kbytes/second in both BASIC 2.0/2.1 and BASIC 3.0.)



Porting to Series 300 and 4.0

Overview

This chapter mainly focuses on one objective:

- Making BASIC programs which have been written for Series 200 computers run on Series 300 computers. (This process is known as “porting” programs.)

Note

If you are porting from a “pre-3.0” version of BASIC to the 4.0 version, then you should also read the preceding “Porting to 3.0” chapter. Anytime you see 4.0 mentioned in this chapter it also refers to all subsequent system versions.

This chapter also discusses the following topics, which may not in all cases be directly related to porting existing Series 200 software to Series 300 computers:

- Configuring the built-in 98644-like RS-232C serial interface in Series 300 computers.
- Using the “98203 keyboard compatibility” mode with ITF keyboards (such as the 46020 keyboard).
- Using the 98546 Display Compatibility Interface in your Series 300 computer (this interface provides the alpha and graphics capabilities of the Model 217 computer).

Note

If you are not porting BASIC 3.0 programs to Series 300 computers (that is, if you will be using BASIC 4.0 on a Series 200 computer), then much of the first part of this chapter may not pertain to you. The subsequent sections called “Modifying the Source Program (Porting to 4.0)” and “BASIC 4.0 Enhancements for Series 200 Computers” will contain useful information for you.

Methods of Porting

Here are several methods of porting Series 200 software to Series 300 machines:

- Just load the program into a Series 300 computer—with no modifications—and run it.
- Write and run a program that properly configures the Series 300 computer for the program.
- Make your Series 300 computer emulate a Series 200 Model 217 computer (by installing a HP 98546 Display Compatibility Interface), and then run your unmodified Series 200 program on it.
- Modify your Series 200 BASIC source program, and then run it on a Series 300 computer with the BASIC 4.0 system.

Each method has a slightly different set of requirements for its use, as described subsequently.

Chapter Organization

This chapter is organized according to the above strategies. It consists of the following sections:

- Description of Series 300 computer hardware, focusing on the enhancements to and differences from Series 200 computers
- Descriptions of porting methods, including when and how to use each:
 - Just loading and running programs
 - Using configuration programs
 - Using the “Display Compatibility Interface”
 - Modifying the program’s source code

Note

Note that you may need to use more than one method in porting a program. For instance, you may need to write a configuration program *and* use the Display Compatibility Interface in order to port a program.

Description of Series 300 Hardware

Acquiring a general understanding of the enhancements or changes to Series 200 computers provided by Series 300 computers will help you to choose a porting method.

Areas of Change

Series 300 computers have changes in the following areas:

- Many choices of processor, display, and human interface boards:
 - Six displays (including a separate, high-speed display controller)
 - Two processors: MC68010, and MC68020 (with MC68881 math co-processor)
 - Battery-backed, real-time clock
 - RS-232C serial interface (similar to the 98644 serial interface)
 - ITF keyboard (“Integrated Terminal Family” keyboard, which is similar to Models’ 217 and 237 keyboards, but different from other Series 200 models’ keyboards)
- No ID PROM (not all Series 200 Models had this feature)

Areas that Did Not Change

It will probably be comforting to know that if a feature is not listed above (and discussed in this chapter), then it is the same for both Series 300 and Series 200 computers.

It may also be comforting to note that Series 300 computers can use most Series 200 accessories and peripheral devices. See the *HP 9000 Series 300 Configuration Reference Manual* for a complete list.

Displays

Series 300 display technology is the most visible area of change from Series 200 computers.

All Series 300 computers utilize bit-mapped alpha display technology, which *combines* alpha and graphics like the display of the Series 200 Model 237. (All other Series 200 models have *separate* alpha and graphics.)

The main difference between “non-bit-mapped” and “bit-mapped” alpha displays lies in whether or not alpha and graphics are separate.

2-4 Porting to Series 300 and 4.0

- With non-bit-mapped alpha displays, alpha is *separate* from graphics. Alpha is produced by character-generating hardware, while graphics are produced by bit-mapping hardware.

(You can use the `ALPHA` and `GRAPHICS` keys to turn on alpha and graphics independently. When alpha is already on, pressing the `ALPHA` key turns off graphics. Similarly, pressing the `GRAPHICS` key while graphics is on turns off alpha.)

- With bit-mapped alpha displays, alpha and graphics are *not* separate. Both alpha and graphics are produced by a combination of software and bit-mapping hardware.

(With BASIC 4.0, there is a way to configure the Series 300 *color* displays as separate alpha and graphics planes. This technique is described in the subsequent “Using a Configuration Program” section.)

An effect of bit-mapped alpha is that both alpha and graphics are dominant. In other words, displaying a character on the screen overwrites all pixels within the character cell; the previous contents of those pixels, which may have been graphics, are lost. Also, any scrolling/clearing of the alpha screen will scroll/clear the graphics information on the screen, since they share the same display plane. Conversely, graphics operations overwrite alpha-related pixels.

With Series 300 computers, you may choose from one of six displays: monochrome and color, each available in both medium-resolution (two monochrome and one color) and high-resolution (one monochrome and two color) versions. (Most Series 200 computers have only one display available for each model.)

- Medium-resolution graphics displays have 512 horizontal by 400 vertical pixels (many of the Series 200 graphics displays had 512×390-pixel graphics displays).

(Series 300 medium-resolution displays actually have 1 024 horizontal pixels. However, BASIC graphics (but not alpha) handles contiguous pairs of horizontal (non-square) pixels as one unit in order to make square dots on the screen. Series 300 medium-resolution displays actually have 512 vertical pixels; however, only 400 are displayed.)

Alpha capabilities of these medium-resolution displays are 80 columns of characters by 26 lines on-screen, plus 51 lines off-screen (as opposed to the

80×25-character alpha displays, with 39 lines off-screen, of many Series 200 computers). The characters on Series 300 medium-resolution displays are in a 12×15-pixel cell. These displays have no blinking mode (except for the alpha cursor), and no half-bright mode.

- High-resolution displays have 1 024 horizontal by 768 vertical pixels. (Series 300 high-resolution displays actually have 1 024 vertical pixels; however, only 768 are displayed.)

Alpha capabilities of high-resolution displays are 48 lines of 128 characters, with no lines off-screen, like the Model 237. The characters are in an 8×16-pixel cell. These Series 300 high-resolution displays also have no half-bright mode and no blinking mode (except for the alpha cursor on all Series 300 displays except the 98700 display controller).

Processor Boards

Two processor boards are available with Series 300 computers:

- Medium-performance boards, which feature an MC68010 processor (10 MHz clock rate).
- Higher-performance boards, which feature an MC68020 processor (16 MHz clock rate) and an MC68881 floating-point math co-processor.

(Series 200 computers have either an MC68000 or MC68010 processor with an 8 or 12.5 MHz clock, depending on model numbers and product options.)

The 68010 is a 16-bit virtual memory microprocessor with a 32-bit internal architecture, while the MC68020 is a 32-bit microprocessor with an internal 256-byte instruction cache (which is normally operative but can be disabled by executing `CONTROL 32,3;0`).

The MC68020 also has a flexible co-processor interface that allows close coupling between the main processor and co-processors such as the MC68881 floating-point math co-processor. The MC68881, which provides full IEEE floating-point math support, can execute concurrently with the MC68020 and usually overlaps its processing with the 68020's processing to achieve higher performance. The MC68881 provides increased performance for floating-point operations, particularly for the evaluation of transcendental functions; refer to the "Efficient Use of the Computer's Resources" chapter in the *HP BASIC Advanced Programming Techniques* manual for further details. (The MC68881

2-6 Porting to Series 300 and 4.0

co-processor is normally operative, but you can disable it by executing CONTROL 32,2;0.)

Battery-Backed Real-Time Clock

Series 300 computers have a built-in, battery-backed, real-time clock as well as a built-in volatile clock. Both have a lower limit of March 1, 1900. However, the upper limit of the volatile clock is August 4, 2079, while the upper limit of the non-volatile clock is February 29, 2000.

(Only Series 200 Models 226 and 236 could have optionally installed battery-backed, real-time clocks. This hardware was included with the HP 98270 Powerfail Option, whose main purpose was to provide power during brown-out or black-out situations.)

Built-In Interfaces

All Series 300 computers have a built-in HP-IB interface, which is the same as the built-in HP-IB interface of all Series 200 computers.

Series 300 computers also feature the following built-in interfaces, which differ slightly from some of their Series 200 counterparts:

- RS-232C serial interface (like the HP 98644 low-cost serial interface).
- HP-HIL keyboard interface (like the one in Models 217 and 237)

Serial Interface

All Series 300 computers have a built-in, 98644-like, serial interface. As with Series 200 Models 216 and 217 built-in serial interfaces, this interface is permanently set to select code 9. However, this interface differs slightly from versions of the Series 200 built-in serial interface (which are like the optional HP 98626 serial interface).

Since the goal of the 98644 is to provide a low-cost serial interface, there are no hardware switches that allow you to specify values for the following parameters:

- Select code (hard-wired to 9)
- Interrupt level (hard-wired to 5)
- Default baud rate (the BASIC system sets default to 9600 baud)
- Default line control parameters (the BASIC system sets defaults to 8 bits/character, 1 stop bit, parity disabled).

If your program expects any other values for the baud rate and line control parameters, you will have to change them programatically (select code and interrupt level cannot be set programmatically). See “Using a Configuration Program” in this chapter for further information.

HP-HIL Keyboard Interface

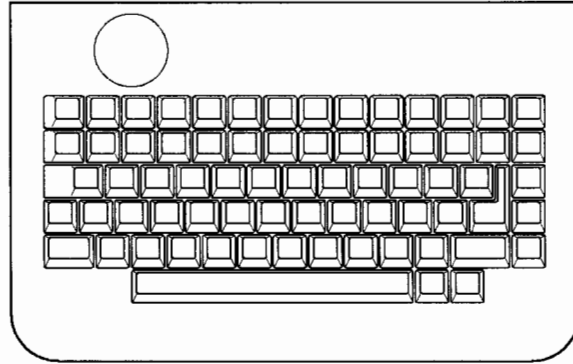
Like the Series 200 Models 217 and 237 computers, Series 300 computers are equipped with ITF (“Integrated Terminal Family”) keyboards connected through an HP-HIL interface (Hewlett-Packard Human Interface Link).

Note With BASIC 4.0 and subsequent system revisions, the HP 98203C keyboard is also *optionally* available. This keyboard has the layout of the HP 98203B keyboard (and Model 226 and 236 built-in keyboards), but it is connected to the computer through the HP-HIL interface. If you will be using this keyboard, you will not have to make any changes to programs that use the HP 98203B-style keyboard.

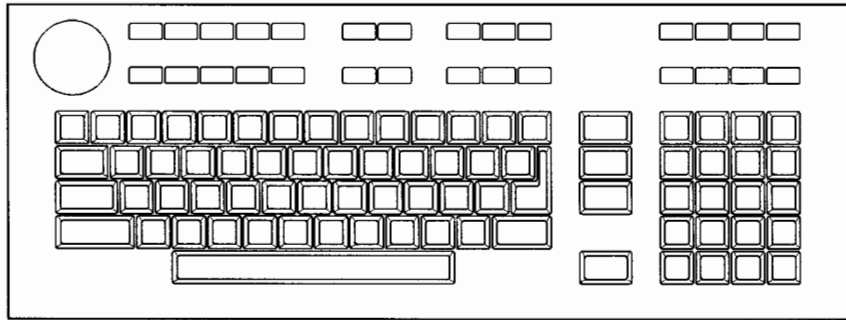
Note If you are porting existing Series 200 software to Series 300 and have already modified it to run on a Model 217 or 237 computer’s ITF keyboard, then you have already made the adjustments necessary for this keyboard. If not, then continue reading this section.

The major human-interface differences between 98203 keyboards and ITF keyboards are in the number and layout of “user” and “system” function keys.

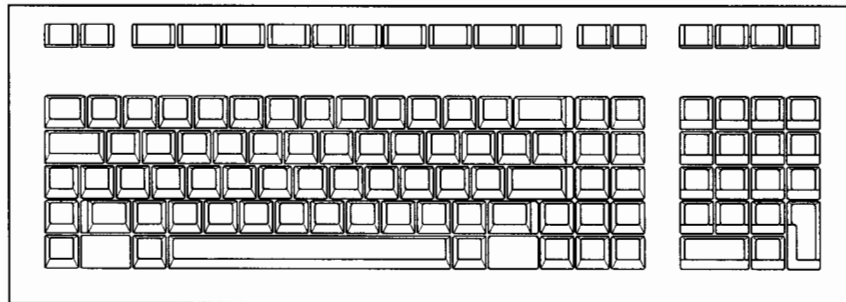
2-8 Porting to Series 300 and 4.0



HP 98203A Keyboard



HP 98203B/C Keyboard



ITF Keyboard

Note that the ITF keyboard has only eight *physical* “user” function keys (**f1** through **f8**), rather than **k0** through **k9**), and lacks some of the *physical* “system” keys (such as **ALPHA** and **RUN**). However, ITF keyboards actually have *more* functionality than 98203 keyboards, because BASIC provides several “system” and “user” definitions for ITF function keys **f1** through **f8**. For complete definitions of each key on every keyboard, see the “Keyboard Reference” chapter of the *Using BASIC* manual.

BASIC also provides a way to emulate the operation of a 98203 keyboard using an ITF keyboard. Using this mode is a convenient way of porting Series 200 programs to Series 300 machines without modifying the source program. For further details of the “98203 compatibility mode”, see the subsequent “Using a Configuration Program” section. (A keyboard overlay is provided with the system to label BASIC definitions of several ITF keys. The subsequent “98203 Keyboard Compatibility Mode” section describes the use of this overlay in both normal and compatibility modes.)

Also note that the 98203 keyboards can produce some keycodes that cannot be produced with the 46020 keyboard. These keycodes are produced by pressing the **EXECUTE** and **EDIT** keys. Thus if the Series 200 program depends upon these keycodes, the source code must be modified. See the subsequent “Modifying the Source Program” section for further details.

ID PROM

Note that there is no built-in ID PROM available with Series 300 computers, as was the case with many models of Series 200 computers. However, an equivalent feature is provided by an optional HP-HIL device—the 46084A ID Module.

If the program reads the ID PROM’s contents with a `SYSTEM$(“SERIAL NUMBER”)` function call, then the program will also read the ID Module’s contents correctly. However, if its contents were read by a CSUB (CSUB stands for Compiled SUBroutine, which is a program written in Pascal and generated using the CSUB Utility), then you will need to use a version that does not read the ID PROM.

Just Loading and Running Programs

This is the most desirable method, since it requires the least amount of work—just load the program into the Series 300 computer, and run it.

You can probably port most of your BASIC 3.0 or 3.01 programs this way.

There are three different actions you can take, depending on who developed your program:

- If HP developed the program, look in the “Operating Systems and Applications” section of the *HP 9000 Series 300 Configuration Reference Manual*. The manual shows which 3.0 or 3.01 applications will run on a Series 300 computer using the 4.0 system.
- If another software vendor developed the program, check with that vendor to determine whether it will run on a Series 300 computer. (You can also take one of the two actions listed below.)
- If you developed the program, you can do one of two things:
 - Read through the following sections to see whether it requires another porting method.
 - Try running it.

Should Problems Arise

If your program will not run on your Series 300 system, then you may want to make considerations such as the following:

- Does it meet all of the criteria listed in the subsequent sections?
- Is there sufficient memory in the computer?
- Are all the necessary devices and corresponding device drivers installed?
- Have you fulfilled *all* other requirements listed by the software developer?

If the program still doesn't run, then you may want to call the organization responsible for supporting the program (the programmer, the software vendor, or HP).

Using a Configuration Program

This method involves writing a program that configures the system for your program. Here are the situations for which this porting method will work:

- The program depends on a “non-default” 98626 serial interface configuration as set by hardware switches.
- The program depends on the 98203 keyboard layout (but does not depend on trapping the **EXECUTE** or **EDIT** keys).
- The program depends on separate alpha and graphics planes (and you have a Series 300 color display which you can configure to have separate alpha and graphics).

HP 98644 Serial Interface Configuration

Here is an example situation for which you could use this method. Suppose your program depends on reading the following “non-default” parameters from the configuration switches on the 98626-like, built-in serial interface in a Model 217:

- 4800 baud
- 7 bits per character (with 1 stop bit) and odd parity.

However, the default parameters for the built-in 98644-like interface in Series 300 computers are as follows:

- 9600 baud
- 8 bits/character (with 1 stop bit), and parity disabled

One solution is to use a short program that selects the desired “non-default” baud rate (4800) and line-control parameters (7 bits, odd parity). This example program changes the “default” parameters by writing to CONTROL registers 13 and 14. (Note that you can also execute these CONTROL statements directly from the keyboard.)

```

100 CONTROL 9,13;4800 !           Baud rate.
110 CONTROL 9,14;IVAL("11001010",2) ! No handshake (bits 7,6)
120 !                               Odd parity (bits 5-3)
130 !                               1 stop bit (bit 2)
140 END !                           7 bits/char (bits 1,0)

```

Enter and run this program on the 4.0 system, making sure that the SERIAL binary program is installed beforehand. The serial card is properly configured by this program, which you may want to verify by reading the corresponding STATUS registers. You can then run the application program.

Another solution is to modify the source program to select these parameters (i.e., insert this segment of code into the program). In such case, you could change the “current” parameters by writing to CONTROL registers 3 (baud rate) and 4 (line control). However, if the interface is reset with the SCRATCH A statement, then the values in these registers will be restored to the “default” values currently in registers 13 and 14. See the *HP BASIC Interfacing Techniques* manual for details on the serial interface registers.

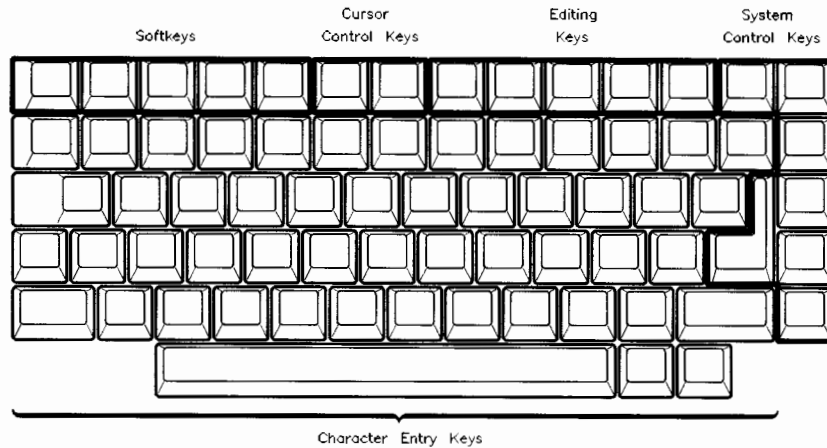
HP 98203 Keyboard Compatibility Mode

The BASIC system provides a mode of keyboard operation in which the ITF keyboards are compatible with (i.e., emulate) 98203 keyboards. Before describing how the compatibility mode works, it will be helpful to review each keyboard’s layout and normal operation.

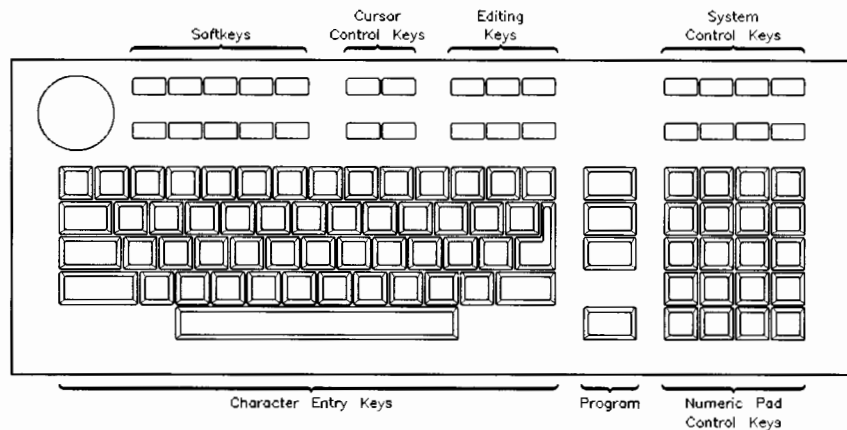
Brief Comparison of Keyboard Layouts

Below are diagrams of each keyboard. They are shown here for the purpose of comparing their physical differences. For a key-by-key description of each one, refer to the “Keyboard Reference” section of the *Using BASIC* manual.

The following figures show the layouts of the 98203 keyboards.



HP 98203A Keyboard



HP 98203B and C Keyboards

Note the “system” keys across the top of the keyboard (two rows across the top and one column down the middle of the larger 98203B; one row across the top and one column down the right side of the smaller 98203A).

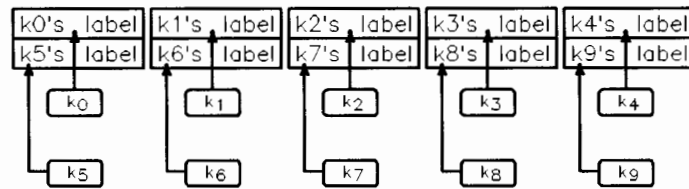
Softkeys on the 98203 keyboards are labeled **(k0)** through **(k9)**. There are corresponding “softkey labels” which can be displayed on the alpha screen. For instance, you can enable the display of the default “typing-aid” labels by executing the following statement.

2-14 Porting to Series 300 and 4.0

LOAD BIN "KBD"

If this binary is already loaded and the "typing-aid" definitions are not currently displayed, execute LOAD KEY (with no file specifier).

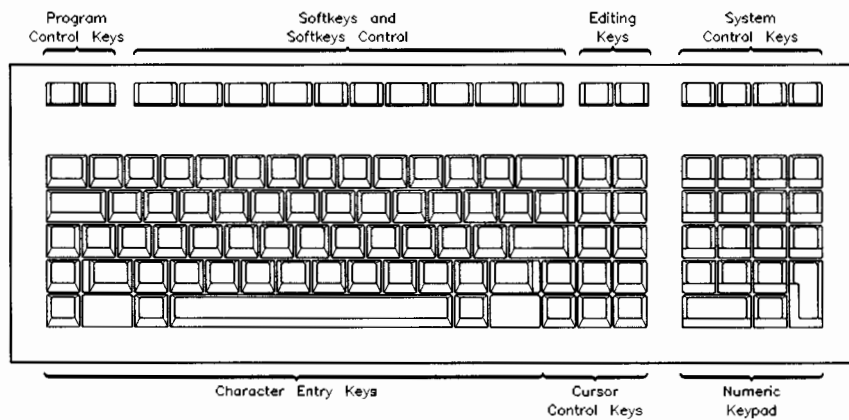
Here is the format of the 98203 softkey labels. (Note that they match the physical layout of the softkeys.)



HP 98203 Softkey Labels

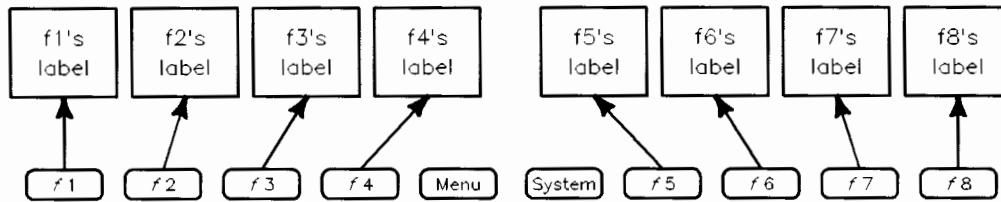
There are 2 rows of 5 labels each. Each label consists of up to 14 characters.

Contrast this layout to that of the ITF keyboards:



ITF Keyboards (such as the 46020)

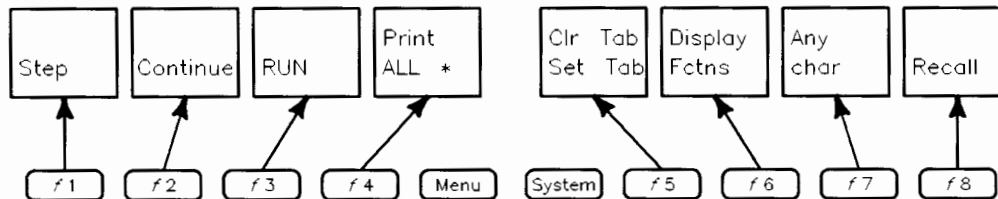
Here are the default ITF “typing-aid” labels and corresponding keys. There is 1 row of 8 labels. Each label consists of up to 16 characters (2 rows of 8 characters per label).



HIL “Typing-Aid” Softkey Labels

Even though the ITF keyboards have fewer physical function keys, they have *more* functionality than 98203 keyboards. This additional functionality is due to the fact that BASIC provides 1 menu of “system” keys (shown below) and 3 menus of “User” definitions for softkeys **f1** through **f8**.

Here is the ITF “System” menu of keys, which you can display by pressing the **Menu** key (if labels are not already displayed) and then the **System** key:



HIL “System” Menu Labels

This menu of softkey definitions provides most of the 98203 system key functions.

As you can see, there are two main areas of differences between 98203 keyboards and ITF keyboards:

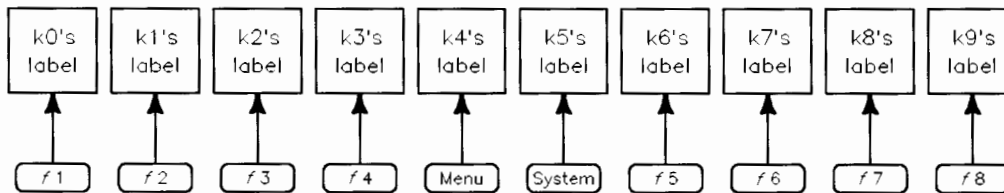
- There are several “system” keys on the 98203 keyboards, such as **STEP**, **CONTINUE** (**CONT** on the smaller 98203A keyboard) and **RECALL** (**RCL** on the 98203A). These system functions are not written on the key-cap labels of ITF keyboards, but the BASIC system functions are available on the System menu.
- Softkeys on the 98203 keyboards are labeled **k0** through **k9**. Thus, there are 20 softkeys available on the larger 98203 keyboards (by using **SHIFT**), and 10 on the smaller 98203 keyboard. Softkeys on the ITF keyboard are labeled **f1** through **f8**. Thus, there are 24 softkeys available on these keyboards (3 menus of 8 keys each). The number and size of screen labels are also different.

Enabling Keyboard Compatibility Mode

You can enter this mode by writing a non-zero value into keyboard control register 15:

```
CONTROL KBD,15;1
```

The following correspondence between function keys and labels is established (if you are in edit mode when you enter this compatibility mode, then edit mode is canceled):



Correspondence Between Function Keys and Labels

There is 1 row of labels, and each label may have up to 14 characters (two rows of 7 characters each).

If you want to fully emulate the 98203 keyboard and corresponding softkeys' display behavior, you will need to execute the following statements:

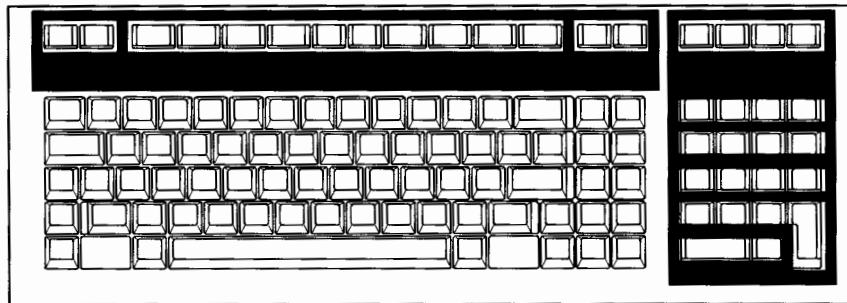
```
CONTROL CRT,12;0  
LOAD KEY
```

The CONTROL statement sets up the “key labels display mode” to match the default behavior of a display with the 98203 keyboard. The LOAD KEY statement loads the default “typing-aid” softkey definitions for the 98203 keyboards.

Using Compatibility Mode

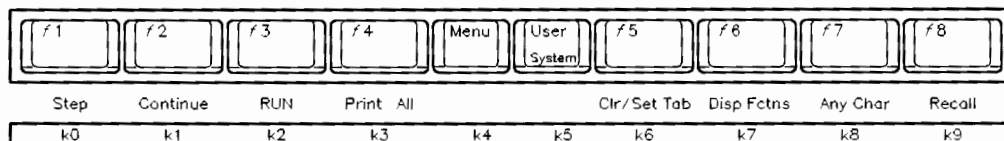
Here is a listing of the correspondence between ITF keys and 98203 keys while in this mode. For a detailed description of each 98203 key's function, see the “Keyboard Reference” chapter of *Using BASIC* manual.

Note Place the BASIC keyboard overlays on the ITF keyboard before reading this section. Also note that you can use these overlays in normal mode as well as in compatibility mode.

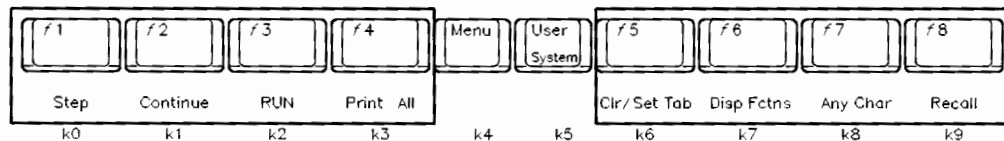


- To access a 98203 *softkey* definition, merely press the appropriate ITF softkey. For instance, the ITF **f1** softkey emulates the 98203 **k0** softkey, and the ITF **Menu** key emulates the 98203 **k4** softkey. (These key definitions are printed on the *bottom* row of the keyboard overlay.)

Similarly, 98203 softkeys **k1** through **k1** are accessed by pressing the ITF **Shift** key with the appropriate softkey.

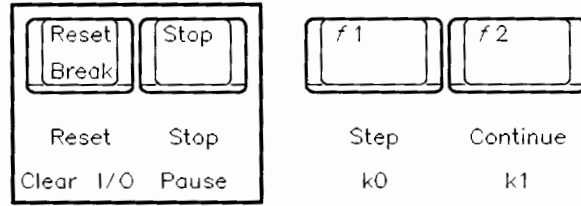


- To access a 98203 *system-key* definition, press **Extend char** with the appropriate ITF softkey. For instance, the ITF **Extend char**-**f1** key emulates the 98203 **STEP** key. (These key definitions are printed on the *top* row of the keyboard overlay. Note that these definitions are the same as in the normal-mode System softkey menu.)

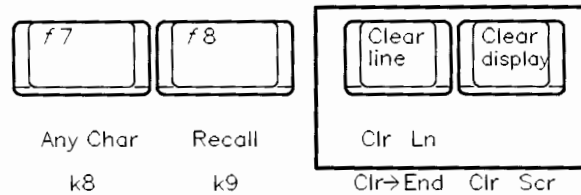


2

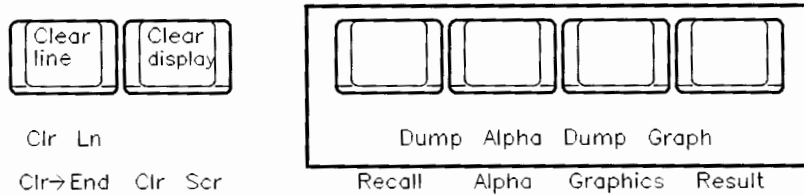
- The 98203 **CLR I/O** and **PAUSE** *system-key* definitions are available by using the ITF **Break** and **Stop** keys (*without* pressing **Extend char**). Note that these key definitions are the same in normal mode.



- The 98203 **CLR→END**, **CLR LN**, and **CLR SCR** *system-key* definitions are available by using the ITF **Clear line**, **Shift Clear line**, and **Clear display** keys. Note that these key definitions are the same in normal mode.

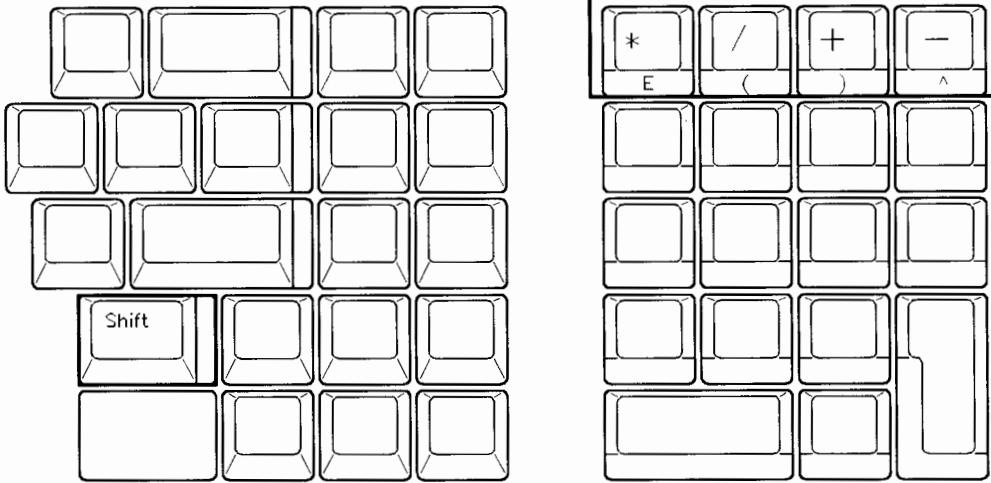
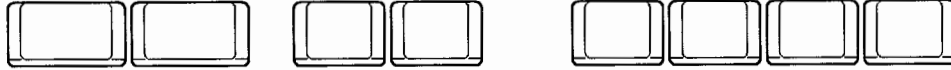


- The 98203 **RECALL**, **ALPHA**, **GRAPHICS**, and **RES** *system-key* definitions are available by using the *unlabeled* ITF keys above the numeric keypad. The shifted keys also have corresponding definitions (for example, **Shift Alpha** is the DUMP ALPHA function). Note that these key definitions are the same in normal mode.



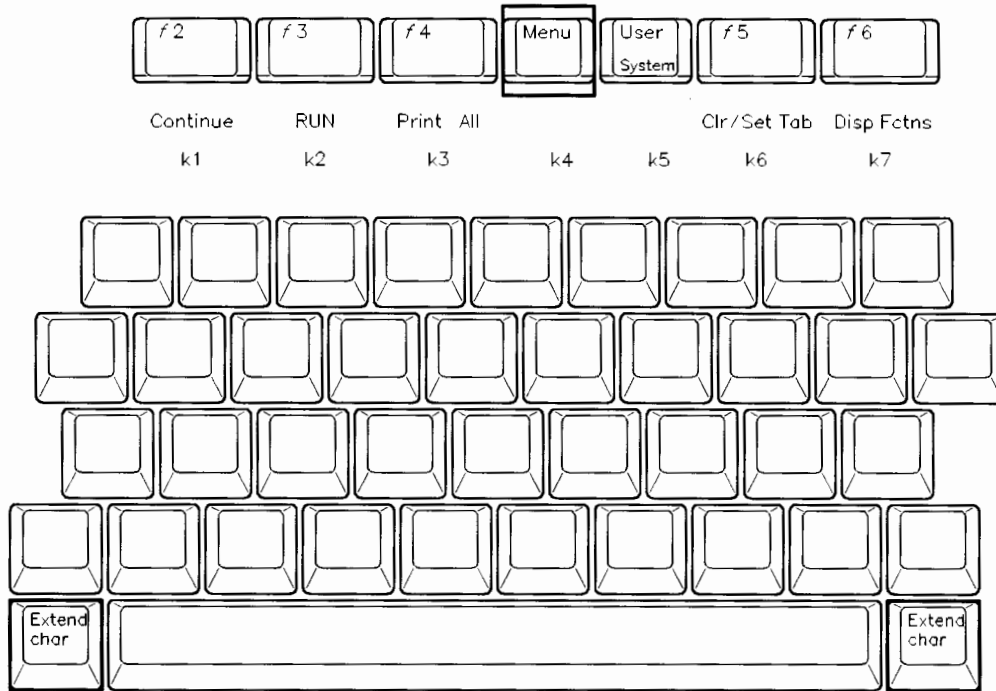
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- When shifted, the *, /, +, and - ITF keys on the top row of the numeric keypad have the same definitions as the keys on the top row of the 98203 numeric keypad. They are E (Shift-*), ((Shift-/),) (Shift+), and ^ (Shift-). Note that these key definitions are the same in normal mode.



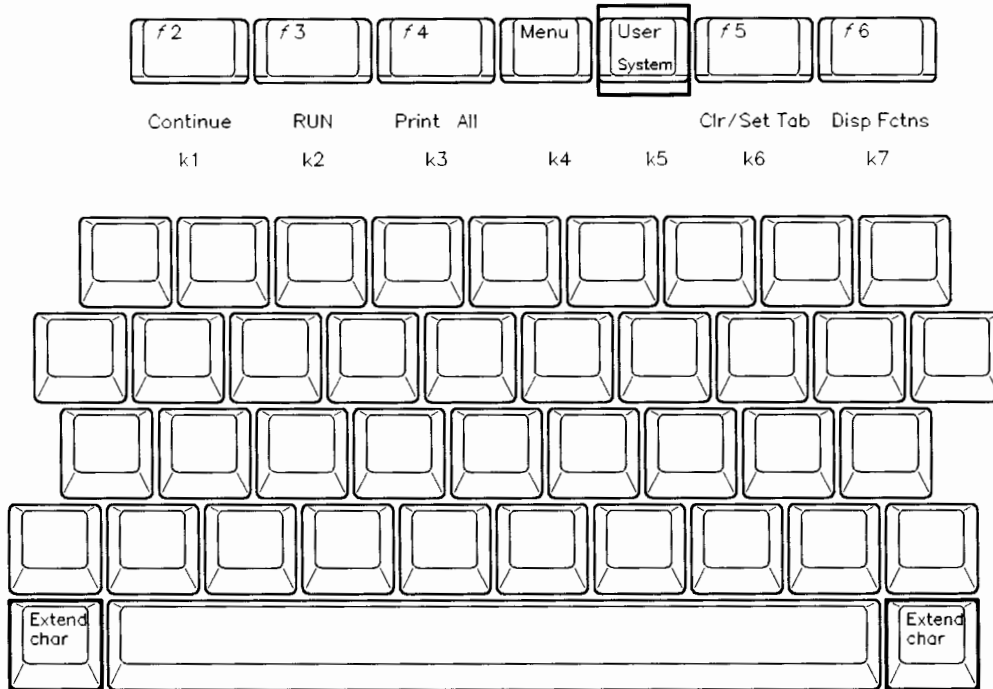
2

- **Extend char** **Menu** is an on/off toggle for the *key labels*. (**Extend char** **Shift** **Menu** produces no visible change.)



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- **Extend char**-**System** exits compatibility mode, and returns you to the ITF “System” key definitions. Similarly, **Extend char**-**User** exits this mode, and returns you to the ITF “User 1” key definitions. (Note that there is no corresponding keystroke to return to compatibility mode.)



Exiting Keyboard Compatibility Mode

In addition to using the **Extend char**-**System** and **Extend char**-**User** keys to exit this mode, you can also use keyboard register 15:

```
CONTROL KBD,15;0
```

If the system is currently in edit mode, then exiting keyboard compatibility mode will also cancel the edit mode.

If you were emulating the 98203 keyboard and corresponding softkeys' display behavior (and want to return to the “normal” behavior), you will need to execute the following statements:

```
CONTROL CRT,12;2  
LOAD KEY
```

The CONTROL statement restores the “key labels display mode” to the default behavior of a display with the ITF keyboard. The LOAD KEY statement restores the default “typing-aid” softkey definitions for the ITF keyboard.

Configuring Separate Alpha and Graphics Planes

With BASIC 4.0 on bit-mapped color (multi-plane) displays, you have the ability to specify which planes are to be:

- write-enabled and used to display alpha
- write-enabled and used to display graphics

This feature allows you to simulate separate alpha and graphics of Series 200 displays. For instance, you will be able to:

- Turn alpha and graphics on and off independently.
- Dump them separately.
- Scroll alpha without scrolling graphics.

An Example

Assuming that you have a four-plane display, you could enable plane 4 for alpha and planes 1 through 3 for graphics. The following program performs this as well as some other operations, as described in the program's comments (note that BASIC 5.0 provides the SEPARATE ALPHA FROM GRAPHICS statement to perform nearly the same functions as this program; see the *HP BASIC Language Reference* for details):

```

100 PLOTTER IS CRT,"INTERNAL";COLOR MAP ! Select Series 300 graphics.
110 FOR I=8 TO 15
120   SET PEN I INTENSITY 0,1,0           ! Set alpha pen colors (green).
130 NEXT I
140 CONTROL CRT,5;0                       ! Set alpha pen to black (temp.)
150 OUTPUT KBD;CHR$(255)&"K";           ! Clear alpha screen.
160 CONTROL CRT,18;8                     ! Select plane 4 for alpha.
170 CONTROL CRT,5;8                     ! Set alpha pen.
180 INTEGER Gm(0)                        ! Declare array for GESCAPE.
190 Gm(0)=7                              ! Set bits 2,1,0, which select
200 GESCAPE CRT,7,Gm(*)                  ! graphics planes 3,2,1.
210 ! PLOTTER IS CRT,"INTERNAL"         ! Return to non-color-map
220 END                                  ! mode (optional).

```

This program provides eight graphics pen colors (either the default or previously defined colors) and a single alpha pen color (green).

For more information concerning graphics displays, see the the “Multi-Plane Bit-Mapped Displays” section of the manual *HP BASIC Programming Techniques, Volume II: General Topics and Graphics*. For more information on alpha displays, see the “Display Interfaces” chapter of the *HP BASIC Interfacing Techniques* manual.

Using the Display Compatibility Interface

This method involves installing an HP 98546 Display Compatibility Interface, which consists of essentially the *separate* graphics and alpha boards of the Series 200 Model 217 computer. You can then direct the system to use the compatibility display, enabling you to run existing Series 200 programs, which depend on this display's characteristics, on your Series 300 computer.

This card set remedies the following situations.

- The program depends on having separate alpha and graphics planes (and you do not have a color display which can emulate this feature, as described in the preceding "Configuring Separate Alpha and Graphics Planes" section).
- The program directly accesses alpha or graphics hardware (such as through a CSUB, rather than through a BASIC graphics statement).
- The program depends on blinking alpha display highlights (characters with codes 130, 134, and 135).
- The program depends on the Model 217's specific graphics resolution (512×390 pixels) or alpha display size (80×25 characters), or upon its specific alignment of graphics pixels and alpha pixels.

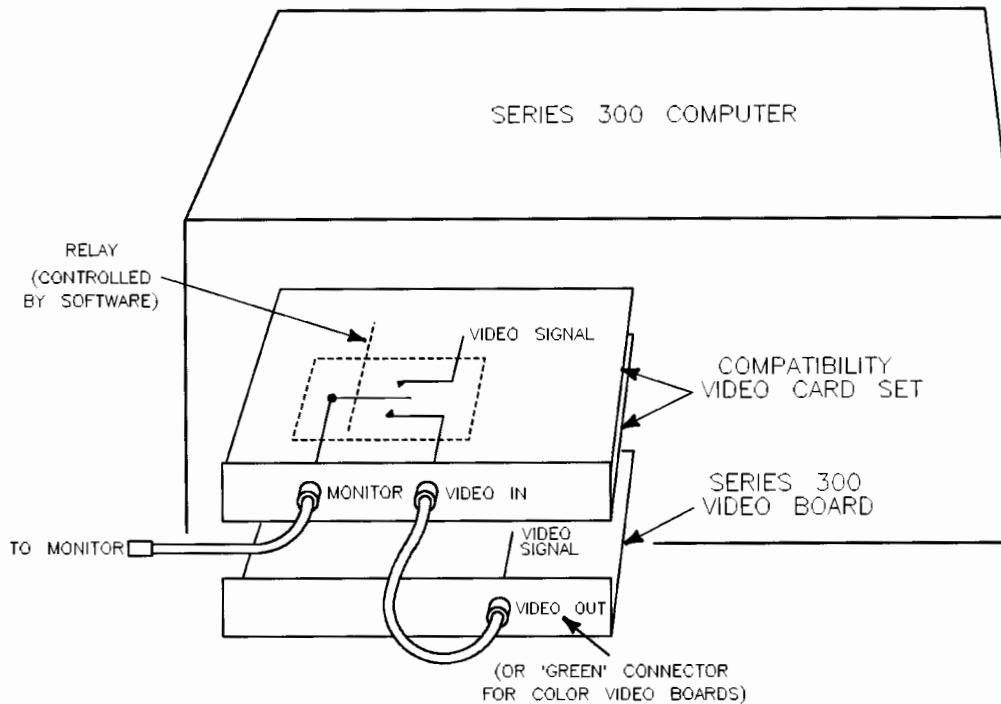
This method is required if any of the above statements is true *and* you cannot modify a program's source code (or don't want to). If you have the program's source code, then you may want to instead make the necessary modifications to it.

If your program requires separate alpha and graphics and also uses color, you have the option of using any color graphics display to drive a separate color monitor. Graphics can be displayed on this color monitor while alpha is display on the original monitor.

Hardware Description

2

The card set consists of two circuit cards joined by a cable.



The HP 98546 Display Compatibility Interface

These cards are:

- An alpha display card, which is like the existing 98204B display controller card except for a relay and an additional BNC video connector on the rear panel.
- A graphics display card, which is identical to the Model 217's graphics card.

The Relay and BNC Video Connectors

The relay on the alpha card is used to switch between using the Series 300 bit-mapped display's signal and using the compatibility display's signal.

Display Compatibility Interface Capabilities

Capabilities of this card are identical to those of the Model 217. The alpha display is an 80×25-character screen with half-bright, blinking, underline, and inverse-video display enhancements. The graphics display is 512×390 monochrome pixels.

Configurations Possible

Here are the video-interface/monitor configurations possible:

- *Shared monitor:* The Display Compatibility Interface and the Series 300 bit-mapped display can share a medium-resolution monitor (monochrome or color).
- *Separate monitors:* The Display Compatibility Interface can use a medium-resolution monitor, and a Series 300 Video Board can use a separate monitor (monochrome or color, whichever is appropriate).
- *Single monitor:* The Display Compatibility Interface can use a medium-resolution monitor (with *no* Series 300 bit-mapped display).

Steps in Using this Card Set

Here are the steps you will take with this method:

1. Turn off the computer.
2. Configure and install the Display Compatibility Interface according to the instructions in its *Installation Note*. Also connect the monitor(s) as described in that note.
3. Turn on the computer, and boot the BASIC system.
4. Load the CRTA display driver binary, if not already installed.
`LOAD BIN "CRTA"`
5. Select the Display Compatibility Interface as the display device.

```
CONTROL CRT,21;1 
```

Note When using one monitor for two different displays (as in the “shared monitor” configuration described earlier), a small amount of time is required for the monitor to synchronize with the new display whenever you switch from one display to the other. It is normal for the screen to flicker when this switch is made.

The preceding CONTROL statement also performs the following actions:

- Chooses and sets up the Display Compatibility Interface’s alpha display as appropriate:

- Sets all CRT registers to the appropriate default values.
- Clears the Series 300 bit-mapped display screen.
- Displays a cursor.
- Displays key labels (if appropriate) in half-bright mode.
- Displays a status indicator, such as the run light (if appropriate).

(See “How the Default Alpha Display Is Chosen” in the “Display Interfaces” chapter of *HP BASIC Interfacing Techniques*. Items 1 and 2 are exchanged and a new selection of the “default display device” is made.)

- Chooses and sets up the Display Compatibility Interface’s graphics display by effectively initializing this display and executing GINIT and PLOTTER IS CRT, "INTERNAL". (The “default graphics display” is chosen according to the order listed under PLOTTER IS in the *HP BASIC Language Reference*.)

Switching Back to the Series 300 Display

The CONTROL statement is also used to select the Series 300 display:

```
CONTROL CRT,21;0 Return
```

The preceding CONTROL statement performs the following actions:

- Chooses and sets up the Series 300's alpha display as appropriate:
 - Sets all CRT registers to the appropriate default values.
 - Clears the Display Compatibility Interface's alpha display.
 - Displays a cursor.
 - Displays key labels (if appropriate).
 - Displays a status indicator, such as the run light (if appropriate).

(See "How the Default Alpha Display Is Chosen" in the "Display Interfaces" chapter of *HP BASIC Interfacing Techniques*. A new selection of the "default display device" is made. Items 1 and 2 are *not* exchanged as in the switch to the Display Compatibility Interface.)

- Chooses and sets up the Series 300 graphics display by effectively initializing the bit-mapped display and executing GINIT and PLOTTER IS CRT, "INTERNAL". (The "default graphics display" is chosen according to the order listed under PLOTTER IS in the *HP BASIC Language Reference*.)

Automatic Display Selection at System Boot

When the BASIC system is booted with *both* the Display Compatibility Interface and the Series 300 bit-mapped display installed, it automatically selects one of them in the following manner:

- If only the CRTA driver is installed, the system selects the Display Compatibility Interface.
- If only the CRTB driver is installed (or if both CRTA and CRTB are present), the system selects the Series 300 bit-mapped display.

If only the Display Compatibility Interface is installed, the system selects it as the display (CRTA must be currently installed, of course). For a more detailed description of how the BASIC system selects the "default display device," see the "Display Interfaces" chapter of *HP BASIC Interfacing Techniques*.

Removing Display Drivers

You can use SCRATCH BIN to remove all but the currently required display driver. In other words, if you are in compatibility display mode, then CRTB is removed. If you are in “native” Series 300 display mode (i.e., not in compatibility mode), then CRTA is removed.

If Your Screen Is Blank

Your screen can go blank (and characters you type in from the keyboard are not “echoed” on the screen) under the following conditions:

- You have both a Display Compatibility Interface and a Series 300 bit-mapped display installed, and they are sharing the same monitor.
- You are not in compatibility mode (i.e., alpha is on the bit-mapped display).
- You are running a BASIC program that contains the following statement:

```
PLOTTER IS 3,"INTERNAL"
```

The execution of this statement causes your screen to go blank. You have just lost your alpha and graphics.



What Happened?

The PLOTTER IS 3, “INTERNAL” statement changed the current plotter device from 6 (bit-mapped display) to 3 (compatibility display). The system is talking to the compatibility cards, and the software-controlled relay that switches from the bit-mapped to the compatibility display has been (implicitly) directed to switch to the compatibility display’s video signal. However, the remainder of the operations performed by the CONTROL CRT,21;1 statement have not been performed. Therefore, you will not be able to see your alpha or graphics.

What To Do Next

Temporary solution: You can do one of two things:

- To return to the bit-mapped display, first press the **Reset** key, and then execute a `SCRATCH A` or `CONTROL CRT,21;0` statement.
- To select the Display Compatibility Interface, execute `CONTROL CRT,21;1`.

Note that you will not see any characters echoed on the display until you have executed one of the above statements.

Long-term solution: Change all references to select code “3” to “CRT” (e.g. `PLOTTER IS CRT, "INTERNAL"`).

Another Related Note

If you want to determine how well your program runs on a Series 300 bit-mapped display and this program executes a `PLOTTER IS 3, "INTERNAL"` statement, and you have Display Compatibility Interface installed, then you will not be able to adequately test the functionality of your software on a bit-mapped display unless you first remove the compatibility hardware (or change the `PLOTTER IS 3, "INTERNAL"` statements to `PLOTTER IS CRT, "INTERNAL"`).

Modifying the Source Program (Porting to 4.0)

This method involves changing or adding to the program’s source code to make an existing (pre-4.0) program perform the desired operations on the 4.0 system.

Here are some, but not all, situations for which this method is required:

- The program depends on a CSUB with version 3.01 (or earlier).
- The program depends upon trapping HP 98203 **EXECUTE** or **EDIT** key codes, which cannot be generated by an ITF keyboard.
- None of the preceding porting methods worked. (In such case, you should read the subsequent “Additional Porting Considerations” section to see if your problem is described therein.)

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If any of the above statements is true, then you must modify the program to run on the 4.0 system. If you do *not* have access to the source code, then you *cannot* port it—you will have to obtain a BASIC 4.0 version of the program, if it is available.

Incompatible CSUBs

An example of this situation is a program that depends upon using a “pre-4.0” CSUB.

To remedy this situation, you will need to obtain a CSUB that is compatible with the BASIC 4.0 system. (This may require modifying the CSUB source program; it will definitely require re-generating a new CSUB with the CSUB 4.0 Utility.)

HP 98203 Specific Key Codes

The 98203 keyboards can generate **EXECUTE** and **EDIT** key codes which cannot be generated by a 46020 keyboard. If your program depends on trapping these key codes, then you will need to modify it to use 46020 keys instead. For instance, you could trap the ITF **Select** key rather than the 98203 **EXECUTE** key. See the “Keyboard Interfaces” chapter of the *HP BASIC Interfacing Techniques* manual for examples of trapping keystrokes with a BASIC program.

Additional Porting Considerations

This section describes the following topics, which may also require consideration in porting programs from “pre-4.0” BASIC programs to the BASIC 4.0 system.

- New SYSTEM\$(“SYSTEM ID”) values for Series 300 computers
- Alpha color changes on Series 300 color displays
- Alpha screen height and graphics scrolling
- GLOAD/GSTORE compatibility
- PLOTTER IS statement
- Hidden color changes
- ON KNOB “interval” parameter for HP-HIL knobs

New SYSTEM\$(“SYSTEM ID”) Values

On Series 300 computers, SYSTEM\$(“SYSTEM ID”) will return two different values:

- S300:10 for computers with an MC68010 processor
- S300:20 for computers with an MC68020 processor

Alpha Color Changes

With multi-plane bit-mapped displays, printing one of the alpha color highlight characters, CHR\$(136) through CHR\$(143), will provide the same colors as on the Model 236C as long as the color map contains *default* values. A user-defined color map which changes the values of any pen in the range 0 to 7 will consequently change the effect of the corresponding color highlight character. See “Display-Enhancement Characters” in the “Useful Tables” appendix of the *HP BASIC Language Reference* for more information.

Alpha Screen Height and Graphics Scrolling

With BASIC 3.0 and later versions, you can limit the height of the alpha portion of the screen. For instance, to limit the alpha portion of the screen to the bottom 11 lines, execute this statement:

```
CONTROL CRT,13;11
```

The screen height parameter of 11 specifies the number of lines to be used for the alpha screen (4 lines of “output area,” and 7 lines used by the system). The value of this parameter may not be less than 9. A corresponding STATUS statement will return the current screen height.

This capability allows you to separate alpha and graphics on a single-plane bit-mapped display screen. You would also have to limit graphics to the upper portion of the screen (which is not used for alpha).

GLOAD/GSTORE Compatibility

Raster images loaded by GLOAD should have been stored (GSTORE) from the same type of display. Otherwise, if the image was stored on a machine with a different graphics resolution or number of bits per pixel, then the resultant image will be scrambled.

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If your program first creates a graphics image and then GSTOREs and GLOADs it, then the image may be truncated (due to the difference in required array sizes). With BASIC 4.0, you can use the GESCAPE statement to determine the required array size.

For example, the Model 236C requires an integer array size of 49 920 elements to store information from the graphics planes in the frame buffer $[(4 \text{ bits/pixel}) \times (512 \times 390 \text{ pixels}) / (16 \text{ bits/integer})]$, while a Series 300 medium-resolution color display requires 102 400 elements $(4 \times (1024 \times 400) / 16)$. The value of 1024 is used because Series 300 medium-resolution bit-mapped displays have non-square-pixels.

See GLOAD and GSTORE in the *HP BASIC Language Reference* for details concerning this topic. With BASIC 4.0, there are new utility CSUBs (Bstore and Bload) that allow you to store and load *specified portions* of the graphics raster. You may alternatively want to use these utilities in favor of using GSTORE and GLOAD.

PLOTTER IS Changes

There are several values that you can use when specifying the graphics display; however, the following examples show the best way:

```
PLOTTER IS CRT,"INTERNAL"  
PLOTTER IS 1,"INTERNAL"
```

CRT is a built-in function that always returns 1. The value of 1 signifies the “default display” (to the PLOTTER IS statement).

The following statement, with select code of 3, specifies a non-bit-mapped display, if there is one; otherwise it is the same as PLOTTER IS 1, “INTERNAL”.

```
PLOTTER IS 3,"INTERNAL"
```

The following statement *always* specifies a bit-mapped display. If one is not currently installed, then an error results.

```
PLOTTER IS 6,"INTERNAL"
```

Refer to the *HP BASIC Language Reference* for further details on the PLOTTER IS statement.

Hidden Color Changes

On a Model 236C display, the following sequence of commands:

```
GRAPHICS OFF
SET PEN 0 INTENSITY 1,0,1
GRAPHICS ON
```

produces the following results.

- The GRAPHICS OFF statement will turn the graphics display off.
- SET PEN 0 is executed while the graphics screen is still blank and when the GRAPHICS ON statement is executed, the previous display contents with modified color map entry 0 is displayed.

On the Series 300 and 98700 displays, the above command sequence produces the following results:

- If the alpha and graphics planes overlap (i.e. the default configuration), then GRAPHICS OFF and GRAPHICS ON are no-op's, so the display will change immediately.
- If the alpha and graphics planes are totally independent (such as in "Configuring Separate Alpha and Graphics Planes" in the "Using a Configuration Program" section), then:
 - GRAPHICS OFF turns the graphics planes off, leaving the alpha plane on.
 - SET PEN *n* INTENSITY *a,b,c* will not be seen on the screen until the GRAPHICS ON statement is executed, *unless* *n* is equal to 0 or specifies an alpha pen.
 - GRAPHICS ON turns on the graphics planes again.

Note

This occurs because alpha and graphics share the same color map on Series 300 and 98700 displays, and PEN 0 is the default alpha background color.

HP-HIL Knob Interval Parameter

The ON KNOB “interval” parameter for the optional HP-HIL knob (46083A) has been implemented in BASIC 4.0 (it was not implemented with HIL knobs in BASIC 3.0 or 3.01). This parameter works same way on an HIL knob as on the non-HIL knob (built into Series 200 98203 keyboards). See the “Using the Knob” section of the “Communicating with the Operator” chapter of this manual.

BASIC 4.0 Enhancements for Series 200 Computers

Although the main objective of BASIC 4.0 was to add support of Series 300 computers, it also added some additional features for Series 200 computer users (these enhancements also pertain to Series 300 computers). This section describes these enhancements.

Note The new HP-HIL graphics devices, new foreign-language ITF keyboards, and HPHIL knob (see the “BASIC 4.0 Enhancements or Series 200 Computers” tables below) can only be connected to computers with an HP-HIL interface. For Series 200 computers, it includes Model 217 and Model 237 computers, and Model 220 computers with an optional HP-HIL interface.

BASIC 4.0 Enhancements for Series 200 Computers

Hardware Enhancements	Software Enhancements
<p><i>Support New HP-HILGraphics Devices:</i></p> <p>Tablets: HP 46087A (A size) HP 46088A (B size)</p> <p>TouchScreen: HP 35723</p>	<p>(Still use GRAPHICS INPUT IS, DIGITIZE, READ LOCATOR, etc.) Can determine maximum hard clip values with GESCAPE operation selectors 20 through 22. (See the "Interactive Graphics" chapter of <i>Graphics Techniques</i>.)</p>
<p><i>Ability to Specify Different Colors for Alpha Display Regions:</i></p> <p>Model 236C Only.</p>	<p>CRT STATUS/CONTROL registers 5 (modified definition) and 15 through 17 (new). (See the <i>HP BASIC Language Reference</i>.)</p>
<p><i>New Graphics Utilities:</i></p> <p>No additional hardware is required.</p>	<p>"Bstore" and "Bload" utilities allow you to store and load specified portions of graphics rasters. "Gdump_rotated" allows you to dump graphics rotated by 90°. (See the "BASIC Utilities Library" chapter of the <i>Installing and Maintaining BASIC</i> manual.)</p>

BASIC 4.0 Enhancements for Series 200 Computers (continued)

Hardware Enhancements	Software Enhancements
<p><i>HP 98644A Serial Interface Registers:</i> Less-expensive than HP 98626A (but has fewer “default” configuration switches).</p>	<p>Interface STATUS/CONTROL registers 13 and 14 allow you to read and change the “SCRATCH A defaults” to get the functionality of switches. (See the “Serial Interface” chapter of <i>HP BASIC Interfacing Techniques</i>.)</p>
<p><i>HP 98203 Keyboard Compatibility Mode:</i> None (useful with Models 217 and 237; also with 220 that uses the optional ITF keyboard).</p>	<p>KBD CONTROL register 15 enables the ITF keyboard to emulate the HP 98203B (Model 226/236) keyboard. (See the preceding “HP 98203 Keyboard Compatibility Mode” section of this chapter.)</p>
<p><i>Support New Foreign-Language ITF Keyboards:</i> Revised HIL “Swiss French*” and “Swiss German*” keyboards are now supported.</p>	<p>SYSTEM\$(“KEYBOARD LANGUAGE”) returns corresponding identifier. (See the <i>HP BASIC Language Reference</i>.)</p>
<p><i>HPHIL Knob Interval Parameter:</i> None (same HIL knob as before).</p>	<p>With BASIC 3.0, the interval parameter for ON KNOB was ignored for HIL knobs. With 4.0, the parameter is used. (See the <i>HP BASIC Language Reference</i>.)</p>
<p><i>Read “Keyboard Input” Line (Non-Destructively):</i> None.</p>	<p>Use SYSTEM\$(“KBD LINE”).</p>

Porting to 5.x

This chapter describes the differences and enhancements of BASIC 5.0 and BASIC 5.1.

The BASIC 5.0 System is the latest revision of the “Series 200/300 Workstation BASIC” product. It consists of miscellaneous new features which further enhance the capabilities of this language and operating system. This chapter describes the incremental features of BASIC 5.0, as well as describes the small changes made to some existing BASIC features. It will help you determine what to do when moving from the 4.0 to the 5.0 revision of this system.

Compatibility with Previous Versions

As with most other version changes to this BASIC language, the 5.0 revision is highly compatible with preceding versions. In other words, using the BASIC 5.0 system:

- You can LOAD and RUN program (PROG) files created with STORE on previous versions of BASIC.
- You can GET and RUN program (ASCII) files created with SAVE on previous versions of BASIC.
- You can use all data files (BDAT and ASCII) created on previous versions of BASIC. (If you will be using the HFS directory format, then you should also read the “Porting and Sharing Files” chapter.)
- If you are using Compiled Subprograms (CSUB’s), you will have to regenerate them using the CSUB 5.0 Utility.

- The BASIC editor is now in a separate binary (EDIT). If you require this, be sure to LOAD BIN “EDIT” before attempting to EDIT, LIST, or SAVE a program.
- The typing-aid softkey definitions have changed slightly from 4.0. If your application depends upon a particular typing-aid definition, then check to see whether it has changed. (If it has, then you can programmatically re-define it with LOAD KEY or SET KEY.)

Categories of New Features

This section describes the general categories of 5.0 features. They are presented roughly in the order you would encounter them while using the system. (Subsequent sections further describe each category, and list where they are described in the BASIC manuals.)

- New hardware supported
- New utilities
- Hierarchical File System (HFS) support
- Human interface enhancements
- Keywords that duplicate register operations
- General programming additions.
- New STATUS and CONTROL registers
- Additional support for HP-HIL devices
- Additional graphics capabilities
- Additional CSUB capabilities

New Hardware Supported

BASIC 5.0 is supported with the new Model 330 and 350 computers.

Note The Local Area Network (LAN) interface available with some of these models is not supported by BASIC.

New Hardware Supported

Computer Model	BASIC Language Support
Model 330	Supported in "Main" system (no binary is required).
Model 350	Supported in "Main" system (no binary is required).

New Utilities

The following utilities have been added to BASIC to simplify and speed up the installation, configuration, verification, and maintenance tasks.

New Utilities

New Feature	New Utility	Tutorial Information
Can verify the operation of disks, printers, plotters, HP-HIL devices, and HP-IB graphics tablets. Also helps you to label your mass storage devices, printers, and plotters.	Peripheral Verification Utility (VERIFY)	“Verifying and Labeling Peripheral” chapter of <i>Installing and Maintaining BASIC</i>
Can install BASIC on LIF and HFS hard and flexible disks, including formatting the disk ¹ and storing the BASIC system on the disk.	System Disk Utility (DISC_UTIL)	“Putting BASIC on a Hard Disk” chapter of <i>Installing and Maintaining BASIC</i>
Can back up and restore entire disk and tape volumes, as well as individual files. Has the ability to specify files and directories with wildcards . (Uses the HP-UX cpio format.)	Backup Utility (BACKUP).	“Maintaining” section of <i>Installing and Maintaining BASIC</i>
Can edit the display font in bit-mapped alpha displays, store the new font in a file, and load it at a later time.	Font Editor Utility (FONT_ED)	“BASIC Utilities Library” chapter of <i>Installing and Maintaining BASIC</i>
Text editor and file-copy utilities called by pressing typing-aid softkeys.	Memory-Resident Utilities (MEM_UTILS)	“BASIC Utilities Library” chapter of <i>Installing and Maintaining BASIC</i>

¹The System Disk Utility is also used to format and check the consistency of an HFS disk, as described in the next section.

3-4 Porting to 5.x

HFS Disk Support

The following features have been added to BASIC (with the HFS binary) to support the Hierarchical File System (HFS) format for disks and other mass storage devices. This file system is compatible with Series 200/300 HP-UX (5.0 and later versions).

HFS Disk Support



New Feature	Supporting System Component	Tutorial Information
BASIC, HP-UX, and Pascal can reside on the same mass storage volume	System Disk Utility (DISC_UTIL) formats HFS volumes	"Putting BASIC on a Hard Disk" chapter of <i>Installing and Maintaining BASIC</i>
BASIC, HP-UX, and Pascal can access compatible files (ASCII and HP-UX).	CREATE and ASSIGN ¹	"Porting and Sharing Files" chapter of this manual
Hierarchical directories are supported (on both hard and flexible disks).	HFS-formatted volumes	"Using Directories and Files" chapter of <i>Using BASIC</i>
Extensible files are available	HFS files	CREATE keyword entry in <i>HP BASIC Language Reference</i>
Access to the HP-UX file-protection scheme (on HFS directories)	PERMIT, CHGRP, and CHOWN statements	"Using Directories and Files" chapter of <i>Using BASIC</i>
Ability to detect and correct HFS inconsistencies	System Disk Utility (DISC_UTIL)	"Maintaining" section of <i>Installing and Maintaining BASIC</i>

¹These are just a few of the I/O Operations (i.e. ENTER, OUTPUT, GET, etc. may also be included).

Note that time stamps are placed on HFS files whenever the BASIC system modifies the contents of the file. LIF files are also time-stamped with the BASIC 5.0 revision (previous versions did not do this).

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Human Interface Enhancements

The following features have been added to the system to improve the BASIC system's human interface. (The editor and lister were put into the EDIT binary so that the entire "main" system could fit on a single disk, not to "improve" the human interface. It does, however, allow you to have a "run-only" system which might be useful in some applications.)

Human Interface Enhancements

New Feature	Supporting System Component (Binary Required)	Tutorial Information
New textual "run light" on the screen (systems with ITF keyboards only).	Enabled whenever softkey labels are on (No binary required)	"Loading and Running Programs" chapter of <i>Using BASIC</i>
Can clear the RECALL key buffer.	SCRATCH R (No binary required)	"Introduction to the System" chapter of <i>Using BASIC</i>
New default typing-aid key definitions.	No new keywords (No binary required)	Various locations in <i>Using BASIC</i>
Additional "sound" capabilities (on computers with HP-HIL interfaces)	SOUND (KBD binary)	"Communicating with the Operator" chapter in <i>HP BASIC Advanced Programming Techniques</i>
Redefinable character fonts (on bit-mapped alpha displays only).	SET CHR, CHRX, and CHRY (CRTX binary)	"Communicating with the Operator" chapter in <i>HP BASIC Advanced Programming Techniques</i>
Separated Program Editor/Lister (LIST) from main system	EDIT, LIST, and SAVE moved to EDIT binary	"Language Extensions, Drivers, and Configuration" chapter of <i>Installing and Maintaining BASIC</i>
New BASIC statements to clear display regions (formerly performed with OUTPUT KBD)	CLEAR SCREEN, CLEAR LINE (CRTX binary)	"Communicating with the Operator" chapter in <i>HP BASIC Advanced Programming Techniques</i>
Can load individual (or all) typing-aid softkeys programmatically	SET KEY (KBD binary)	"Communicating with the Operator" chapter in <i>HP BASIC Advanced Programming Techniques</i>

New Keywords that Duplicate Register Operations

Several STATUS and CONTROL register operations have been duplicated by keywords which perform the same action.

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Keywords Duplicating Register Operations

New Keyword	Register Operation Duplicated
DISPLAY FUNCTIONS ON	CONTROL CRT,4;1
DISPLAY FUNCTIONS OFF	CONTROL CRT,4;0
ALPHA PEN Pen_number	CONTROL CRT,5;Pen_number
KEY LABELS ON	CONTROL CRT,12;2
KEY LABELS OFF	CONTROL CRT,12;1
ALPHA HEIGHT Lines	CONTROL CRT,13;Lines
ALPHA HEIGHT	Restores default (when Lines omitted)
PRINT PEN Pen_number	CONTROL CRT,15;Pen_number
KEY LABELS PEN Pen_number	CONTROL CRT,16;Pen_number
KBD LINE PEN Pen_number	CONTROL CRT,17;Pen_number
SET ALPHA MASK Mask_value	CONTROL CRT,18;Mask_value
SET DISPLAY MASK Mask_value	CONTROL CRT,20;Mask_value
SYSTEM KEYS	CONTROL KBD,2;0
USER 1 KEYS	CONTROL KBD,2;1
USER 2 KEYS	CONTROL KBD,2;2
USER 3 KEYS	CONTROL KBD,2;3
KBD CMODE ON	CONTROL KBD,15;1
KBD CMODE OFF	CONTROL KBD,15;0

3-8 Porting to 5.x

For tutorial information, see the “Display Interfaces” and “Keyboard Interfaces” chapters of *HP BASIC Interfacing Techniques*. (The KBD register statements are in the KBD binary; all others are in the CRTX binary.)

General Programming Additions

The following features are used in BASIC programming.

General Programming Additions

New Feature	New Keyword (Binary Required)	Tutorial Information
Complex math	COMPLEX data type, supported in most math operations (COMPLEX binary)	“Numeric Computation” chapter in the <i>HP BASIC Programming Guide</i>
Hyperbolic functions	SINH, COSH, TANH, etc. (COMPLEX binary)	“Numeric Computation” chapter in the <i>HP BASIC Programming Guide</i>
Searching arrays for patterns and conditions	MAT SEARCH (MAT binary)	“More About Numeric Arrays” chapter in <i>HP BASIC Advanced Programming Techniques</i>
Copying subarrays	MAT enhancement (MAT binary)	“Numeric Arrays” chapter in the <i>HP BASIC Programming Guide</i>
New string variable function (returns DIMensioned string length).	MAXLEN function (No binary required)	“String Manipulation” chapter in the <i>HP BASIC Programming Guide</i>
Error-trapping feature enhancements.	CAUSE ERROR, ERRLN, ERROR RETURN, ERROR SUBEXIT, CLEAR ERROR (No binary required)	“Handling Errors” chapter in the <i>HP BASIC Programming Guide</i>
Can programmatically specify which system to re-boot	SYSBOOT enhancement (No binary required)	<i>HP BASIC Language Reference</i>

New STATUS/CONTROL Registers

The following new STATUS and CONTROL registers have been added in BASIC 5.0.

New STATUS/CONTROL Registers

New Register	Definition
STATUS 32,4;Batt_clock_type	Returns the following values: 0 => no battery-backed clock; 1 => HP 98270 battery-backed clock (Models 226 and 236 only); 2 => HP-HIL battery-backed clock.
STATUS KBD,16;Scroll_disabled	Reading the STATUS register allows you to determine whether the PRINT area of the display can be scrolled by keystrokes or equivalent operations (the default is to allow scrolling). 0 => scrolling enabled 1 => scrolling disabled
CONTROL KBD,16;Disable_scroll	Writing a 1 to the CONTROL register disables scrolling (useful to prevent scrolling of alpha display; writing a 0 to the register enables scrolling).
STATUS KBD,17;Auto_menu	Automatic menu switching: 1 => enable (default) 0 => disable
CONTROL KBD,17;Disable_auto	Automatic menu switching: mode. <>0 => enable 0 => disable This register controls whether a system with an ITF keyboard will switch to (from) the User 2 Menu automatically on entering (leaving) EDIT mode.

See the “Using the Clock and Timers” chapter of the *HP BASIC Programming Guide* for details on determining clock type. See the “Keyboard Interfaces” chapter of *HP BASIC Interfacing Techniques* for details of disabling scrolling. Also see the descriptions of these registers in the “Useful Tables” section of this manual or the *HP BASIC Language Reference*.

Additional HP-HIL Support

The following features provide greater support for Hewlett-Packard Human Interface Link (HP-HIL) devices. All of these capabilities require the KBD binary.

Additional HP-HIL Support

New Feature	New Keyword (Binary Required)	Tutorial Information
Capability of setting up interrupts for and communicating with many HP-HIL devices (useful when writing your own HP-HIL device drivers)	ON HIL EXT, HIL SEND, and HILBUF\$ (KBD binary)	“HIL Devices” chapter of <i>HP BASIC Interfacing Techniques</i>
Capability of setting up interrupts for and reading pulses from the HP 46085A Control Dial (9-knob) Box	ON CDIAL, CDIAL, and OFF CDIAL (KBD binary)	“Communicating with the Operator” chapter in volume 1 of this manual

Additional Graphics Features

The following graphics features have been added to the BASIC system.

Additional Graphics Features

New Feature	Keyword (Binary Required)	Tutorial Information
New register that disables scrolling the display (to avoid scrolling graphics on bit-mapped alpha displays)	CRT register 16	"Introduction to Graphics" chapter of <i>HP BASIC Graphics Techniques</i>
Can now send HPGL commands to PLOTTER IS device or file.	GSEND (GRAPH binary)	"Using Plotters and Printers" chapter of <i>BASIC Graphics Techniques</i>
Can simulate separate alpha and graphics rasters of Series 200/300 displays with a single statement (formerly required a short program)	SEPARATE ALPHA, MERGE ALPHA	"Using Graphics Effectively" chapter of <i>HP BASIC Graphics Techniques</i>

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Additional CSUB Capabilities

The following capabilities have been added to CSUB's (Compiled Subroutines—created using the Pascal Workstation System and CSUB Utility).

Additional CSUB Capabilities

New Feature	General Capability	Tutorial Information
CSUB's can now perform I/O operations.	Categories of I/O procedures now available: <ul style="list-style-type: none">■ Most of the Pascal I/O Procedure Library■ Some of the BASIC file I/O capabilities■ Some display I/O capabilities■ Some keyboard I/O capabilities■ All SYSTEM\$ capabilities	<i>CSUB Utility</i> manual

5.1 Enhancements

BASIC 5.1 provides additional software capabilities and improvements in documentation.

New Capabilities



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New Feature	Description
PaintJet™ Support (HP 3630A Color Graphics Printer)	A CSUB performs a color dump. See the “BASIC Utilities Library” chapter of the <i>Installing and Maintaining the BASIC System</i> manual.
HP 98548A, HP 98549A, and HP 98550A Display Support	These cards are high resolution bit-mapped display interfaces. (Note that on these displays, the alpha cursor will not blink.)
New CSUB Utility Features	Passing COMPLEX and I/O-path-name parameters to CSUB's. See the <i>HP BASIC 5.1 CSUB Utility</i> manual.
HP 98646A VME Interface CSUB	This CSUB was formerly a separate product, but is now included in the BASIC 5.1 product (there are no new features). See the “BASIC Utilities Library” chapter of the <i>Installing and Maintaining the BASIC System</i> manual.

Manual Changes

In order to make the installation and maintenance of the BASIC Language System easier, the *Installing, Using and Maintaining the BASIC System* manual has been divided into two manuals:

- *Installing and Maintaining*
- *Using BASIC*

Duplicating Files with the LINK Command

The COPY command creates a duplicate file by copying a file's contents under a different file name. On the other hand, the LINK command creates additional filenames which refer to the same file. This is done by creating:

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- A new file name (an entry in a directory).
- A **pointer** to the existing file's contents (note that the contents are *not* duplicated).

Thus, LINK saves disk space, because there is only one copy of the body of the file (but there are two file names, or links, to the file's contents).

It is important to remember that the LINK command is usable only with HFS and SRM volumes.

A Simple Example

Executing the following statement:

```
LINK "Existing_file" TO "New_name"
```

links the file name called `New_name` to the existing file called `Existing_file`.

Characteristics of Linked Files

As mentioned before, LINK makes a new name and creates a pointer to an existing file. This gives the file some useful, but sometimes subtle, characteristics. For instance, an OUTPUT to a data file will change its contents. Using ENTER with any file linked to the changed file will reflect the change. (Note that there is only one copy of the file's data but two or more file names are linked to it.)

If you RE-STORE or RE-SAVE a file that is linked to other files, a new file will be created and the link to the original file will be *broken*. In this case the RE-STORE'd or RE-SAVE'd file is changed but the linked files are *not* changed.

The keyword LINK is like the COPY command and in some cases they can be used interchangeably. However, COPY results in two different files, while LINK results in one file with two different file names linked to it. LINK is used when you need to save disk space or you want the OUTPUT command to change the contents of all linked files. COPY should be used if you want OUTPUT to modify one version of the file but not all versions.

More Examples of Creating Linked Files

The first example below creates an HP-UX file and links it to another file. It then outputs data to the original file. Finally the contents of each file (which are identical) are displayed.

```

100 CREATE "File_1",1          ! Create an HP-UX file.
110 !
120 LINK "File_1" TO "File_2" ! Link "File_2" to "File_1".
130 !
140 ASSIGN @File_1 TO "File_1" ! Open File_1 for writing.
150 !
160 String$="This is a test." ! Assign the output string.
170 OUTPUT @File_1;String$    ! Output message to all linked files.
180 !
190 ASSIGN @File_1 TO *       ! Close File_1 before reading it.
200 !
210 ASSIGN @File_1 TO "File_1" ! Open File_1 for reading.
220 ENTER @File_1;String1$     ! Read @File_1 into String1$
230 PRINT "The contents in File_1: ";String1$ ! Print String1$
240 ASSIGN @File_1 TO *       ! Close File_1
250 !
260 ASSIGN @File_2 TO "File_2" ! Open File_2 for reading.
270 ENTER @File_2;String2$     ! Read @File_2 into String2$
280 PRINT "The contents in File_2: ";String2$ ! Print String2$
290 ASSIGN @File_2 TO *       ! Close File_2
300 !
310 END

```

Here are the results of running the program:

```
The contents in File_1: This is a test.
```

```
The contents in File_2: This is a test.
```


Example of Breaking a Link

The next example shows how RE-STORE breaks a link. Create the program:

```
10 PRINT "Original Program"  
20 END
```

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Next give this file the name `Original` and store and create a link to it:

```
STORE "Original"  
LINK "Original" TO "New_name"
```

Modify the program called `New_name` to read:

```
10 PRINT "Modified Program"  
20 END
```

Now store the program using the RE-STORE command:

```
RE-STORE "New_name"
```

If you next LOAD the program called `Original` and LIST it, you will find that it remains unchanged because the link between `Original` and `New_name` is broken. (That is, there are now two files on the system, each being slightly different from the other.)

Porting and Sharing Files

There are three different types of mass storage formats supported by BASIC:

- Logical Interchange Format (LIF)
- Shared Resource Manager (SRM)
- Hierarchical File System (HFS)

With each of these types of formats, BASIC supports three types of data files, as well as other types of files used by the BASIC system:

- ASCII
- BDAT
- HP-UX
- PROG
- BIN
- SYSTEM

This chapter describes what tasks you will need to perform in transporting BASIC files from one type of volume to another. It also describes how to share HP-UX files between Series 200/300 BASIC, HP-UX, and Pascal systems.

Sharing HFS Disks and Data Files

With the introduction of BASIC 5.0, it is now possible to share data files between BASIC applications and HP-UX applications using HFS volumes. This allows you to develop a total solution that takes advantage of the best features of each available operating system.

- As an example, a system can use BASIC for instrument control or automated data acquisition and then use HP-UX applications to analyze or manipulate the data for statistical quality control or management information systems.
- HP-UX also allows a gateway to networking capabilities that are becoming an important part of information sharing in the factory.
- Another advantage of HP-UX is the availability of the HP-UX Starbase Graphics Library and Graphics Hardware, which provides many additional graphics features that are not available with the BASIC Operating System.

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General Compatibility Requirements

In order to share data files between BASIC and HP-UX, there must be compatibility of:

- *File types* (both operating systems must be able to read and write a file to be shared)
- *Data representations* (both operating systems must write and interpret the bytes in the file in the same manner)

These requirements will be explored here, and examples of sharing data files between BASIC and HP-UX will be shown.

A Note About HP-UX File Terminology

From the following matrices, we see that BASIC and HP-UX can easily share files of “type HP-UX”:

- On BASIC, these files will be listed with CAT as being of type **HP-UX**.
- On HP-UX, these files will be listed as **text** or **data**, depending on the *contents* of the file.

From the HP-UX viewpoint, this type of file can be called an “HP-UX text” file or an “HP-UX binary” file. The “HP-UX text” file contains data written in ASCII representation, while the “HP-UX binary” file contains data written in internal representation.

Common File Types

The following matrix shows which file types are supported by each operating system available on Series 300 computers.

Data File Support Matrix

Operating System or Language	ASCII	BDAT	Pascal Text ¹	HP-UX
BASIC 4.0 (or earlier)	Y	Y		
BASIC 5.0 (or later)	Y	Y		Y
Workstation Pascal 3.12 (or earlier)	Y		Y	
Workstation Pascal 3.2 (or later)	Y		Y	Y
Technical BASIC				²
HP-UX C	³			Y
HP-UX Pascal	³			Y
HP-UX FORTRAN	³			Y
MS-DOS	⁴			

Legend:

- ¹ "Pascal Text" files include type ".TEXT" files and type "Data" files that contain text.
- Y means that the Operating System or Language can easily read or write the file type with a native language program.
- ² HP-UX Technical BASIC can only handle HP-UX files that contain text.
- ³ HP-UX has utilities to transfer LIF files to HFS volumes (lifcp, etc.).
- ⁴ Utilities are available for MS-DOS to transfer LIF files.

4-4 Porting and Sharing Files

Common Data Types

Once a common file type to be used has been identified, the next step is to determine the data types that can be used within the file. To share data within a file between BASIC and HP-UX, the data type must be a type that is supported in both operating systems. The following matrix shows which data types are supported by each operating system available on Series 200/300 computers.

Data-Type Support Matrix

Operating System or Language	16-Bit Integer	32-Bit Integer	32-Bit Real	64-Bit Real	128-Bit Complex ¹	String	Null-Terminated String
BASIC 4.0 (and earlier)	Y			Y		Y	
BASIC 5.0 (and later)	Y			Y	Y	Y	²
Workstation Pascal 3.12 (and earlier)	Y	Y		Y		Y	
Workstation Pascal 3.2 (and later)	Y	Y		Y		Y	
Technical BASIC		Y	Y	Y		Y	
HP-UX C	Y	Y	Y	Y		Y	Y
HP-UX Pascal	Y	Y	Y	Y		Y	
HP-UX Fortran	Y	Y	Y	Y	Y	Y	Y
MS-DOS	Y	Y	Y	Y		Y	Y

Legend:

¹ The 128-bit complex data type is equivalent to two 64-bit reals.

Y means that the Operating System or Language can easily read or write the data type with a native language program.

² This data type works with “HP-UX binary” data files only.

From this matrix, we see that BASIC and HP-UX can easily share data that is 16-bit integer, 64-bit real, 128-bit complex, string, and null-terminated strings. Before you can access this data, however, you must know:

- Which data types are used in the file.
- The order in which they are used.

4-6 Porting and Sharing Files

Then you can use the corresponding data types in the programming language while reading the data. For example, BASIC and HP-UX C must have this data type matching to share data:

Data-Type Matching Between BASIC and C

BASIC	C
INTEGER	short
REAL	double
COMPLEX	2 double's
String	array of char

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HP-UX Text and Binary Files

“HP-UX text and binary” files are the native file types supported by HP-UX on HFS volumes. Support for this data file type has been added in BASIC 5.0 to allow sharing data files with HP-UX applications. BASIC still retains full support for all existing data file types, ASCII and BDAT, but some keywords have been updated to provide support for HFS disks and HP-UX text and binary files.

In particular, the ASSIGN, OUTPUT, and ENTER keywords now support “HP-UX text” and “HP-UX binary” files. (Note once again that these are both considered to be an HP-UX file *type* in BASIC; the only difference is in the file *contents*.)

A new CREATE statement has also been added to allow HP-UX files to be created from the BASIC system. To create an HP-UX file, use the CREATE keyword without the BDAT or ASCII secondary keywords.

```
CREATE "HPUX_file",10
```

When the ASSIGN statement is executed to open a file, the file type in the file header is examined. If the file is BDAT or ASCII, it will be treated as such. Otherwise, the file will be treated as:

- An “HP-UX binary” file (if it is assigned with FORMAT OFF)
- An “HP-UX text” file (if it is assigned with FORMAT ON).

Examples of HP-UX File Access: Textual Numeric Data

Some examples will demonstrate how to access an HP-UX text file from BASIC and from HP-UX. The first program below is a BASIC program that writes some real numbers into an HP-UX text file.

```
10  ! RE-STORE "SHARE_TEXT"
20  !
30  ! Create & Assign the output file.
40  !
50  CREATE "TEXT_DATA",1           ! Create an HP-UX file.
60  ASSIGN @File TO "TEXT_DATA";FORMAT ON ! Treat as "text" file.
70  !
80  ! Output the data to the HP-UX Text file.
90  !
100 FOR N=-9.0 TO 8.5 STEP .07
110   OUTPUT @File;N
120 NEXT N
130 ASSIGN @File TO *
140 !
150 END
```

In this BASIC program, the file TEXT_DATA is an HP-UX file into which this program writes 250 real numbers. The ASSIGN statement is performed with FORMAT ON, thus specifying that this file is to be treated as a “text” file—using the ASCII data representation. (Note that the default FORMAT attribute for an HP-UX file is FORMAT OFF.) This program also demonstrates that file access of an “HP-UX text” file is performed with the same statements that would be used for access of an ASCII or BDAT file.

The next program is an HP-UX C program to read the data file that the above BASIC program wrote.

```
#include <stdio.h>
main()
{
    float  X, Y;
    FILE   *datafile, *fopen();

    /**/
    /**/ Open file to read data /**/
    /**/
    datafile = fopen("/users/workstation/basic/files/TEXT_DATA", "r");
    if (datafile == NULL) {
        printf("Can't open file.\n");
        exit(1);
    }
    /**/
    /**/ Get data from file and print data /**/
    /**/
    for (X = 1.0; X <= 250.0; X += 1.0) {
        fscanf(datafile, "%f", &Y);
        printf("%f\n", Y);
    }
    fclose(datafile);
}
```

In this HP-UX C example, the file TEXT_DATA is the “HP-UX text” file into which the BASIC program wrote 250 real numbers. Note that the HP-UX C program reads these real numbers as strings with the “fscanf” routine, then converts each string back to the real number value with the “%f” conversion specification.

Note Data in an “HP-UX text” file is stored as ASCII characters, and this data can be read and edited by HP-UX editors or read by HP-UX commands such as “cat” and “more.”

The next program is an HP-UX Technical BASIC program to read the data file which the preceding BASIC program wrote.

```
10 CLEAR
20 REAL x,y
30 name$="TEXT_DATA"
40 ASSIGN 14 TO name$
50 FOR x=1 TO 250
60 ENTER 14 ; y
70 PRINT x,y
80 NEXT x
90 ASSIGN 14 TO "*"
100 END
```

4

This HP-UX Technical BASIC example reads the file TEXT_DATA into which the BASIC program wrote real numbers. Note that Technical BASIC can convert each string back to the real number value with the number builder in the ENTER statement. This program demonstrates the simplicity of HP-UX Technical BASIC when used for sharing files between HP-UX Technical BASIC and the BASIC workstation environment.

Below is the hexadecimal dump of the first 40 bytes of the file TEXT_DATA, which will be used to get a better understanding of how BASIC formatted the data when it wrote to this "HP-UX text" file; contrast it to the following ASCII dump of the same file. (A listing of the program is shown at the end of this chapter.)

Contents of TEXT_DATA

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	
0	2d	39	d	a	2d	38	2e	39	33	d	
10	a	2d	38	2e	38	36	d	a	2d	38	
20	2e	37	39	d	a	2d	38	2e	37	32	
30	d	a	2d	38	2e	36	35	d	a	2d	

HP-UX Text File Contents

4-10 Porting and Sharing Files

Here are the contents of the first 40 bytes of the file TEXT_DATA, shown in hexadecimal format. To show that the data items in an “HP-UX text” file are ASCII characters, the ASCII equivalent of this same data is now shown below.

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	-	9	"CR"	"LF"	-	8	.	9	3	"CR"
10	"LF"	-	8	.	8	6	"CR"	"LF"	-	8
20	.	7	9	"CR"	"LF"	-	8	.	7	2
30	"CR"	"LF"	-	8	.	6	5	"CR"	"LF"	-

ASCII Character Equivalent

This table shows that a real number output to the HP-UX text file by BASIC is output as a string of ASCII characters representing the real number and this real number string terminated by “CR” and “LF” characters.

Examples of HP-UX File Access: Textual Strings

The next data type to be demonstrated will be strings. The first program below is a BASIC program that writes some strings into an “HP-UX text” file.

```
10  ! RE-STORE "SHARE_STR2"
20  !
30  INTEGER N
40  !
50  ! Create & Assign the output file.
60  !
70  CREATE "STR2_DATA",1           ! Create HP-UX file.
80  ASSIGN @File TO "STR2_DATA";FORMAT ON ! Treat as "text" file.
90  !
100 ! Output the strings to the data file
110 !
120 FOR N=-9 TO 240
130   OUTPUT @File;"This is "&TRIM$(VAL$(N))&" line"
140 NEXT N
150 ASSIGN @File TO *
160 !
170 END
```

In this BASIC example, the file STR2_DATA is an “HP-UX text” file into which this program writes 250 data strings. The ASSIGN statement is again performed with FORMAT ON to specify that the data are to be represented in ASCII format (an “HP-UX text” file).

The next program is an HP-UX C program to read the data file that the above BASIC program wrote.

```
#include <stdio.h>
main()
{
    int    X;
    char   Strng[40];
    FILE   *datafile, *fopen();

    /**/
    /**/ Open file to read data /**/
    /**/
    datafile = fopen("/users/workstation/basic/files/STR2_DATA", "r");
    if (datafile == NULL) {
        printf("Can't open file.\n");
        exit(1);
    }
    /**/
    /**/ Get string data from file and print data /**/
    /**/
    for (X = 0; X <= 249; X += 1) {
        fgets(Strng, 40, datafile);
        printf("%s", Strng);
    }
    fclose(datafile);
}
```

In this HP-UX C example, the file STR2_DATA is the “HP-UX text” file into which the BASIC program wrote 250 data strings. Note that the HP-UX C program reads these data strings into an “array of char” with the “fgets” routine. The “fgets” routine used here terminates with the new-line character, then replaces this new-line character with a NULL character.

Below is the hexadecimal dump of the first 40 bytes of the file STR2_DATA, which will be used to get a better understanding of how BASIC stored the strings when it wrote to this “HP-UX text” file.

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	54	68	69	73	20	69	73	20	2d	39
10	20	6c	69	6e	65	d	a	54	68	69
20	73	20	69	73	20	2d	38	20	6c	69
30	6e	65	d	a	54	68	69	73	20	69

HP-UX Text File Contents with Strings

4

These are the contents of the first 40 bytes of the file STR2_DATA, shown in hexadecimal format. To prove that the data in an “HP-UX text” file is ASCII characters, the ASCII equivalent of this same data is now shown below.

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	T	h	i	s		i	s		-	9
10		l	i	n	e	"CR"	"LF"	T	h	i
20	s		i	s		-	8		l	i
30	n	e	"CR"	"LF"	T	h	i	s		i

ASCII Character Equivalent

This table shows that a string output to the HP-UX text file by BASIC is output as a string of ascii characters with no added length header bytes and terminated by “CR” (carriage-return) and “LF” (line-feed) characters.

Examples of HP-UX File Access: Binary Real Values

There are three different types of data that can be stored in an HP-UX file that BASIC can also access. These data types are REAL, INTEGER, and string. The first type to be demonstrated in examples will be files of REAL data. The first program below is a BASIC program that writes some REAL numbers into an “HP-UX binary” file.

```
10 ! RE-STORE "SHARE_REAL"
20 !
30 ! Create & Assign the output file.
40 !
50 CREATE "REAL_DATA",1
60 ASSIGN @File TO "REAL_DATA";FORMAT OFF ! Treat as "binary" file.
70 !
80 ! Output the real numbers to the data file
90 !
100 FOR N=-9.0 TO 8.5 STEP .07
110   OUTPUT @File;N
120 NEXT N
130 ASSIGN @File TO *
140 !
150 END
```

In this BASIC program, the file REAL_DATA is an HP-UX file into which this program writes 250 real numbers. Note that the ASSIGN statement is performed with FORMAT OFF, thus specifying that this file is to be written as internal representation numbers. This program also demonstrates that file access of an “HP-UX binary” file is performed with the same keywords that would be used for access of a BDAT file.

The next program is an HP-UX C program to read the data file that the above BASIC program wrote.


```

#include <stdio.h>
main()
{
    int    X;
    double Y[250];
    FILE   *datafile, *fopen();

    /***                               ***/
    /*** Open file to read data ***/
    /***                               ***/
    datafile = fopen("/users/workstation/basic/files/REAL_DATA", "r");
    if (datafile == NULL) {
        printf("Can't open file.\n");
        exit(1);
    }
    /***                               ***/
    /*** Get real data from file and print data ***/
    /***                               ***/
    fread((char *)Y, sizeof(Y[0]), 250, datafile);
    for (X = 0; X <= 249; X += 1)
        printf("%f\n", Y[X]);
    fclose(datafile);
}

```

4

In this HP-UX C example, the file REAL_DATA is an “HP-UX binary” file into which the BASIC program wrote 250 real numbers. Note that the HP-UX C program reads these real numbers into an array of double with the “fread” routine. This data must be handled as type double in C to remain compatible with the 64-bit real format used in BASIC. This data *cannot* be read and edited by HP-UX editors or read by HP-UX commands such as “cat” and “more.” However, this data representation may allow for more efficient disk space use since every real number takes 8 bytes of disk space. The I/O transfer rates are also higher, since neither the output or the input routines need to format the data. In many cases, the internally represented numbers provide greater accuracy than would an ASCII representation of the number.

4-16 Porting and Sharing Files

Below is the hexadecimal dump of the first 40 bytes of the file REAL_DATA, which will be used to get a better understanding of how BASIC represented the real number data when it wrote to this HP-UX (or "HP-UX binary") file.

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	c0	22	0	0	0	0	0	0	c0	21
10	dc	28	f5	c2	8f	5c	c0	21	b8	51
20	eb	85	1e	b8	c0	21	94	7a	e1	47
30	ae	14	c0	21	70	a3	d7	a	3d	70

HP-UX Binary File Contents with Real Numbers

The real number data in an HP-UX binary file is formatted in IEEE-standard, 64-bit, floating-point notation for real numbers.



Examples of HP-UX File Access: Binary Integers

The next data type to be demonstrated in examples will be files of integer data. The first program below is a BASIC program that writes some integer values into an HP-UX file.

```
10  ! RE-STORE "SHARE_INT"
20  !
30  INTEGER N
40  !
50  ! Create & Assign the output file.
60  !
70  CREATE "INT_DATA",1
80  ASSIGN @File TO "INT_DATA";FORMAT OFF ! Treat as "binary" file.
90  !
100 ! Output the integer numbers to the data file
110 !
120 FOR N=-9 TO 240
130   OUTPUT @File;N
140 NEXT N
150 ASSIGN @File TO *
160 !
170 END
```

4

In this BASIC program, the file INT_DATA is an HP-UX file into which this program writes 250 integer numbers. The ASSIGN statement is again performed with FORMAT OFF to specify that the internal data representation is to be used (which makes the file an “HP-UX binary” file).

The next program is an HP-UX C program that reads the data file that the above BASIC program wrote.

```

#include <stdio.h>
main()
{
    int    X;
    short  Y[250];
    FILE   *datafile, *fopen();

    /***          ***/
    /*** Open file to read data ***/
    /***          ***/
    datafile = fopen("/users/workstation/basic/files/INT_DATA", "r");
    if (datafile == NULL) {
        printf("Can't open file.\n");
        exit(1);
    }
    /***          ***/
    /*** Get integer data from file and print data ***/
    /***          ***/
    fread((char *)Y, sizeof(Y[0]), 250, datafile);
    for (X = 0; X <= 249; X += 1)
        printf("%d\n", Y[X]);
    fclose(datafile);
}

```

4

In this HP-UX C example, the file INT_DATA is the HP-UX binary (or untyped) file into which the BASIC program wrote 250 integer numbers. Note that the HP-UX C program reads these integers into an array of short with the “fread” routine. This data must be handled as type short in C to remain compatible with the 16-bit integer format used in BASIC. An HP-UX binary file allows more efficient disk-space use than an HP-UX text file, since each integer number takes 2 bytes of disk space. An HP-UX binary file is also faster because no format-conversion is required.

Below is the hex dump of the first 40 bytes of the file "INT_DATA", which will be used to get a better understanding of how BASIC formatted the integer number data when it wrote to this HP-UX binary file.

BYTE	+0		+1		+2		+3		+4		+5		+6		+7		+8		+9		
0		ff		f7		ff		f8		ff		f9		ff		fa		ff		fb	
10		ff		fc		ff		fd		ff		fe		ff		ff		0		0	
20		0		1		0		2		0		3		0		4		0		5	
30		0		6		0		7		0		8		0		9		0		a	

HP-UX Binary File Contents with INTEGER Values

4

INTEGERS in an HP-UX binary file are formatted in 16-bit two's-complement notation.

Examples of HP-UX File Access: Binary Strings

The first program below is a BASIC program that writes some strings into an HP-UX binary file.

```
10 ! RE-STORE "SHARE_STR"
20 !
30 INTEGER N
40 !
50 ! Create & Assign the output file.
60 !
70 CREATE "STR_DATA",1
80 ASSIGN @File TO "STR_DATA";FORMAT OFF ! Treat as "binary" file.
90 !
100 ! Output the strings to the data file
110 !
120 FOR N=-9 TO 240
130     OUTPUT @File;"This is "&TRIM$(VAL$(N))&" line"
140 NEXT N
150 ASSIGN @File TO *
160 !
170 END
```

In this BASIC example, the file STR_DATA is an HP-UX file into which this program writes 250 data strings. The ASSIGN statement is again performed with FORMAT OFF to specify that the internal data representations are to be used (an "HP-UX binary" file). Each string output to the file has a null character, CHR\$(0), appended to the end of the string automatically by the OUTPUT statement. This null character is used by the HP-UX C program as a string-termination character.

The next program is an HP-UX C program to read the data file that the above BASIC program wrote.

```
#include <stdio.h>
main()
{
    int I, X;
    char Strng[40];
    FILE *datafile, *fopen();

    /**          ***/
    /** Open file to read data ***/
    /**          ***/
    datafile = fopen("/users/workstation/basic/files/STR_DATA", "r");
    if (datafile == NULL) {
        printf("Can't open file.\n");
        exit(1);
    }
    /**          ***/
    /** Get string data from file and print data ***/
    /**          ***/
    for (X = 0; X <= 249; X += 1) {
        I = 0;
        while ((Strng[I] = getc(datafile)) != '\000')
            I++;
        printf("%s\n", Strng);
    }
    fclose(datafile);
}
```

In this HP-UX C example, the file STR_DATA is the HP-UX file into which the BASIC program wrote 250 strings. Note that the HP-UX C program reads these strings into an “array of char” with the “getc” routine reading each character. The “while” loop repeats until a null character has been read by the “getc” routine.

Below is the hexadecimal dump of the first 60 bytes of the file "STR_DATA". This shows how BASIC formatted the strings in this HP-UX binary file.

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	54	68	69	73	20	69	73	20	2d	39
10	20	6c	69	6e	65	0	54	68	69	73
20	20	69	73	20	2d	38	20	6c	69	6e
30	65	0	54	68	69	73	20	69	73	20
40	2d	37	20	6c	69	6e	65	0	54	68
50	69	73	20	69	73	20	2d	36	20	6c

HP-UX Binary File Contents with Strings

4

To help visualize how this data is stored in an HP-UX binary file, the ASCII equivalent of this same data is now shown below.

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	T	h	i	s		i	s		-	9
10		l	i	n	e	"NUL"	T	h	i	s
20		i	s		-	8		l	i	n
30	e	"NUL"	T	h	i	s		i	s	
40	-	7		l	i	n	e	"NUL"	T	h
50	i	s		i	s		-	6		l

ASCII Character Equivalent

This table shows that each string written by BASIC was terminated by a null character. There is no carriage return or line feed.

Examples of ASCII File Access

The file types demonstrated so far have been HP-UX files that both BASIC and HP-UX can easily access with a native language program. When the file type is a ASCII file, it can still be accessed from HP-UX.

This example writes real numbers into a ASCII file.


```
10 ! RE-STORE "SHARE_ASC"
20 !
30 ! Create & Assign the output file.
40 !
50 CREATE ASCII "ASC_DATA",1
60 ASSIGN @File TO "ASC_DATA"
70 !
80 ! Output the data to the ASCII file.
90 !
100 FOR N=-9.0 TO 8.5 STEP .07
110   OUTPUT @File;N
120 NEXT N
130 ASSIGN @File TO *
140 !
150 END
```

4

The next program is an HP-UX C program to read the data file that the above BASIC program wrote.

```

#include <stdio.h>
#include <math.h>
main()
{
    float Y, Result, rval;
    short I[1];
    int J, X;
    char Strng[40];
    FILE *datafile, *fopen();

    /**          ***/
    /** Open file to read data ***/
    /**          ***/
    datafile = fopen("/users/workstation/basic/files/ASC_DATA", "r");
    if (datafile == NULL) {
        printf("Can't open file.\n");
        exit(1);
    }
    /**          ***/
    /** Get voltage data from file and print data ***/
    /**          ***/
    fseek(datafile, 512, 0);
    for (X = 1; X <= 250; X += 1) {
        fread((char *)I, sizeof(I), 1, datafile);
        rval = I[0];
        if ((Result = fmod(rval, 2.0)) != 0.0)
            I[0] ++;
        J = 0;
        while (J < I[0]) {
            Strng[J] = getc(datafile);
            J++;
        }
        sscanf(Strng, "%f", &Y);
        printf("%f\n", Y);
    }
    fclose(datafile);
}

```

4

In this HP-UX C example, the file ASC_DATA is the ASCII file into which the BASIC program wrote 250 real values. Note that the HP-UX C program reads the 2-byte length header with the “fread” routine, then uses this length number to read the same number of characters with the “getc” routine. The “sscanf” routine then converts each string back to the real number value with the “%f” conversion specification. This program also requires the “fseek” routine to force the file pointer to skip over the 512-byte header block that BASIC inserts at the beginning of the ASCII file.

Below is the hexadecimal dump of significant portions of the first 560 bytes of the file ASC_DATA, which shows how BASIC formatted the data when it wrote to this ASCII file.

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	
0	80	0	48	46	53	4c	49	46	0	0	
10	0	1	10	0	0	0	0	0	0	1	
20	0	0	0	0	0	0	0	1	0	0	
30	0	1	0	0	0	3	11	11	11	11	
40	11	11	0	0	0	0	0	0	0	0	
.	
240	0	0	0	0	0	0	0	0	11	11	
250	11	11	11	11	0	0	57	53	5f	46	
260	49	4c	45	20	20	20	0	1	0	0	
270	0	2	0	0	0	3	86	12	5	15	
280	54	16	80	1	0	0	0	0	0	0	
290	0	0	0	0	0	0	0	0	ff	ff	
.	
510	0	0	0	2	2d	39	0	5	2d	38	
520	2e	39	33	20	0	5	2d	38	2e	38	
530	36	20	0	5	2d	38	2e	37	39	20	
540	0	5	2d	38	2e	37	32	20	0	5	
550	2d	38	2e	36	35	20	0	5	2d	38	

ASCII File Contents with Real Values

4

The ASCII equivalent of this same data is shown below.

BYTE	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
0	80hex	"NUL"	H	F	S	L	I	F	"NUL"	"NUL"
10	"NUL"	"SOH"	"DLE"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"SOH"
20	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"SOH"	"NUL"	"NUL"
30	"NUL"	"SOL"	"NUL"	"NUL"	"NUL"	"EXT"	"DC1"	"DC1"	"DC1"	"DC1"
40	"DC1"	"DC1"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"
.
240	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"DC1"	"DC1"
250	"DC1"	"DC1"	"DC1"	"DC1"	"NUL"	"NUL"	W	S	_	F
260	I	L	E				"NUL"	"SOH"	"NUL"	"NUL"
270	"NUL"	"STX"	"NUL"	"NUL"	"NUL"	"EXT"	86hex	"DC2"	"ENQ"	"NAX"
280	T	"SYNC"	80hex	"SOH"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"
290	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	"NUL"	FFhex	FFhex
.
510	"NUL"	"NUL"	"NUL"	"STX"	-	9	"NUL"	"ENQ"	-	8
520	.	9	3		"NUL"	"ENQ"	-	8	.	8
530	6		"NUL"	"ENQ"	-	8	.	7	9	
540	"NUL"	"ENQ"	-	8	.	7	2		"NUL"	"ENQ"
550	-	8	.	6	5		"NUL"	"ENQ"	-	8

4

ASCII Character Equivalent

This table shows the 512 byte header block that BASIC puts at the beginning of a LIF ASCII file on HFS disks. The portions of this block not shown in the table contains all zeros. This table also shows the 2-byte length header at the beginning of each string. Note that the strings have no added termination characters.

HP-UX File Dump Utility

When debugging problems that can arise from BASIC and HP-UX sharing data files, it may be necessary to look at the contents of data within the file. This program is an HP-UX C program to read the contents of a file and display the contents in hexadecimal format.

```
#include <stdio.h>
main(argc, argv)
int argc;
char *argv[];
{
    int X, Y, values[20], start, end;
    FILE *datafile, *fopen();

    printf("Contents of %s\n",argv[1]);
    /**          ***/
    /** Open file to read data ***/
    /**          ***/
    datafile = fopen(argv[1], "r");
    if (datafile == NULL) {
        printf("Can't open file %s\n",argv[1]);
        exit(1);
    }
    /**          ***/
    /** Get data from file and print data ***/
    /**          ***/
    sscanf(argv[2], "%d", &start);
    sscanf(argv[3], "%d", &end);
    fseek(datafile, start, 0);
    printf("BYTE|");
    for (X = 0; X <= 9; X += 1) {
        printf("%4+d |",X);
    }
    printf("\n");
    for (X = 0; X <= 3; X += 1) {
        printf("-");
    }
    printf("+");
}
```

4

```

for (Y = 0; Y <= 9; Y += 1) {
    for (X = 0; X <= 5; X += 1) {
        printf("-");
    }
    printf("+");
}

printf("\n");
for (Y = start; Y <= end; Y +=10) {
    printf("%3d |",Y);
    for (X = 0; X <= 9; X += 1) {
        values[X] = getc(datafile);
        values[X] = values[X] & 0377;
        printf("%4x  |",values[X]);
    }
    printf("\n");
}
fclose(datafile);
}

```

4

Once this program has been compiled, it is executed by the following syntax:

prog_name file_name start end

in which:

prog_name is the name of the compiled program that is to be executed

file_name is the file to dump

start is the starting byte at which to begin the dump

end is the last byte of the dump

Porting LIF Files to SRM

This section summarizes ways you can modify existing programs that use LIF disks to allow those programs to access the SRM system.

When modifying programs to access SRM-controlled mass storage device(s), you should be aware that:

- LIF and SRM mass storage file specifiers may differ and string variable names that contain file specifiers may need corresponding modification.
- References to mass storage volume specifiers (msvs) throughout the program may have to be altered.
- Allowances may have to be made for directory path specification.
- LIF protect codes may differ from SRM passwords. The syntax for protecting SRM files is different from that used for LIF files.

SRM File Specifiers

Composition of SRM File Names

All file names for local mass storage are one to 10 characters long, while SRM file names contain one to 16 characters. Remote file names can contain the period character (.) while local files cannot. If file name compatibility between resources is required, use 10 or fewer characters and do not use periods within SRM file names.

SRM File and Mass Storage Device Specification in String Variables

Modifying programs for use with SRM resources generally requires changing the value, and often the length, of the string variables used to specify files and mass storage devices. The statements that assign the actual values to the string variables may have to be modified individually.

Some programs use one string variable for the entire file specifier. For instance:

```
100 DIM File_specifier$[32]
110 LINPUT "Enter file specifier", File_specifier$
120 ON ERROR GOTO 110 ! Try again if improper specifier.
130 ASSIGN @Path TO File_specifier$
140 OFF ERROR
```

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If one variable is used for all file specifiers (as in the preceding example), only the length of the variable needs to be changed to allow for the additional characters allowed in SRM file specifiers.

The maximum number of characters that can be entered into a string variable from the keyboard in one operation is a good size for a file specifier variable.

- Series 200 Models 216, 220, 226 and 236 allow up to 160 characters. Series 300 computers with medium-resolution displays also allow 160 characters.
- Model 237 allows 256 characters. Series 300 computers with high-resolution displays also allow 256 characters.

Thus, the length of `File_specifier$` in the preceding example's DIM statement would be changed from 32 to 160 or 256, accordingly.

Note that the system mass storage device (the current MASS STORAGE IS device) will be accessed if no `msvs` is explicitly specified.



SRM Mass Storage Volume Specification

Some programs use separate variables for the file name and volume specifiers. For example:

```
ASSIGN @Path TO Filename$&Msvs$
```

If so, both variables may have to be dimensioned to greater lengths. Allowing 34 characters for the file name variable accommodates a 16-character file name, a 16-character password, and the “<” and “>” password delimiters (for example, “ASCDEFGHIJ123456<1234567890123456>”). The SRM volume specifier may occupy up to 54 characters.

Other programs may use MASS STORAGE IS statements throughout the program instead of including the msvs in each file specifier. For instance:

```
MASS STORAGE IS Left_drive$  
ASSIGN @File TO File_name$
```

Unless variable(s) are used to specify the msvs and each variable is assigned a value in only one place, you may have to modify each MASS STORAGE IS statement to specify the desired SRM volume.

Allowing for SRM Directory Paths

Suppose the following program needs to be modified to include a SRM file's directory path.

```
100 DIM Filename$[14],Msvs$[20]
.
.
.
500 Filename$="SLIDES"
510 Msvs$=":HP9895,700"
.
.
.
1000 ASSIGN @File TO Filename$&Msvs$
1010 OUTPUT @File;Data(*)
1020 ASSIGN @File TO *
.
.
.
2000 ASSIGN @File TO Filename$&Msvs$
2010 OUTPUT @File;Data(*)
2020 ASSIGN @File TO *
```

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In the next example, it is probably easiest to add another string variable for the (optional) directory path name. For example:

```
100 DIM Dir_path$[160],File_name$[80],Vol_spec$[80]
    .
    .
    .
500 Dir_path$="FRED/DATA_FILES/"
510 File_name$="SLIDES"
520 Vol_spec$=":REMOTE 21,1"
    .
    .
    .
1000 ASSIGN @File TO Dir_path$&File_name$&Vol_spec$
1010 OUTPUT @File;Data(*)
1020 ASSIGN @File TO *
```

If the `Dir_path$` variable is null, the statement looks exactly like it did before the modification. If the `Vol_spec$` variable is null, the current mass storage device is accessed. The only difference is in the allowable length of the string variables.

SRM Passwords vs. LIF Protect Codes

The PROTECT statement syntax for SRM files is different from the syntax for LIF files. Depending on the type of mass storage that is being used, you can use either of the following to decide which syntax will be used:

1. Try the non-SRM syntax with an ON ERROR statement enabled. If an error occurs, see if it indicates that the mass storage device is an SRM. An Error 1 occurs when the following statement is executed on an SRM file:

```
PROTECT file specifier,protect code
```

2. If the program uses a string to store the volume specifier, check for a non-zero value of `POS(Vol_spec$,"REMOTE")`. This alternative is easier to implement than alternative 1 but will not work if the program accesses the default device when `Vol_spec$` is empty.

If the program looks for a password error (Error 62) at ASSIGN time, the program may have to be modified because the system may not detect the password error until an ENTER @Path or OUTPUT @Path is attempted.

Copying Item-by-Item Using ENTER and OUTPUT

You may copy a file from LIF to SRM mass storage one item at a time, as illustrated in the programs that follow. These programs use the ENTER and OUTPUT statements to copy data item-by-item from a LIF BDAT file to an SRM BDAT file.

The first program creates and fills a BDAT file named BDAT_FILE.

```
10    CREATE BDAT "BDAT_FILE:INTERNAL",10
20    ASSIGN @Local TO "BDAT_FILE:INTERNAL"
30    !
40    FOR Item=1 TO 50
50    OUTPUT @Local;"String data item"
60    NEXT Item
70    !
80    ASSIGN @Local TO *
90    END
```

The second program copies the contents of BDAT_FILE item-by-item into a file (also called BDAT_FILE) in the SRM directory named General (shown in the previous illustration).

```
100   DIM String_item$[20]
110   CREATE BDAT "PROJECTS/General/BDAT_FILE:REMOTE",10
120   ASSIGN @Local TO "BDAT_FILE:INTERNAL"
130   ASSIGN @Remote TO "PROJECTS/General/BDAT_FILE:REMOTE"
140   !
150   FOR Item=1 TO 50
160   ENTER @ Local;String_item$
170   OUTPUT @Remote;String_item$
180   NEXT Item
190   !
200   ASSIGN @Local TO *
210   ASSIGN @Remote TO *
220   END
```

Accessing Files Created on Non-Series-200/300 SRM Workstations

Regardless of the kind of the computer or language system, ASCII files can be shared among all workstations on the SRM.

This example shows how you can access an ASCII file named `Prog_x`, which was created on an HP 9845 with the `SAVE ASCII` statement.

In this example, `Prog_x` is in an HP 9845 workstation user's directory called `COMMON`. `COMMON` is located in the directory `WORK_45`, which is at the root of the SRM directory structure. The password `mypass` protects the `READ` capability on `WORK_45`. All access capabilities on `COMMON` are public.

To access `Prog_x` on a Series 200/300 Workstation, you would type:

```
GET "WORK_45<mypass>/COMMON/Prog_x:REMOTE"
```

or

```
GET "/WORK_45<mypass>/COMMON/Prog_x"
```

The system would then put `Prog_x` into your workstation. Keep in mind that, with `GET`, any lines containing syntax that is invalid for Series 200/300 BASIC will be stored as commented program lines (such as `100 ! BEEPER 10,10`).



BASIC/UX Differences and Enhancements

Introduction

There are three implementations of HP BASIC:

- | | |
|-----------|---|
| BASIC/WS | The Workstation implementation, which is a combined language and operating system that runs on HP 9000 Series 200/300 computers. |
| BASIC/DOS | BASIC/DOS is an implementation of HP BASIC for the HP Measurement Coprocessor, that plugs into a PC. |
| BASIC/UX | The HP-UX implementation, which is essentially the BASIC interpreter and part of the BASIC Workstation operating system that runs as a set of processes “on top of” the HP-UX operating system. |

This chapter describes the differences and enhancements that BASIC/UX provides to the BASIC/WS implementation. (It does *not* describe the differences between BASIC/DOS and BASIC/WS. See the documentation supplied with the HP Measurement Coprocessor for that information.)

Prerequisites to Reading this Chapter

In order to understand the information in this chapter, you should:

- Already be familiar with the BASIC/WS implementation of HP BASIC (otherwise, this “delta” information will not make much sense to you).
- Have a copy of the BASIC/UX manual set available (so you can look up some of the details of the brief descriptions given here).

Compatibility Between BASIC/UX and BASIC/WS

The BASIC/UX implementation is highly compatible with the BASIC/WS implementation. Nearly all programs written for BASIC/WS will run (with *minor* modifications) on the BASIC/UX system. However, because BASIC/WS has its own operating system and BASIC/UX runs on the HP-UX operating system:

- Some BASIC/WS capabilities do not work on BASIC/UX.
- Some BASIC/WS keywords work differently on BASIC/UX.
- BASIC/UX has also added new keywords to the BASIC/WS keyword set.

This chapter provides a *brief summary* of these differences and enhancements. For a *detailed* description of a *particular* difference or enhancement, refer to the BASIC manual specified in the table entry (in this chapter) that describes that feature.

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Are You Porting BASIC/WS Programs to BASIC/UX ?

One of the main benefits of reading this chapter is that it will help you determine what will be required to port existing BASIC/WS programs to run on the BASIC/UX system. If you are porting existing software, you should at least scan this chapter *before* reading the chapter called “Porting BASIC/WS Programs to BASIC/UX.”

Summary of BASIC/UX Differences

The following tables list the differences between BASIC/UX and BASIC/WS keywords. Note that not all features mentioned exist on all versions of BASIC/UX. For example, BASIC/UX 300/400 supports terminals, but BASIC/UX 700 does not. Therefore, references to terminals apply to BASIC/UX 300/400 only. For a detailed list of differences between BASIC/UX 300/400 and 700, see the “Porting from BASIC/UX 300/400 to BASIC/UX 700” chapter later in this manual.

5-2 BASIC/UX Differences and Enhancements

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
ALPHA ON ALPHA OFF	Turns the alphanumeric display on or off.	On a console, these keywords function the same as for BASIC/WS. However, on a terminal or in X Windows these keywords are no-ops. The reason for this is on terminals alpha and graphics are separated and cannot be merged and in X Windows alpha and graphics are merged and cannot be separated.
ASSIGN	Assigns an I/O path name and attributes to a device, group of devices, a mass storage file, or a buffer.	Extended to allow piping to/from HP-UX commands (such as " <code> lp</code> ") and to allow output to windows.
CAT	Lists the contents of a mass storage directory or provides information on a specified PROG file.	For HFS directories, the device selector, unit, and volume numbers normally found in the first line are not displayed, and the device type is shown as HFS. Also, CAT on BASIC/UX recognizes additional file types which may be found on HFS volumes (e.g., PIPE). CAT has not changed for LIF or SRM directories.

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
CONTROL CRT,18	Sets the alpha write-enable mask to a bit pattern.	Same as the description for the keywords ALPHA ON and ALPHA OFF.
CONTROL CRT,21	Switches between Series 200 CRT compatibility mode and native bit-mapped mode.	Not supported.
CONTROL KBD,11	Sets the knob pulse mode.	KNB2_0 binary functionality is not supported on BASIC/UX.
CONTROL 32	This <i>pseudo</i> select code is used to turn on and off parity checking, system (memory) cache, and processor (instruction) cache.	Control registers 0, 1, and 3 are not supported on pseudo select code 32; however, all of its status registers are supported.
CREATE	Creates a new file.	The default permission for files and directories created on HFS volumes may be modified using the HP-UX <code>umask (1)</code> command.

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Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
CSUB	CSUBs are typically compiled BASIC or Pascal subprograms. Their capabilities are described in the <i>Developing CSUBs for BASIC/WS</i> manual.	BASIC/WS CSUBs cannot be loaded into BASIC/UX. If you have source code and an HP-UX compiler for that language, you may be able to compile and build a BASIC/UX version of the CSUB. However, there may be differences in the dialect and/or library support of a language on two different platforms. Recoding may be needed to restore the original functionality of the CSUB. Some functionality, like display hardware access, may not be possible from a BASIC/UX CSUB.
Datacomm and Serial Interfaces: CONTROL Registers STATUS Registers	Supported as stated in the BASIC/WS documentation.	Some registers are not supported or have slightly different definitions, some registers have been added, and READIO and WRITEIO are not supported. Also, the HP 98642A 4-Channel Multiplexer has been added as a new interface that is supported by BASIC/UX.
DUMP ALPHA DUMP GRAPHICS	Copies the output of the alpha or graphics display to a printing device.	Extended to support output to windows and named or unnamed pipes. Note that windows can only receive alpha output. Also, DUMP GRAPHICS is not supported on terminals.

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Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
DUMP DEVICE IS	Specifies which device receives the data when either DUMP ALPHA or DUMP GRAPHICS is executed without a device selector.	Extended to support output to windows and named or unnamed pipes. Note that windows can only receive alpha output.
ENTER	Used to input data from a specified source and assign the value(s) entered to variable(s).	Extended to support input from a named or unnamed pipe.
ERRM\$ ERRN	ERRM\$ returns the text of the error message associated with the most recent program execution error. ERRN returns the number of the most recent error.	BASIC/UX provides new errors in the range 186 to 198 and 810 to 867. (All error messages are listed in the appendices of the <i>HP BASIC Language Reference</i> and <i>HP BASIC Condensed Reference</i> .)
GESCAPE CRT, 7	Sets the graphics write- and display-enable masks.	Not supported in windows or terminals.
GLOAD	Loads the contents of an INTEGER array into a frame buffer.	Not supported on terminals.

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Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
GRAPHICS INPUT IS	Assigns the graphics input device for DIGITIZE, READ LOCATOR, etc.	Works the same as with BASIC/WS on a console. In a window environment, use the keyword SET HIL MASK to select graphics input devices not used by the window manager. Terminals are restricted to input from the keyboard.
GRAPHICS ON/OFF	Turns the graphics display on or off.	Same as the description for the keywords ALPHA ON and ALPHA OFF.
GSTORE	Stores the contents of the frame buffer into an INTEGER array.	Not supported on terminals.
HFS Formatted Disks	Requires that HFS disks be connected to the system to access them.	Requires that all HFS disks be "mounted" before they can be accessed. This allows file buffering to be performed, which greatly improves performance. Also note that with BASIC/UX, all HFS volumes are joined into a single hierarchy (by the HP-UX operating system). In addition, STATUS register 2 is not supported for an I/O path name assigned to a file on an HFS volume.

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
HP-IB Interfaces	Supported as stated in the BASIC/WS documentation.	Register 255 added for control of locking and burst mode. DMA support may not be available on some systems.
HP-HIL Commands: IDD RNM EXD RST RSC	These HP-HIL commands work as stated in the BASIC/WS documentation.	Since BASIC/UX cannot determine the number of bytes in a packet of information returned when you execute these commands, it uses the null byte as a packet terminator. This means that it will return up to the maximum number of bytes in a packet and ignore all trailing null bytes.
INITIALIZE	Prepares (formats) mass storage media for use by the computer.	Works the same as with BASIC/WS; however, only an <i>unmounted</i> disk may be INITIALIZE'd.
Interfaces not supported on BASIC/UX: HP Parallel BCD EPROM Powerfail Bubble Memory	Supported as stated in the BASIC/WS documentation.	These interfaces are not supported on BASIC/UX; however, you can gain access to their hardware by using the keywords READIO and WRITEIO on BASIC/UX 300/400 (not on BASIC/UX 700). The HP Parallel interface is supported by the HP-UX lp facilities.

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Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
KNOBX KNOBY	Return the net number of horizontal knob pulses (KNOBX) or vertical knob pulses (KNOBY).	Use BASIC/WS 3.0 definitions (and the KNB2_0 binary/definition is not supported).
LIST	Lists the program currently in memory, and then shows the amount of memory available for program storage.	Lists the program, and then shows the sum of the memory available for program storage, stack, and COM.
LOAD BIN	Loads binaries into memory.	Not supported by BASIC/UX, because all BASIC/WS binaries are part of the BASIC/UX system. Optional BASIC/UX binaries are loaded with the -L command line parameter.
ON/OFF CYCLE ON/OFF DELAY ON/OFF TIME ON/OFF TIMEOUT	Enable/cancel event-initiated branches.	Clock/timer resolution is 20 milliseconds (vs. 10 for BASIC/WS). A child process of BASIC/UX is spawned to handle timers. A specified ON TIMEOUT value applies to an entire I/O request, not to each data byte as on BASIC/WS. Therefore, ON TIMEOUT values may need to be changed when porting BASIC/WS to BASIC/UX.
OUTPUT	Outputs items to a specified destination (device, I/O path, or string variable).	Works the same as with BASIC/WS; however, you can also output to a window and named or unnamed pipe.

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
Memory Volume	BASIC/WS allows you to create a memory volume in your computer's random access memory (RAM). This provides a fast means for storing and retrieving files.	BASIC/UX will not support TRANSFERs to memory volumes. Also, BASIC/UX only supports LIF formatted memory volumes. It does not support HFS formatted memory volumes.
msvs (mass storage volume specifier)	Allows you to specify mass storage devices other than the default volume.	Allows mapping of a volume specifier to an HP-UX directory name by using the specifier DISK in your BASIC/UX configuration file (.rmbrc). Also when the device type is HFS, the device selector is ignored unless it is mapped. Finally, ":HFS" may be used to refer to the current working directory (the HFS directory that you had most recently moved to using the MASS STORAGE IS command).
PASS CONTROL	Passes Active Controller capability to a specified HP-IB device.	Passing control to an interface connected to a swap device or a mounted file system is <i>not</i> allowed.

5-10 BASIC/UX Differences and Enhancements

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
PLOTTER IS PRINTALL IS PRINTER IS	PLOTTER IS selects the system plotting device. PRINTALL IS selects a printing device for error messages, and PRINTER IS specifies the default system printing device (for PRINT, CAT, etc.).	These statements have been extended to allow: <ul style="list-style-type: none">■ Piping of output to an HP-UX command (for instance, to a spooler such as "<code> plt</code>").■ Redirection of output to a window. Also, PRINTALL IS has been extended to include files.
PRINT LABEL	Gives a name to a mass storage volume.	Not supported on HFS volumes.
READ LABEL	Reads a volume label into a string variable.	Not supported on HFS volumes.
RE-SAVE	Creates an ASCII file and copies program lines as strings into that file.	BASIC/UX will create an HP-UX type file or an ASCII file, depending on the original file type.
"Run Light" and Other Activity Indicators	An asterisk (*) and other textual messages are shown in the lower, right-hand corner of the screen.	BASIC/UX provides: <ul style="list-style-type: none">■ No Run Light indicator (this is on if KEY LABELS is off)■ A new activity indicator (Execute)

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
SAVE	Creates an ASCII file and copies program lines as strings into that file.	BASIC/UX will create an HP-UX type file instead of an ASCII file when saving a program on an HFS volume.
SC	Returns the interface select code associated with an I/O path name.	Not supported for an I/O path name assigned to a file on an HFS volume. Also, it is not supported for HP-UX pipes.
SCRATCH BIN	Clears what SCRATCH A does, plus it clears all binaries except the CRT driver for the CRT in use.	All binaries are permanently loaded and therefore are non-scratchable.
SEPARATE ALPHA FROM GRAPHICS	Used to simulate the separate alpha and graphics rasters of Series 200 displays.	Same as the description for the keywords ALPHA ON and ALPHA OFF.
SET ALPHA MASK	Sets the alpha write-enable mask to a bit pattern	Same as the description for the keywords ALPHA ON and ALPHA OFF.
SET DISPLAY MASK	Sets the display write-enable mask to a bit pattern.	Same as the description for the keywords ALPHA ON and ALPHA OFF.

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Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
SET TIME	Resets the time-of-day given by the real-time clock.	Affects the "local" BASIC/UX clock value only (HP-UX system time and date will not change). It also allows re-synchronization with HP-UX time.
SET TIMEDATE	Resets the absolute seconds (time and date) given by the real-time clock.	Affects the "local" BASIC/UX clock value only (HP-UX system time and date will not change). It also allows re-synchronization with HP-UX time.
SRM Interface	Provides access to the HP Shared Resource Manager.	BASIC/UX only supports one SRM interface card per system. Also, the semantics for LOCK are different if more than one BASIC/UX process is running on the same system. Finally, support is only provided for SRM STATUS registers 3 and 6.
STATUS and CONTROL Registers: Datacomm RS-232	Supported as described in the BASIC/WS documentation.	Some registers are not supported or have slightly different definitions.

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
STORE SYSTEM	Stores the BASIC/WS operating system and all binaries currently in memory.	Not supported on BASIC/UX (not needed, since there are no separate binaries).
SYSBOOT	Returns control to the BOOT ROM to restart the system selection and configuration process.	Not supported on BASIC/UX.
SYSTEM\$ ("AVAILABLE MEMORY")	Returns the amount of memory available for program storage.	Returns the sum of the memory available for program storage, stack, and COM.
SYSTEM\$ ("MASS MEMORY")	Returns X000YZ0000000000 where: X = Number of internal disk drives; Y = Number of initialized EPROM cards; Z = Number of bubble memory cards. (If Y or Z exceed 9, an asterisk appears.)	Always returns 0000000000000000.

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
SYSTEMS\$ ("MASS STORAGE IS")	Returns the mass storage unit specifier of the current MASS STORAGE IS device as it appears in the CAT heading.	For HFS volumes, the device selector, unit, and volume numbers are not shown. For LIF and SRM volumes, it has not changed.
SYSTEMS\$ ("SERIAL NUMBER")	Returns one of the following: <ul style="list-style-type: none"> ■ Bytes 4-14 of an ID PROM (if present); ■ An encoded serial number from an HP-HIL ID module (if present); otherwise, it returns the null string.	Returns an encoded serial number from an HP-HIL ID module (if present); otherwise, it returns the null string.
TIMEDATE	Returns the current value of the real-time clock.	Works the same as with BASIC/WS; however, resolution is limited to 20 milliseconds (vs. 10 ms with BASIC/WS).

Keyword/ Feature	BASIC/WS Description	BASIC/UX Description
TIMEZONE IS	Specifies the offset from Greenwich Mean Time, providing compatibility with HP-UX time stamps on files when switching back and forth between the BASIC and HP-UX systems.	Works the same as on BASIC/WS; however, when used without a parameter the time zone is resynchronized with the HP-UX time zone.
TRANSFER	Initiates unformatted I/O transfers, which can take place concurrently with continued program execution.	Supports BASIC/WS TRANSFER-related statements. Runs as a separate process. TRANSFER is only supported for HFS (not for SRM, LIF, or MEMORY volumes).
WAIT	Causes the computer to wait approximately the number of seconds specified before executing the next statement.	Works the same as on BASIC/WS; however, accuracy is load dependent, but generally 40 milliseconds (vs. 10 ms on BASIC/WS).

BASIC/UX Mass Storage Differences

This section covers mass storage differences between BASIC/WS and BASIC/UX. Topics covered are:

- Maximum Number of Open HFS Files
- Locking SRM Files
- Leaving SRM Files Open

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- SRM Security
- Using SRM Interface Cards with BASIC/UX
- Accessing LIF Media by a Single User



Maximum Number of Open HFS Files

The HP-UX operating system imposes a limit on the maximum number of file descriptors that each process may use at any time (typically 60). BASIC/UX generally uses at least 10 of these internally. Any time an HFS file is opened, another file descriptor is put into use until the file is closed. Note that opening a LIF or SRM file *does not* require the use of a file descriptor. If the maximum number of open files is reached, then some files must be closed. This may be done by executing `ASSIGN TO *`, pressing the **Reset** key, or executing `SCRATCH A`.

Locking SRM Files

BASIC/UX allows several instances of HP BASIC to be run on the same system. However, the SRM server assumes that each process is running on a different system. Because of this, the semantics of `LOCK` are different if more than one BASIC/UX process is trying to access the same file at the same time. For example, an `ENTER` normally hangs until the file is unlocked. If the file is locked by another BASIC/UX process on the same system, however, the `ENTER` returns error 481.

Leaving SRM Files Open

Because the BASIC/WS is a single user system, it can request that the SRM server close all files open for that system. This “clean up” operation is performed when the system boots, when a **Reset** key or `SCRATCH A` is done, etc. BASIC/UX, however, is a multi-user system, and such an action could cause the files of other users on the same system to be closed inappropriately. BASIC/UX attempts to close all files that it opens, however, there may occasionally be some left open for this reason. In general this is not a problem. These files may be closed by executing the “remove user” command on the SRM console, or running the `hp-ux srmclean(1)` utility. Be sure that no one else is using the SRM from that system before taking these actions.

SRM Security

Because the HP-UX operating system allows multiple users to access the SRM from the same system, some access security is lost.

Using SRM Interface Cards with BASIC/UX

SRM interface card support is different on various HP-UX operating system versions and BASIC/UX versions. If you are using:

- An HP-UX version *prior to* 8.0 with a BASIC/UX version *prior to* 6.2, only one SRM card is supported per system. This card can be shared simultaneously by several processes (BASIC/UX and/or the HP-UX SRM utilities); however, the performance will decrease as the number of processes using it increases.
- BASIC/UX 300 version 6.2 or BASIC/UX 300/400 version 6.3 or later, multiple SRM cards are supported per system. This is because HP-UX version 8.0 and later has a driver allowing multiple SRM cards. However, if SRM/UX is accessing an SRM card, that card cannot be accessed by other processes. Refer to the *SRM-UX System Administrator's and User's Guide* for more information.
- HP-UX version 9.0 or later with BASIC/UX 700 version 7.0 or later, SRM cards are *not* supported. This is because Series 700 computers do not support SRM interface cards; thus, BASIC/UX 700 does not support the SRM driver. Access to SRM/UX files is still available directly on an SRM/UX server or via LAN (NFS) for remote servers. However, BASIC/UX 700 is not able to participate in the SRM/UX locking mechanism.

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Accessing LIF Media by a Single User

It is highly recommended that only one process access a LIF media at a time. The HP-UX operating system coordinates multiple processes accessing the HFS file system simultaneously, and the SRM server does the same thing for the SRM file systems. However, there is no such support for multiple processes accessing the same LIF media simultaneously. For this reason, if more than one process does try to access the same LIF media at the same time, the media may become corrupt and data may be lost. Also, the accurate detection of media change can only be done when one process is accessing the media. Single process access is enforced for Amigo protocol devices. Once a process has

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begun accessing an Amigo protocol device, it “owns” that device until the **Reset** key is hit, a SCRATCH A is performed, or the process terminates.

Overview of BASIC/UX Enhancements

Since BASIC/UX runs on the HP-UX operating system, it provides you with essentially all of the capabilities of HP-UX. Here are the categories of these new features:

- Multi-tasking (the ability to run several processes/programs concurrently—for example, support of HP terminals).
- Multi-user environment (the ability for several users to use the system simultaneously).
- Additional system status and configuration information (regarding processes, operating system, and windowing system).
- Ability to run HP-UX commands from within BASIC/UX.
- Networking capabilities (such as remote file access and network file transfer).
- Window management capabilities (X Windows).
- Additional interface control:
 - Interface mapping (for non-supported interfaces) — Series 300/400 only.
 - Interface locking.
 - Burst I/O — Series 300/400 only.
- Use of HP-UX pipes.
- Selecting HP-HIL devices.
- HP-UX signal handling.
- HFS File buffering.
- Graphics buffering.

The following tables list the BASIC/UX enhancements to BASIC/WS.

Entering and Exiting the BASIC/UX Environment

Since the BASIC/UX system runs on the HP-UX operating system, you have the ability to enter BASIC/UX from an HP-UX shell prompt. (You can also have your System Administrator set up your console to automatically “wake up” in the BASIC/UX system. See the *Installing and Maintaining HP BASIC/UX* for details.)

Keyword/Feature	Description
rmb	Enters you into the BASIC/UX system (from an HP-UX shell).
QUIT	Exits you from the BASIC/UX system (returns you to an HP-UX shell).

5

Multi-Tasking and Multi-User Capabilities

You can run several BASIC/UX processes at the same time by executing the `rmb` command from within a windowing environment (while in an HP-UX shell). Each BASIC/UX process can be running a separate BASIC/UX program at the same time that other processes are running. (See *Using HP BASIC/UX* for instructions.)

You can also have several users running processes concurrently on the HP-UX system. Each one will be on a separate console or terminal. (See the HP-UX documentation for more details on this capability.)

Note that each additional BASIC/UX process uses RAM, swap, processes, and other limited HP-UX resources. Starting too many BASIC/UX processes can adversely effect system performance and/or cause HP-UX to run out of resources.

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System Status and Configuration Information

The SYSTEM\$ function has some additional capabilities with BASIC/UX.

Keyword/Feature	Description
SYSTEM\$(“PROCESS ID”)	Returns the process identifier of the main BASIC/UX process.
SYSTEM\$(“VERSION:OS”)	Returns the operating system version and name.
SYSTEM\$(“WINDOW SYSTEM”)	Returns information that describes the windowing system currently in use.

Running HP-UX Commands from within BASIC/UX

You can send commands to HP-UX while in the BASIC/UX system. For instance, the following command returns a printout of a calendar for the current month:

```
EXECUTE "cal"
```

The results of the command appear in the HP-UX window from which BASIC/UX was started.

Keyword/Feature	Description
EXECUTE	Gives you access to the HP-UX operating system for executing commands and programs.

5

Window Management

A windowing system gives you the ability to partition your screen into several “panes”, each of which is the display for a process. The BASIC/UX system uses the X Windows system. (The X Windows documentation provides a more complete description of a windowing system.)

Keyword/Feature	Description
CLEAR WINDOW	Clears the contents of the specified window.
CONTROL CRT, 22	Shuffles a specified window number to the top or bottom of the window stack.
CREATE WINDOW	Creates a window which can be accessed by BASIC/UX.
DESTROY WINDOW	Deletes a window created by BASIC/UX.
LIST WINDOW	Shows a list of all active BASIC/UX windows.
MOVE WINDOW	Moves a window to another x-y location on the screen.
SCRATCH WINDOW	Destroys all windows created from within the current BASIC/UX process. (Note that it will not remove the “boot” BASIC/UX window.)

5

Additional Interface Control

The BASIC/UX system runs “on top of” the HP-UX multi-tasking, multi-user system. In this environment, several processes/users may attempt to access an interface simultaneously. Therefore, BASIC/UX provides a way of “locking” an interface to a process so that no other process(es) may use it.

BASIC/UX 300/400 also has the capability of using HP-UX’s “burst mode” of I/O operations. This mode is generally faster than the default (non-burst) mode of I/O operations used with BASIC/UX.

5-22 BASIC/UX Differences and Enhancements

There are a few interface cards that are not supported by BASIC/UX such as the EPROM and BCD interface cards. To access these interface cards, you need to use memory-mapped I/O. Once one of these interfaces is memory mapped into the BASIC/UX address space, you can access locations on the interface using the keywords READIO and WRITEIO. (READIO and WRITEIO to interface cards is not supported on BASIC/UX 700.)

The following keywords and registers provide you access to the above mentioned features:

Keyword/Feature	Description
CONTROL <i>Sel_code</i> , 255 STATUS <i>Sel_code</i> , 255	CONTROL turns interface mapping, locking, and burst I/O on or off. STATUS queries the status of locking and burst mode for the interface at the specified select code.

Using HP-UX Pipes

The HP-UX system has a feature called a “pipe”, which is a special memory buffer that is used to hold the output of one command so that it can be used as the input to another command. Pipes may be used with the following commands:

- ASSIGN
- CONTROL
- DUMP DEVICE IS
- ENTER
- OUTPUT
- PLOTTER IS
- PRINTALL IS
- PRINTER IS
- STATUS
- TRANSFER

These statements have been extended to allow piping of output to an HP-UX command (for example, to a spooler such as "| plt").

Selecting HP-HIL Devices

With BASIC/UX, you have additional control capabilities for HP-HIL devices. You can enable or restrict a BASIC/UX process' access to selected HP-HIL devices by setting and clearing bits in a mask.

Keyword/Feature	Description
SET HIL MASK	Enables the specified HP-HIL devices to be used by the BASIC/UX system. (All other HP-HIL devices cannot be used by this particular BASIC/UX process.)

Trapping HP-UX Signals

HP-UX processes use signals to communicate among one another. BASIC/UX can set up interrupt-branching to trap these signals.

Keyword/Feature	Description
ON EXT SIGNAL OFF EXT SIGNAL	ON EXT SIGNAL defines an end-of-statement branch to be taken when an HP-UX signal is received. OFF EXT SIGNAL cancels the branch.
STATUS 33, <i>Register</i>	Queries HP-UX system signal information. (The <i>Register</i> number corresponds to an HP-UX signal. See the <i>HP BASIC/UX Language Reference</i> for a complete list of signals and register numbers.)
ENABLE EXT SIGNAL DISABLE EXT SIGNAL	Enable and disable a specified HP-UX signal to cause interrupts (end-of-statement branches) or to cause default actions.

HFS File Buffering

File buffering describes the way that the system handles data going to and coming from a disk.

If file buffering is enabled: The system writes all file output data into a memory buffer. This buffer is then written onto the disk whenever it is filled, and at regular intervals (typically every 30 seconds) by the HP-UX `syncer` (1M) daemon. This buffering action reduces wear on the disk and speeds up most disk operations.

If file buffering is disabled: All data output to the file is sent to the memory buffer then immediately to the disk.

File buffering usually speeds up disk operations, but at the risk of losing the memory buffer's contents (if power were to fail before the buffer is flushed).

Note that file buffering is *only* available with HFS files. (LIF files are never buffered, and only the SRM controller dictates how buffering is handled with SRM files.)

Keyword/Feature	Description
<code>CONTROL IO_path, 9</code> <code>STATUS IO_path, 9</code>	<code>CONTROL</code> turns file I/O buffering on or off. <code>STATUS</code> queries the status of file I/O buffering.

Graphics Buffering

Graphics buffering describes the way that the system handles data going to and coming from the frame buffer. The following are GESCAPE operation selectors that help you perform graphics buffering:

Keyword/Feature	Description
GESCAPE	Operation selectors have the following definitions: 10 turns graphics buffering on; 11 turns graphics buffering off; 12 returns the current graphics buffering mode; 13 flushes the graphics buffer.

5

BASIC/UX Mass Storage Enhancements

This section covers mass storage enhancements included with BASIC/UX. Topics covered are:

- Locking HFS Files
- Accessing Networked HFS File Systems
- Using Long File Names on the HFS File System.

Locking HFS Files

The keywords LOCK and UNLOCK have been extended to work with HFS file systems. In general, the semantics are very similar to those of the SRM file system. For information on LOCKing and UNLOCKing HFS files, read the section “Locking HFS Files” in the chapter “Data Storage and Retrieval” found in the *HP BASIC Programming Guide*.

Accessing Networked HFS File Systems

BASIC/UX has been extended to allow access to networked HFS file systems through Remote File Access (RFA) and Network File Service (NFS). This allows files on other systems to be accessed in many of the same ways that local files are accessed. For information on networking with BASIC/UX, read the section “If You Have Networking Options” in the chapter “Using HP-UX Commands in BASIC/UX” found in the *Using HP BASIC/UX* manual.

Using Long File Names on the HFS File Systems

The HP-UX operating system supports two types of HFS file systems. The Short File Name (SFN) system has a maximum file name length of 14 characters. Long File Name (LFN) systems, however, allow file names to be up to 255 characters long. BASIC/WS only supports SFN file systems, however, BASIC/UX will work with both types. See your HP-UX operating system documentation for details.

Porting to BASIC/UX

Most BASIC/WS programs will run on a BASIC/UX system with little or no modification. This chapter describes the process of copying, running, debugging, and modifying BASIC/WS programs for use on BASIC/UX.

General Steps

1. Copy the BASIC/WS program to a disk that you are using for BASIC/UX. (This is a simple operation, since both systems can access HFS and LIF, and BASIC/WS and BASIC/UX 300/400 can access SRM. However, please note that BASIC/UX 700 cannot access SRM. SRM/UX can also accomplish this.)
2. Run the program to find all *run-time* errors. As you encounter each error, note the BASIC keyword and look it up in the preceding chapter or in the *HP BASIC Language Reference*. Make the change, and re-run the program to find the next run-time error.
3. Once you have corrected all the run-time errors, you should store the program.
4. Run the program again to locate all *silent* errors (ones that do not generate a BASIC error message, but that do cause the program to work differently on BASIC/UX).
5. Once you have located and corrected all errors, store or save the program. This will complete the porting process.

Prerequisite

If you are not already in BASIC/UX, you need to enter it before completing the previous tasks. For information on how to do this, read the chapter called “Entering and Leaving BASIC/UX” in the *Using HP BASIC/UX* manual.

Copying BASIC/WS Files to BASIC/UX

BASIC/WS programs can be stored in files on three possible disk formats:

- HFS (Hierarchical File System).
- LIF (Logical Interchange Format).
- SRM (Shared Resource Manager).

Since the BASIC/UX 300/400 system also supports all three of these disk formats, you must decide whether to use the same disk or to use the HP-UX system’s HFS disk. Again, please note that BASIC/UX 700 supports HFS and LIF only — it does *not* support SRM. (SRM/UX uses HFS format.)

This section describes the necessary steps for copying files.

Prerequisites

In order to use a LIF disk from BASIC/UX 300/400, the appropriate device files must be set up in your `/dev/rmb` directory. For information on how to do this, read the section “Setting Up LIF Devices” in the chapter “Maintaining the BASIC/UX System” in the *Installing and Maintaining HP BASIC/UX* manual.

To use a LIF disk from BASIC/UX 700, it is *recommended* (not required) that the appropriate files are set up in your `/dev/rmb` directory. However, you must specify the path that you use in the `.rmbrc` file for BASIC/UX 700.

Copying Files from a LIF Disk

The following steps copy a file from a LIF disk to your current BASIC/UX working directory.

1. Catalog the files on the floppy using the CAT command. For example, the following command assumes you have a disk drive located at device selector 702 with unit 1.

```
CAT ":",702,1"
```

2. Look at the catalog listing of the files on the disk and select the file you wish to COPY. For example, if you select file **Prog1**, execute the following command to copy the file into your current BASIC/UX working directory:

```
COPY "Prog1:",702,1" TO "Prog1"
```

This file can now be loaded as explained in the section “Debugging the Program.”

To copy multiple files with a single command, refer to the “Wildcards” section in Volume 2 of the *HP BASIC Language Reference*.

Copying Files from an SRM Disk

The following are steps required to copy a file from the SRM file system into the current working directory of your BASIC/UX system. (These steps assume your BASIC/UX system is on a Series 300 or 400 computer that is connected to an SRM system through an HP 98629A or HP 50961A interface card located in your computer’s backplane.) The steps are as follows:

1. Catalog the files on the SRM file system using the CAT command. For example, the following command assumes the SRM interface is located at select code 8 and the file you are looking for is located in the root-level “USERS” directory on the server with node number 1.

```
CAT "/USERS:REMOTE 8,1"
```

2. Look at the cataloged listing of the files on the disk and select the file you wish to COPY. For example, if you select a file `/USERS/Prog1`, execute the following command to copy the file into your current BASIC/UX working directory:

```
COPY "/USERS/Prog1:REMOTE 8,1" TO "Prog1"
```

This file can now be loaded into memory as explained in the section "Debugging the Program."

To copy multiple files with a single command, refer to the "Wildcards" section in Volume 2 of the *HP BASIC Language Reference*.

Copying Files from a Mounted HFS File System

The following are steps required to copy a file from a mounted HFS disk into the current working directory of your BASIC/UX system. (These steps assume the HFS disk has been "mounted" in the HP-UX system. If not, see your System Administrator.)

The steps are as follows:

1. Catalog the files on the HFS disk using the CAT command. For example, the following command assumes the HFS disk is mounted at the location of the `/disk` directory.

```
CAT "/disk"
```

2. The following COPY command copies the file named "Prog1" located in the root-level `disk` directory:

```
COPY "/disk/Prog1:HFS" TO "Prog1:HFS"
```

where "Prog1" is the name of the new copy of the file. (The files can have the same name if they are not in the same directory.) Note that if your current MASS STORAGE IS directory is on HFS, you may omit the `:HFS` portion of the above file specifiers.

To copy multiple files with a single command, refer to the "Wildcards" section in Volume 2 of the *HP BASIC Language Reference*.

Debugging the Program

Overview

This section explains how to load, run, debug, and correct your BASIC/WS programs.

Prerequisites

You should have already copied all BASIC/WS programs into your current BASIC/WS working directory.

Loading the Program

To load a program, use either the GET or LOAD command. The GET command allows you to load ASCII and HP-UX files, and the LOAD command allows you to load PROG-type files. The PROG types are explained in the following table:

PROG-type Files

TYPE	Number	Compatibility
PROG	-5808	BASIC/WS can LOAD/STORE BASIC/UX 300/400 can LOAD/STORE BASIC/UX 700 can LOAD
PROG2	-12976	BASIC/UX 700 can LOAD/STORE

Note that BASIC/UX 300/400 can LOAD and STORE PROG files *only*. In contrast, BASIC/UX 700 can LOAD PROG files, but BASIC/UX 700 then STOREs the file in a new file format called PROG2, which has the number -12976. BASIC/UX 700 can LOAD and STORE any PROG2 file.

Since BASIC/UX 300/400 and BASIC/WS cannot LOAD the new PROG2 format, programs that must be ported from BASIC/UX 700 back to BASIC/UX 300/400 or BASIC/WS must use the GET/SAVE (ASCII) format. If you try to LOAD a PROG2 file on BASIC/UX 300/400, LOAD is not performed and Error 58 (Improper file type) is reported.

BASIC/UX 300/400 and BASIC/WS are unable to report PROG2 information in CAT statements and will, instead, display their type-number (-12976).

To determine whether the file you are loading is an ASCII or a PROG-type file, execute the CAT command. This command will list the TYPE attribute for the files in your current directory or the directory that you specified when you executed the CAT command. Once you have determined the type of file you are to load, you can then select the appropriate command for loading that file. For example, assuming there is a file named `Prog1` in the directory you are currently in, you would execute either the command:

```
GET "Prog1"           If an ASCII or HP-UX type file.
```

or

```
LOAD "Prog1"         If a PROG-type file.
```

Note that you can MSI to any file system (LIF, SRM, or mounted HFS) and use the above commands to load a file. For more information on loading programs, read the chapter “Loading and Running Programs” in the *Using HP BASIC/UX* manual.

Also, when you LOAD a PROG file into BASIC/UX 700, you may get warnings advising you that parts of the file could not be LOADED. These are CSUBs or BASIC Compiler subprograms and functions that are specific to BASIC on Series 200/300/400, which cannot be used in BASIC/UX 700. They must be reconstructed and, in some cases, rewritten before they can be used on BASIC/UX 700. For more information on doing this, please refer to the *Developing CSUBs for BASIC/UX 700* manual.

Note that the messages saying which parts of the PROG file could not be LOADED into BASIC/UX 700 may flash by too quickly to read. To retain these messages on the screen, turn on PRINTALL before doing the LOAD.

Finally, some SRM-related keywords are not usable in BASIC/UX 700, although they will translate correctly from PROG to PROG2 format. This is because BASIC/UX 700 does not support SRM. When the program is RUN or STEPped, these keywords will cause the error:

```
ERROR 1 in line number, Missing Binary SRM
```

6-6 Porting to BASIC/UX

These SRM-related keywords are: PROTECT with SRM syntax, and CAT with the PROTECT keyword. Examples of these syntaxes are:

```
100 PROTECT "Afile",("apassword":MANAGER)
```

```
210 CAT;PROTECT
```

Additionally, PROTECT with SRM syntax cannot be entered using the keyboard, and GET on a SAVED program containing it will cause an error. However, PROTECT with LIF syntax (for example, PROTECT "Afile", "xy") presents no problems.

Running the Program

To run a program that has been loaded into memory, use the RUN command. For example, type:

```
RUN 
```

or press the softkey **RUN**.

Subsequent pages describe how to correct errors in the program.

Recognizing and Correcting Run-Time Errors

If the BASIC/UX system should encounter an error while the program is running (a "run-time" error), it will report an error message containing the line number where the error occurred. For example:

```
ERROR 150 IN 110 Bad select code or device spec
```

where 150 is the error number, 110 is the line number where the error occurred (in some cases it is the approximate line number), and **Bad select code or device spec** is the error message. These items are important in correcting your program's run-time errors. It would be a good idea to write this information down as well as the statement that you feel caused the error.

The steps you need to take toward correcting your run-time errors are as follows:

1. Look up the error number in the appendix titled “Error Messages” in the *HP BASIC Language Reference*. This will in some cases give you a more complete error message and better help you determine what is wrong.
2. Use the statement’s keyword to direct you to the location in the “Summary of Keyword Differences” chapter that will help you in most cases find a solution to the run-time error. For example, if the run-time error is an I/O error dealing with the TRANSFER statement, then you would look for the TRANSFER statement in the “Summary of Keyword Differences” table in the preceding chapter. This table will give you a comparison of how this keyword is used on BASIC/WS and BASIC/UX. It also refers to a more detailed tutorial in one of the *Techniques* manuals. (Note that the *HP BASIC Language Reference* contains the most detailed information on each BASIC keyword.)
3. Once you have found what your error is, correct it and re-run the program. You should continue to do this until you have corrected all the run-time errors in your program. When the errors have all been corrected, you should make sure that there are no “silent” errors in the program. Silent errors are differences in the way the program *actually* runs now and how it *should* run (see the next section).
4. When there are no more run-time errors in your program, you should RE-STORE or RE-SAVE it.

Recognizing and Correcting Silent Errors

Silent errors are differences between:

- The way the program *should* run, and
- The way it *actually* runs on BASIC/UX.

They do *not* generate an error message, as is the case with run-time errors.

For example, the color of your graphics output might have changed. This is not an error that would cause the program to stop working; however, it is an error and it must be corrected to make the program function as it did prior to running it on BASIC/UX.

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The steps to take toward correcting your silent errors are as follows:

1. Locate the places in the program that exhibit behavior different from the way the program used to work.
2. Isolate the silent error to a certain part of your program by:
 - Reading the program listing.
 - Single-stepping through the program using the **Step** key (**f1**) in the System menu of your ITF keyboard).
 - Using the **Pause** key where unusual behavior occurs.

The procedures for using these statements to troubleshoot a program are described in the chapter called “Debugging Programs” found in the *HP BASIC Programming Techniques* manual. Following the procedures explained in these sections will help you find the statement that is causing your silent error.

3. Use the statement’s keyword to direct you to the location in the “BASIC/UX Differences and Enhancements” chapter that helps you, in most cases, find a solution to the silent error. For example, if the silent error is a graphics error dealing with the SEPARATE ALPHA FROM GRAPHICS statement, then you would look for this statement in the “Summary of Keyword Differences” table. The table gives you a comparison of how this keyword is different from BASIC/WS to BASIC/UX. It also provides a reference to more detailed information. Continue debugging until you have corrected all errors in your program.
4. When the errors have all been corrected, RE-STORE or RE-SAVE the program. It is ready for use on BASIC/UX.

Note that RE-STORE will not work on a Series 700 in this case, because BASIC/UX 700 stores programs in a new format called PROG2. PROG2 is not LOADable by BASIC/WS or BASIC/UX 300/400. Therefore, STORE the program under a new name on a Series 700.



Porting to 6.x

This chapter describes the new features of BASIC 6.x. It will help you determine what to do when porting programs from the 5.x versions of BASIC to 6.x.

Compatibility with Previous Revisions

BASIC 6.x is highly compatible with previous versions. This includes compatibility with the other implementations of HP BASIC including BASIC/UX and BASIC/DOS. Using BASIC 6.x you can:

- LOAD and RUN program (PROG) files created with STORE on previous versions of BASIC.
- GET and RUN program (ASCII or HP-UX) files created with SAVE on previous versions of BASIC.
- Use all data files (BDAT, ASCII, and HP-UX) created on previous versions of BASIC.

Note

If you are using compiled subprograms (CSUBS), you must relink them using the BASIC 6.0 CSUB Utility (sold separately). Refer to the section “CSUB Enhancements” for more information.

New Computers Supported

Different 6.x versions of BASIC include support for new computers:

- BASIC 6.0 includes support for the Model 345, 375, and V/360 computers.
- BASIC 6.2 includes support for the Model 362, 380, and 382 computers.
- BASIC/UX 6.2 and 6.3 include support for Series 400 computers.

The following table summarizes the new computers that BASIC 6.x supports.

New Computers Supported

Computer	BASIC Language Support
Model 345	BASIC Main (no binary required)
Model 375	BASIC Main (no binary required)
Model 380	BASIC Main and MCMATH binary
Model V/360 and V/382	Operation supported by BASIC Main (no binary required). VXIbus access provided via the optional VXI binary and utilities.
Model 362	BASIC Main (no binary required)
Model 382	BASIC Main and MCMATH binary
Series 400 (400s/400t/425s/425t/425e)	BASIC/UX only

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Note that some Model 362 and 382 computer configurations include monochrome multi-plane displays. Standard BASIC 6.2 color features will be mapped into gray scale on these systems.

New Interfaces Supported

The following table summarizes new interface hardware that BASIC 6.2 and BASIC/UX 6.3 support. Refer to the following subsections for more details regarding these interfaces.

New Interfaces Supported

Interface	BASIC Language Support
SCSI	SCSI binary
VXI	VXI binary (BASCIC/WS only)
HP Parallel	PLLEL binary
HP 98638 8-port Mux RS-232C	BASIC/UX only
APCI 3-port RS-232C	BASIC/UX only

HP SCSI Interface Support

Note that SCSI is *not* supported for peripherals other than disk drives. No SCSI Level II devices are supported.

BASIC/UX supports SCSI-based devices mounted as HFS file systems via HP-UX. See the *HP-UX System Administrator Manual* for more information. Also, to access LIF volumes on SCSI disk drives with BASIC/UX, please refer to the next subsection.

Booting from a SCSI disk drive requires boot ROM revision C or later. Series 200 computers and some Series 300 computers do not include this boot ROM revision and cannot provide system boot capability. In this situation, BASIC/WS can boot from a different interface (HP-IB or SRM), load the SCSI binary, and then access SCSI drives.

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Accessing LIF Volumes on SCSI Disk Drives

BASIC/UX supports the following HP SCSI disk drives with LIF.

Note Not all SCSI devices are equivalent, and the SCSI protocol can have several variations. Therefore, you *cannot* assume that a SCSI device is supported unless it is on this list.

- Built-in floppy disk drives (DD and HD media with formats: 256, 512, and 1024 bytes/sector).
- Built-in hard disk drives.
- C1701A 6300 650/A optical disk drive (format: 1024 bytes/sector)
- 7959S disk drive.
- C2212A and C2213A disk drives.

To access LIF volumes on SCSI disk drives with BASIC/UX, you must create a character device file for each SCSI drive that will use LIF volumes:

1. Login as **root**.
2. Create a device file for each SCSI drive that will access LIF volumes by typing:

```
/etc/mknod /dev/rmb/scsiN c 47 0xss0N00
```

Where:

N = the SCSI address of the device

ss = the select code of the SCSI interface

Use the appropriate minor number for your device. The following example shows the minor number for the internal floppy drive of a Model 382 computer:

```
/etc/mknod /dev/rmb/scsi0 c 47 0x0e0000
```

3. Type in:

```
chmod 666 /dev/rmb/scsiN
```

Again, substitute the SCSI address of the device for *N*.

Note that the first access to a newly inserted floppy in a Model 382 drive will be slow (approximately 10 seconds), but subsequent accesses will have normal response times. This is because the floppy drive supports multiple block sizes and needs to determine the block size of the floppy disk on the first access.

VXI Interface Support

BASIC/WS 6.21 supports access to the VXIbus when used with a Model V/360 or V/382 embedded VXI controller and the VXI binary. BASIC enables the embedded controller to access and manipulate the VXIbus backplane and VXIbus instruments directly.

Note that the VXI binary and utilities are not included in the standard BASIC product. Rather, they are available as a separate product from Hewlett-Packard Company.

BASIC/UX 6.2 and 6.3 do not have a VXI binary and do not support access to the VXIbus except in certain user-generated CSUBs.

HP Parallel Interface Support

BASIC/WS 6.2 supports the HP Parallel printer interface (Centronics compatible) for Models 345, 375, 362, 380, and 382.

BASIC/UX 6.2 and 6.3 provide access to HP Parallel devices through the `lp` spooler.

RS-232C Interface Support

BASIC/UX added support for the new HP 98638 multiplexer (Mux) and APCI interfaces, as explained in the following subsections. For more information on RS-232C interface support, refer to the *HP BASIC Interface Reference* manual.

HP 98638 Interface

BASIC/UX 6.2 and 6.3 support the HP 98638 8-port Mux interface. It can be accessed from BASIC/UX because it appears to be two HP 98642 interfaces. These will have two consecutive select codes. `rmbconfig` will create 8 device files in `/dev/rmb`, for example:

```
/dev/rmb/mux2800
:
/dev/rmb/mux2803
/dev/rmb/mux2900
:
/dev/rmb/mux2903
```

APCI Interface

BASIC/UX 6.3 also supports the APCI 3-port RS-232C interface, which is the built-in RS-232C for Model 382 and Series 400 computers. You can use APCI port 1 (select code 9) in the same way as the previous built-in HP 98644 interface (select code 9).

BASIC/UX 6.3 allows you to configure the other ports via the `rmbrc` configuration file. To do this, refer to the “Select Code Aliasing” subsection later in this chapter. When properly configured, all three ports can be used as separate serial interfaces.

The optional APCI 3-port cable (HP part number K2292) provides convenient access to port 2 (select code 5) and port 3 (select code 6). However, all lines are available on the 25-pin connector at the back of the computer, if you wish to build your own cabling.

New Keyboard Support

BASIC/UX 6.3 supports three keyboards that can be connected to Series 300/400 workstations or 700/RX terminals. These keyboards can be used in Console Mode or in the X Window System:

HP 46021A	HP-HIL	ITF
HP C1429A	HP-HIL	PC-101
HP C1405A	PS/2	PC-101

Mapping PC-101 Keyboards onto ITF

In order for the PC-style keyboards to perform the same BASIC functions as an HP ITF keyboard, you must map some of their keys to ITF functions. Mapping PC-101 keyboard keys onto ITF is done differently depending on whether:

- BASIC/UX is running in Console Mode or in X Windows.
- The PC-101 keyboard has an HP-HIL or a PS/2 interface.

The following subsections cover these different cases.

Console Mode Keyboard Mapping

The key mapping listed in the following table has been devised for Console Mode. This mapping is based on the one used with the DOS Measurement Coprocessor, with some changes needed to better handle keys present in the HP-UX/non-DOS environment. Since only HP-HIL keyboards (ITF or PC-101) can be used in Console Mode, BASIC/UX can identify the type and enable the proper mapping.

In the following table:

- The first column lists the function that BASIC/UX will perform.
- The second column lists the associated label visible on the keyface of an ITF keyboard (and the keystrokes required to reach it).
- The third column lists the associated label visible on the keyface of the PC keyboard (and the keystrokes required to reach it).

Keyboard Mappings

BASIC Function	ITF Keyface	PC-101 Keyface
Clear I/O	Break	Scroll Lock
Reset	Reset (Shift-Break)	Shift-Scroll Lock
Pause	Stop	Pause
Stop	Shift-Stop	Break (Shift-Pause)
Menu	Menu	Print Screen
Shift-Menu	Shift-Menu	Shift-Print Screen
System	System	Num Lock
User	User (Shift-System)	Shift-Num Lock
Ins Char	Insert char	Insert
Ins Line	Insert line	Shift-Insert
Del Char	Delete char	Delete
Del Line	Delete line	Shift-Delete
Clr->End	Clear line	End
Clr Ln	Shift-Clear line	Shift-End
Clr Scr	Clear display	Ctrl-End
Home	Home (hollow up-arrow)	Home
Shift-Home	Shift-Home	Shift-Home
Select	Select	Shift-Enter
Recall	F9	F9
Shift-Recall	Shift-F9	Shift-F9

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Keyboard Mappings (continued)

BASIC Function	ITF Keyface	PC-101 Keyface
Alpha	F10	F10
Dump Alpha	Shift-F10	Shift-F10
Graphics	F11	F11
Dump Graph	Shift-F11	Shift-F11
Result	F12	F12

X Window System Keyboard Mapping

When running BASIC/UX in the X Window System with a PC-101 keyboard, it is important to know which of the two keyboard models is being used. You'll need this information to perform the appropriate keyboard mapping, and to select the corresponding value for the `-K` option when executing the `rmb` command (see the `rmb` man page).

The HP C1429A is typically used with Series 300/400 computers and has *two* HP-HIL connectors on the back of it. The other model, the HP C1405A, is used only with 700/RX terminals and has a single PC-style connector on its back.

Once the keyboard model has been identified, you can easily perform the key mappings needed to operate BASIC/UX in X Windows by executing the X utility `xmodmap` with one of two files: either `xmodmap.PC.HIL`, or `xmodmap.PC`. These files are placed in the `/etc/newconfig/rmb` directory during BASIC/UX installation.

If you have an HP C1429A HP-HIL PC keyboard, the command:

```
/usr/bin/X11/xmodmap /etc/newconfig/rmb/xmodmap.PC.HIL
```

will map the keys to the appropriate functions in X Windows, as specified in the file `xmodmap.PC.HIL`.

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If you have an HP C1405A keyboard, the command:

```
/usr/bin/X11/xmodmap /etc/newconfig/rmb/xmodmap.PC
```

will map the keys to the appropriate functions in X Windows, as specified in the file `xmodmap.PC`.

You may want to place one or both of these commands in your `$HOME/.x11start` file, in the `/usr/vue/config/Xsession` file if you use HP VUE, or in the `$HOME/.xsession` file for 700/RX terminals.

Users of 700/RX terminals with PC-101 PS/2-style keyboards may also want to examine the `xmodmap` file distributed with the 700/RX software in `/usr/lib/X11/700X/examples/hpemulation`. This file provides an alternate mapping that allows the PC keyboard to emulate the HP ITF keyboard. This mapping is less convenient for BASIC/UX users, but maps some ITF keys that are not used by BASIC/UX.

Note To ensure proper operation of PC-style keyboards with BASIC/UX, run the `xmodmap` utility with the appropriate file, and provide the corresponding value (ITF, PC, or PC_HIL) to `rmb` using the `-K` option. For more information, consult the man pages for `xmodmap` and `rmb`.

Differences Between Console Mode and X Windows

In X Windows, the BASIC function “Clr Ln” (Clear Line) must be mapped to `(Alt)-(End)` on both PC keyboards, instead of `(Ctrl)-(End)` as is done in Console mode. This is due to differences in the way Console mode and X Windows produce events in conjunction with modifier keys.

In addition, *for the PC/HIL keyboard only*, the BASIC function “Clr Scr” (Clear Screen) cannot be mapped to `(Shift)-(End)`. Instead, it must be mapped to `(Shift)-(Keypad)-(End)` (that is, `(Shift)` in conjunction with the key labeled both `(1)` and `(End)` on the numeric keypad). This altered mapping of Clear Screen affects *only* the PC/HIL keyboard.

As mentioned earlier, with a PC keyboard and a 700/RX terminal, you may also wish to examine the `xmodmap` file distributed with the 700/RX software in `/usr/lib/X11/700X/examples/hpemulation`. This file provides an alternate mapping that allows the PC keyboard to emulate the HP ITF keyboard. This mapping is less convenient for BASIC/UX users, but maps some ITF keys that are not used by BASIC/UX.

By studying the `xmodmap.PC.HIL` and `xmodmap.PC` files, it is possible to customize the mappings to your own taste.

Better Keyboard Support in X Windows for Latin Languages

BASIC/UX now supports HP's Latin-based foreign language keyboards on both local and remote X displays. In addition, the problem where the `SYSTEM$("KEYBOARD LANGUAGE")` statement improperly reported the keyboard nationality when connected to a remote X display has been solved.

HP Terminals with Non-U.S. Keyboards

Although BASIC/UX properly maps characters produced by non-U.S. keyboards connected to HP terminals, the `SYSTEM$("KEYBOARD LANGUAGE")` statement *cannot* properly report the nationality of such keyboards. This is because RS-232C terminals provide no way to query the nationality of the keyboard.

BASIC Language Convergence

A number of language extensions were made to the HP BASIC language definition with the introduction of BASIC/UX. For details about these enhancements, refer to the "BASIC/UX Differences and Enhancements" chapter of this manual. To provide better compatibility between BASIC/WS and BASIC/UX applications, BASIC/WS 6.0 and later versions has incorporated these language extensions.

The operation of these keywords on BASIC/WS systems differs in some cases from the BASIC/UX definition. Generally, BASIC/WS operation of these keywords falls into three categories:

- Keywords that syntax and list, but do not execute.
- Keywords that syntax, list and execute, but have no effect upon system operation or return a known value.
- Keywords that syntax, list, execute and provide capability similar to the BASIC/UX definition.

This section provides a brief summary of these differences and enhancements. For a detailed description of a particular keyword, refer to the *HP BASIC Language Reference*.

All keywords listed in the following tables will syntax, LIST and LOAD on BASIC/WS 6.x. For each BASIC/UX keyword, the table includes information about the binary file required for operation and how this keyword operates in BASIC/WS 6.x.

Keywords From BASIC/UX

Keyword	Binary	Execution in BASIC/WS
CLEAR WINDOW	RMBUX	ERROR Not in a Window System
CREATE WINDOW	RMBUX	ERROR Not in a Window System
DESTROY WINDOW	RMBUX	ERROR Not in a Window System
LIST WINDOW	RMBUX	ERROR Not in a Window System
MOVE WINDOW	RMBUX	ERROR Not in a Window System
DISABLE EXT SIGNAL	RMBUX	ERROR Feature not supported by this OS
ENABLE EXT SIGNAL	RMBUX	ERROR Feature not supported by this OS
ON EXT SIGNAL	RMBUX	ERROR Feature not supported by this OS
OFF EXT SIGNAL	RMBUX	ERROR Feature not supported by this OS
ENABLE EXT SIGNAL	RMBUX	ERROR Feature not supported by this OS
EXECUTE	RMBUX	ERROR Feature not supported by this OS
QUIT or BYE	RMBUX	ERROR Feature not supported by this OS

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Keywords From BASIC/UX (continued)

Keyword	Binary	Execution in BASIC/WS
SET HIL MASK	None	This statement has no effect.
SET TIME	CLOCK	With no argument, this statement has no effect.
SET TIMEDATE	CLOCK	With no argument, this statement has no effect.
SYSTEM\$("PROCESS ID")	CRTX	This function returns 0.
SYSTEM\$("VERSION:OS")	None	This function returns 6.x WS.
SYSTEM\$("WINDOW SYSTEM")	None	This function returns Console.
TIMEZONE IS	CLOCK	With no argument, the statement has no effect.
PLOTTER IS <i>numexp</i> , "WINDOW"	GRAPH	ERROR 700 Bad plotter specification
DUMP ALPHA <i>numexp</i> ...	None	The numeric expression must evaluate to 1 or an error will occur.
DUMP DEVICE IS <i>strex</i> p	GRAPH	This is a variant of DUMP DEVICE IS where <i>strex</i> p specifies a file as the destination of DUMP ALPHA or DUMP GRAPHICS. The behavior is analogous to PRINTER IS <i>file</i> .
PRINTALL IS <i>strex</i> p	None	This is a variant of PRINTALL IS, where <i>strex</i> p specifies a file as the printall device. The behavior is analogous to PRINTER IS <i>file</i> .

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Keywords From BASIC/UX (continued)

Keyword	Binary	Execution in BASIC/WS
GESCAPE CRT , <i>selector</i>	GRAPHX	GESCAPE <i>selectors</i> 10-13 were added to BASIC/UX to control graphics buffering. BASIC/WS 6.x will accept these selectors, but always returns "0". These commands have no effect in BASIC/WS.
CONTROL <i>sc</i> , 255 STATUS <i>sc</i> , 255	HPIB or GPIO	Register 255 was added to HPIB and GPIO interfaces to control interface locking, mapping, and IO Burst extensions. BASIC/WS accepts these registers in a STATUS statement and returns "3". These CONTROL statements have no effect in BASIC/WS.
CONTROL @ <i>path</i> , 9 STATUS @ <i>path</i> , 9	None	For paths assigned to file names, this register controls file buffering on a per file basis. BASIC/WS accepts these registers and returns "0". These commands have no effect on BASIC/WS.
CONTROL <i>sc</i> , 22 STATUS <i>sc</i> , 22	None	ERROR 163 I/O interface/driver not present (Only values between 600 and 699 are accepted.)
CONTROL <i>sc</i> , 23 STATUS <i>sc</i> , 23	None	This register was added to return terminal compatibility mode. BASIC/WS accepts this register when <i>sc</i> evaluates to 1 (CRT) and always returns "1". These commands have no effect in BASIC/WS.

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Keywords From BASIC/UX (continued)

Keyword	Binary	Execution in BASIC/WS
CONTROL 33; <i>numexp</i> STATUS 33; <i>numexp</i>	None	This pseudo select code was added to manage external signals in BASIC/UX. BASIC/WS will not support this select code. An error will be reported if a statement accessing select code 33 is executed.
SCRATCH ALL SCRATCH A SCRATCH BIN SCRATCH B SCRATCH COM SCRATCH C SCRATCH RECALL SCRATCH R SCRATCH WINDOW SCRATCH W	None	These statements work the same as in BASIC/UX, except SCRATCH W and SCRATCH WINDOW generate an error (ERROR 863: Not in a Window System)

Globalization Enhancements (BASIC/WS and BASIC/UX Only)

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In addition to the one-byte ASCII and Japanese Katakana character sets supported by previous revisions, BASIC/WS 6.x and BASIC/UX 6.2 also supports two-byte characters, such as Japanese Kanji. The support of general two-byte character handling is called **globalization**. Note that you must purchase specific **localization** binaries to get support for a particular language's character set. At the time of first release, BASIC 6.2 supports localization for Japanese only. Localization binaries for other two-byte languages may be available at later dates—contact your local Hewlett-Packard Sales Representative for details.

A new globalized CRT driver, CRTD, is included in BASIC 6.x. You do not need to use CRTD unless you are using a localized version of BASIC.

Note

Due to PC hardware differences, BASIC/DOS 6.2 does not support globalization.

Some new keywords are available to support two-byte characters, but they are not discussed in this chapter. The keywords added to support two-byte character handling are:

- CVT\$
- DICTIONARY IS
- FBYTE
- GFONT IS
- SBYTE
- SYSTEM\$(*various_specifiers*)
- Secondary keywords:
 - EXCHANGE
 - SHIFT IN/OUT

Globalization, localization, two-byte characters, and CRTD are discussed in detail in the “Globalization Overview” and “Features of Globalized BASIC” chapters of this manual.

File Related Enhancements

Wildcards

BASIC 6.x supports wildcards for file name matching with many file related commands. Note that wildcard recognition is disabled at power-on and after SCRATCH A or SCRATCH BIN. You must manually enable wildcard recognition.

For a detailed discussion of wildcards with examples, refer to the WILDCARDS entry in the *HP BASIC Language Reference*.

Appending to Files

BASIC 6.x allows you to specify the optional secondary keyword APPEND with many commands which write to files. When APPEND is omitted, the file is overwritten. When APPEND is specified, new data is appended to the end of the file.

The following commands support APPEND:

- ASSIGN
- DUMP DEVICE IS
- PRINTALL IS
- PRINTER IS
- PLOTTER IS

Refer to the *HP BASIC Language Reference* for details on the proper use of APPEND with each keyword.

Overwriting Files

BASIC 6.x allows you to specify the secondary keyword PURGE with the following file related commands:

- COPY
- LINK

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A More Forgiving GET

BASIC 6.2 allows you to GET files that use a carriage return/line feed combination to terminate a line. This makes it easier to GET files created on certain computers, such as PCs.

Changes to the rmbrc Configuration File

Obsolete Statements

The `HEAP_PREALLOC` and `RMB_SHMEM_ADDR` statements that were sometimes used in the 5.x `rmbrc` configuration file are no longer needed and are not implemented in BASIC/UX 6.x. To avoid harmless error messages, simply remove these statements from old configuration files.

New Capabilities

There are three new capabilities in BASIC/UX 6.3 that you can enable in the `rmbrc` configuration file (`/usr/lib/rmb/rmbrc` or `$HOME/.rmbrc`):

- Select code aliasing.
- Selective open.
- Graphics driver selection.

These new capabilities are discussed in the following subsections.

Select Code Aliasing

Select code aliasing lets you alias, or map, a physical interface select code to a virtual select code for BASIC/UX use. To do this, use the new form of the `INTERFACE` statement:

```
INTERFACE vs = ps; [ NORMAL  
                    AUTOMAP  
                    AUTOLOCK  
                    AUTOBURST ]
```

Where:

vs = virtual select code

ps = physical select code

Note that the original form of the `INTERFACE` statement is still recognized. That form is:

```
INTERFACE ps; [ mode ]
```

Since BASIC/UX can only access select codes 7 and greater, select code aliasing is useful for interfaces that have physical select codes less than 7. For example, the APCI serial interface has physical select codes 5, 6, and 9. To have BASIC/UX access the physical select codes 5 and 6, you could create these virtual select codes for the APCI interface with the new **INTERFACE** statement:

```
INTERFACE 10 = 5;  
INTERFACE 11 = 6;
```

BASIC/UX would then use the virtual select codes that are mapped to the physical select codes in the interface. For example, an **OUTPUT 10** statement would send data to APCI port 2 at physical select code 5.

Also note that the bootscreen display (**rmb -b**) reports the results of select code aliasing. Each select code entry now has the form:

```
HPxxxxx at ps -> vs /dev/rmb/dev_name
```

Where:

ps = physical select code
vs = virtual select code
dev_name = device file name

This shows the mapping of physical select codes to virtual select codes. If an interface is not mapped, then the physical and virtual select codes listed are the same. However, any physical select codes below 7 that are not mapped will be ignored and will not be listed in the bootscreen. Also, if a device file is not listed, then the interface was not opened, or the open failed, and the interface is not accessible to BASIC/UX programs.

Selective Open

Prior to BASIC/UX 6.3, BASIC/UX opened every device file it found and reset some interfaces. This interfered with other users who were using those interfaces. The **SELECTIVE_OPEN** statement in version 6.3 lets you disable the automatic opening of device files.

The form of the statement is:

```
SELECTIVE_OPEN = { ON }  
                  { OFF }
```

7-20 Porting to 6.x

When you specify `SELECTIVE_OPEN = ON` in the configuration file, BASIC/UX will open only those devices specified by an `INTERFACE` statement (see the previous subsection on “Select Code Aliasing”). Note that if an interface is not opened, BASIC/UX cannot access it.

If no `SELECTIVE_OPEN` statement appears in the configuration file, the default action is to open all the device files that have appropriate permissions, as was the behavior of BASIC/UX before version 6.3.

Graphics Driver Selection

When running in Windows on a local display, BASIC/UX can use either the X graphics driver (`sox11`) or the direct display interface driver (Starbase). The Starbase driver provides faster performance of some operations, such as labeling. However, the `sox11` driver provides compatibility with other X applications, such as HP SharedX.

The form of the statement is:

$$\text{X_GRAPHICS_DRIVER} = \left\{ \begin{array}{l} \text{ON} \\ \text{OFF} \end{array} \right\}$$

If you specify `X_GRAPHICS_DRIVER = ON` in the configuration file, BASIC/UX will use the `sox11` graphics driver. This is the same as specifying `rmb -X` on the command line.

The choice of drivers applies only to Windows on a local display. Remote X displays always use the `sox11` driver, and Console Mode always uses the Starbase driver.

Note Some displays on the Model 382 may lose sync when BASIC/UX is started in Windows mode. To prevent this Starbase problem, you must specify the X graphics driver. The configuration file is a convenient place to make this specification.

Human Interface Enhancements

READ KEY

BASIC 6.x provides READ KEY to allow you to read typing-aid softkey definitions created with SET KEY. Refer to the *HP BASIC Language Reference* for a detailed description with examples.

RUNLIGHT ON/OFF

BASIC 6.x allows you to turn on or off the runlight (status indicator) at the bottom right side of the display using RUNLIGHT ON/OFF. This lets you create tidier displays and make neater graphics dumps to printers.

BASIC/UX in X Windows

This section covers the following topics regarding BASIC/UX in X Windows:

- Setting the size of the BASIC/UX icon.
- Window resizing.
- New caps lock behavior.
- Support for HP SharedX on local X displays.

For information on customizing X Windows colors and on using Katakana fonts in X Windows, please refer to the *Installing and Maintaining HP BASIC/UX* manual.

Setting the Size of the BASIC/UX Icon

When iconified, BASIC/UX 6.3 provides an icon for the X window manager to display. You can choose from three icon sizes by specifying the path and bitmap file name as the window manager's `iconImage` X resource.

The three bitmap files are automatically copied to the `/usr/lib/X11/bitmaps` directory when you install BASIC/UX. The bitmap files are:

- `Rmb.s.bm` (small)
- `Rmb.m.bm` (medium)
- `Rmb.l.bm` (large)

You can specify the bitmap file you want either in your `.Xdefaults` file, or by loading the bitmap file into the resource manager database using `xrdb`. For example:

```
Vuewm*rmb.iconImage:  bitmap_path_name/bitmap_file_name
```

And for `mwm`, do:

```
Mwm*rmb.iconImage:  bitmap_path_name/bitmap_file_name
```

Where:

bitmap_path_name = the full path name (default is `/usr/lib/X11/bitmaps`)

bitmap_file_name = the bitmap file name for the icon size you want

For example: `/usr/lib/X11/bitmaps/Rmb.m.bm` for the medium-sized icon.

If you are also using HP VUE 3.0, you can add an **RMB** icon and a Personal Toolbox icon for BASIC/UX to the VUE interface. To create these icons, refer to the "BASIC/UX Icons in HP VUE" subsection later in this chapter.

Window Resizing

Since BASIC/UX does not support interactive resizing of its main window or any subordinate windows, BASIC/UX now provides “hints” to the window manager to let it know that resizing operations should not be allowed on any of the BASIC/UX windows. Because window resizing is controlled by the window manager, and not all window managers respond to hints (some are not ICCCM compliant), your window manager may be unable to disallow window resizing for the BASIC/UX windows.

This does *not* mean that you cannot change the size of the BASIC/UX window. BASIC/UX provides full support for X Windows geometry specifications. Once BASIC/UX is booted, however, its window is not resizable. This is also true for CREATED WINDOWS—once such windows are created (at any size and position you choose), you cannot resize them.

New Caps Lock Behavior

In X Windows, BASIC/UX now starts up in lowercase mode by default. BASIC/UX also behaves much more like standard X clients, in that it does not examine or modify the state of the caps lock resource.

In the X Windows client/server model, the X server *exclusively* owns the caps lock resource and does not make it available for clients. Hence, the X server automatically applies the current caps lock state to each alphabetic character that you type, and then passes on the upper- or lowercase character (as appropriate) to the client.

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Like all other X clients then, BASIC/UX does not display any indication of the caps lock state, nor does it ever set or clear the caps lock state. Thus, the Caps indicator is no longer displayed. In addition, the statement "STATUS KBD,2;Variable" always returns 0, and the statement "CONTROL KBD,2;Value" does nothing.

A by-product of these changes is that BASIC/UX now coexists peacefully with other X Window-based software applications. Previously, the X calls that BASIC/UX made to usurp caps lock events caused some of these applications to quit unexpectedly. This no longer occurs.

Also as a side effect of these changes, you may notice that the `DIGITIZE` command only works when caps lock is off. This behavior occurs because mouse click events are reported as different events when caps lock is off as opposed to when caps lock is on. If you use `DIGITIZE` or its related commands in X Windows, you will want to leave the caps lock off.

If you must have the caps lock behavior that was present in BASIC 5.x, you can run `BASIC/UX` with the `-C` command line option for caps lock compatibility mode. `BASIC/UX` will then simulate the `BASIC/WS` behavior for caps lock.

Support for HP SharedX on Local X Displays

If you wish to run `BASIC/UX` on your local X display and share its window with other users' X displays using HP's SharedX product, you can run `BASIC/UX` with the `-X` command line option. This option tells `BASIC/UX` to use only X library calls when talking to the local display.

Normally, `BASIC/UX` uses direct Starbase calls for better performance when connected to a local display. HP SharedX cannot share windows of applications that make direct Starbase calls. Therefore, this option lets you bypass this difficulty.

BASIC/UX Icons in HP VUE

Adding an Icon to the Front Panel

If you use HP VUE 3.0, you can further customize BASIC/UX by adding an RMB icon to the VUE Front Panel. This icon can have two actions: `START_RMB` and `RUN_RMB`. To set up the icon and add it to the Front Panel:

1. Do one of the following, depending on whether you already have a customized `vuewsrc` file in your `$HOME` directory or not.

- If you do *not* already have a customized `vuewsrc` file, type in:

```
cp /etc/newconfig/rmb/sys.vuewsrc $HOME/.vue/vuewsrc
```

- If you have a customized `vuewsrc` file already, look in the `/etc/newconfig/rmb/sys.vuewsrc` file and locate the `CONTROL Rmb` information it contains. Then merge the `CONTROL Rmb` information into your existing `vuewsrc` file.

2. Type:

```
cp /etc/newconfig/rmb/rmb.ad $HOME/.vue/types
```

3. From the Workspace Menu, select `Restart Workspace Manager`.

Creating a Personal Toolbox Icon

You can create either a regular or a “drag and drop” Personal Toolbox icon for BASIC/UX under VUE. Procedures for creating these icons are covered in the following subsections.

Regular Icon. To create a regular Personal Toolbox icon for BASIC/UX under VUE, do the following:

1. *Optional:* Create a custom icon, using the IconEditor tool in the Personal Toolbox, and save it in a convenient spot.
2. Open the General Toolbox and select Utilities. Use CreateAction to create an RMB button. Enter a `Name` such as `START_RMB`.

3. Enter a **Command Line**. The following example invokes BASIC/UX in the background, using X-graphics. Other **rmb** command line options are also allowed.

```
/bin/sh -c "/usr/bin/rmb -X &"
```

4. Choose the **Window Type** of No Output.
5. Leave the **Filename Prompt** empty.
6. *Optional:* If you have created a custom large icon for BASIC/UX, put its full path name in the **Large Icon** field. Alternately, you can select an existing icon from the **/usr/vue/icons** directory.
7. *Optional:* If you have created a custom small icon for BASIC/UX, put its full path name in the **Small Icon** field. Alternately, you can select an existing icon from the **/usr/vue/icons** directory.
8. *Optional:* Put your choice of description into the **Description** field.
9. Click on **Apply**.

The new icon should appear in your Personal Toolbox window. When you double click this icon, BASIC/UX will start after a brief delay.

“Drag and Drop” Icon. To create a “drag and drop” Personal Toolbox icon for BASIC/UX under VUE, follow the same procedure as for creating a regular icon (in the previous subsection), except:

- Enter a different **Command Line**. The following example invokes BASIC/UX in the background, using X-graphics, and requests a single parameter \$1, which is the name of a program file to execute. Other **rmb** command line options are also allowed.

```
/bin/sh -c "/usr/bin/rmb -X $1 &"
```

- Type an appropriate prompt into the **Filename Prompt** entry area, such as:

```
Name of a BASIC program to run?
```

This new icon should appear in your Personal Toolbox window. When you double click this icon, a dialog will appear asking you for the name of a program file to run. After you click **OK**, BASIC/UX will start and run the program, if you provided a valid file name. If you drag a program file onto this icon, BASIC/UX will start up and run the program.

It is a good idea to leave the CreateAction window open until you have tested your new icon. It is easy to make changes and select **Apply** while the utility is still running. When you are satisfied with your new icon, select **Close** at the bottom of the CreateAction window.

CSUB Enhancements

BASIC/WS and BASIC/DOS Only

The internal architecture of BASIC revision 6.0 and above is designed to ease the maintenance associated with compiled subprograms (CSUBS). When you port a program containing CSUBS from any prior revision of BASIC to 6.0, you must relink the CSUBS using the BASIC 6.0 CSUB Utility (sold separately). However, CSUBS compiled for BASIC 6.0 will port directly to BASIC revisions 6.0 and above *without relinking*.

BASIC/UX Only

If you write CSUBs which access BASIC/UX COM blocks containing I/O path names and/or buffers, note that BASIC/UX 6.3 has changed how CSUBs access COM. For information on this change, please refer to the *READ ME Before Developing CSUBs for HP BASIC/UX 6.3* document that accompanies the *Developing CSUBs for HP BASIC/UX 6.2* manual.



Binary Enhancements

New Binaries

RMBUX (BASIC/WS and BASIC/DOS)

This binary allows non-BASIC/UX implementations of BASIC to syntax, list, and execute certain commands previously available only in BASIC/UX. These commands are summarized in this chapter in the section “BASIC Language Convergence.”

CRTD (BASIC/WS)

This display binary (CRT driver) is included primarily to support the two-byte raster characters used by certain localized versions of BASIC, such as Japanese localized BASIC.

MCMATH (BASIC/WS)

This binary provides a library of mathematical routines that are used by computers with the Motorola 68040 processor, e.g., Model 382.

PLLEL (BASIC/WS)

This binary allows execution of I/O operations over the HP Parallel interface, built in with some Series 300 models. See the *HP BASIC 6.2 Interface Reference* for more information.

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Changes in HFS Binary

Certain keywords previously required the HFS binary. The following keywords no longer require HFS or any other binary to execute:

- LINK
- PERMIT
- CHOWN
- CHGRP

Miscellaneous Additions and Changes

Keyword Additions and Changes

<i>Keyword</i>	<i>Description</i>
INMEM	This function tests whether the specified subprogram is in memory.
CALL	The CALL statement now supports calling subprograms specified by a string, for example: <code>CALL Subname\$ WITH (Param1,Param2\$)</code>
SCRATCH	The SCRATCH statement now accepts the specifiers ALL, A, BIN, B, COM, C, RECALL, R, WINDOW, and W.
SYSTEM\$	The SYSTEM\$ statement now allows you to request current settings for: <ul style="list-style-type: none">■ WILDCARDS■ WINDOW SYSTEM■ PROCESS ID■ VERSION:OS■ VERSION:BASIC Additional requests are allowed when localization binaries are loaded.

CRT Register 21

BASIC 6.x expands the function of CRT STATUS/CONTROL register 21. In previous versions of BASIC, this register was used only to indicate whether the display was in bit-mapped or non-bit-mapped mode. In BASIC 6.x, this register is used to selectively activate any one of the supported CRT binaries that are currently in memory. Refer to the STATUS/CONTROL register tables in the “Interface Registers” appendix of the *HP BASIC Language Reference* for details.

Porting from BASIC/UX 300/400 to BASIC/UX 700

HP BASIC/UX 700 is a port of the BASIC/UX product from the HP Series 300/400 computer systems to the Series 700 (HP Precision Architecture) systems on HP-UX. BASIC/UX 700 is highly compatible with previous versions of BASIC/UX 300/400.

This chapter explains the differences between BASIC/UX 300/400 and 700. This information will help you determine what to do when porting programs to BASIC/UX 700.

Changes to the BASIC/UX Core

The internal structure of BASIC/UX was significantly redesigned for Series 700. The key changes to the BASIC/UX core are explained in the following subsections.

Long Line Numbers

Previous BASIC/UX versions supported an INTEGER-sized line number for program lines. This limited the size of programs to 32766 lines in memory at one time.

BASIC/UX 700 supports a double-sized line number. Thus, the largest line number is now greater than 2 billion (2147483646). This reduces the need for users to swap SUBs for large programs and alleviates one of the requirements for a compiler.

Large Symbol and Token Tables

The internal tables for previous versions of BASIC/UX limited the number of symbols in either the MAIN program, any one SUB, or DEF FN to 7268 symbols and to 32767 characters for symbol names (including the length byte for each symbol name). These symbols include variable names, line labels, SUB names, COM names, and so forth.

These tables increased in BASIC/UX 700 to allow 2147483647 symbols and a total of 2147483647 characters for symbol names for each context (MAIN program, SUB, or DEF FN).

Math Capabilities

BASIC/UX 700 uses the standard C libraries for math. This affects the operation of BASIC/UX 700 in several ways, as explained in the following subsections.

Select Code 32 Register 7

This register was added as the math exception register to allow control over some of the math exceptions. Only bits 2 through 0 are used. Bit 2 handles floating point exceptions in CSUBs, with the values:

- 1: Enables math exceptions in CSUBs. Exceptions are trapped and propagated to the BASIC program as error 21.
- 0: Disables math exceptions.

Note that the default value can also be set using the `rmbrc` file variable `csub_math_except`. The format for this statement is:

$$\text{csub_math_except} = \left\{ \begin{array}{l} \text{on} \\ \text{off} \end{array} \right\}$$

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8-2 Porting from BASIC/UX 300/400 to BASIC/UX 700

Bits 1 and 0 are defined as the underflow mode bits, with the values:

0: Error mode. This mode generates a math exception (error 21) on underflow.

1: Fastmode. This mode enables hardware fastmode, if available. This causes the hardware to substitute 0.0 for underflowed values. If the hardware does not support fastmode, then this field reverts to error mode.

2: Ignore mode. This mode causes all underflows to be ignored. This can result in denormalized numbers in the range 2.2E-308 to 4.5E-324. For values below 4.5E-324, the result is 0.0.

Note that you can also set the default value you want using the `rmbrc` file variable `underflow_mode`. The format for this statement is:

$$\text{underflow_mode} = \left\{ \begin{array}{l} \text{error} \\ \text{fastmode} \\ \text{ignore} \end{array} \right\}$$

With `underflow_mode=ignore` it is recommended (for compatibility with HP BASIC/UX 300/400, HP BASIC/WS, and the other `underflow_mode` settings) that you check the absolute value of potentially denormalized numbers against `MINREAL` and set them to 0 if they are denormalized. For example:

```
IF ABS(Small_num)<MINREAL THEN Small_num=0
```

The IEEE 754 Math specification defines the values `INF` (infinity) and `NaN` (not a number). These numbers cannot normally be created by BASIC; however, they may appear when data is read from interfaces, files, pipes, or other applications that can create these numbers. With HP BASIC/UX 700, computations using `INF` and `NaN` give these results:

<code>±INF</code>	will produce <code>±INF</code> .
signalling <code>NaN</code>	will produce a signalling <code>NaN</code> .
non-signalling <code>NaN</code>	will produce <code>ERROR 21 Exception in math operation</code>

With HP BASIC/UX 700, printing **INF** and **NaN** gives these results:

+INF	will produce the text “++”
-INF	will produce the text “---”
signalling NaN	will produce the text “?”
non-signalling NaN	will produce ERROR 21 Exception in math operation

Earlier versions of HP BASIC will give errors when you try to print or otherwise format **INF** or **NaN** as ASCII, but will usually not generate errors when computations are done with them.

Select Code 32 Register 2

This register, which allows for disabling hardware assists and performing all math in software, is no longer supported. Therefore, the error message **Feature not supported on BASIC/UX** will be displayed.

Note To ignore this error, use the **-e** option to **rmb**, or set **ERROR_MODE=OFF** in the configuration file.

Math Function Ranges

The range of values allowed for the trigonometric functions in BASIC/UX 700 are different from those allowed in previous BASIC versions. Also, many trigonometric functions in BASIC/UX 700 will underflow for very small values, unless the underflow mode is set to ignore (**CONTROL 32, 7; 2**). For more information on the range of values allowed for each function, refer to the *HP BASIC Language Reference* manual.

Math Precision

The precision of the math routines is reduced in BASIC/UX 700. The difference is limited to a couple of LSBs of roundoff error. This is due to hardware differences (the Series 300/400 hardware assists use 80-bit internal precision, whereas the Series 700 hardware assists use the IEEE-standard, 64-bit precision), as well as to the different algorithms used in the math library. As before, exact comparison of REAL numbers is discouraged due to roundoff errors, but this is especially the case when moving between Series 300/400 and Series 700 systems.

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8-4 Porting from BASIC/UX 300/400 to BASIC/UX 700

A particularly insidious example of number precision differences occurs when a REAL value is compared to a value generated from a DATA statement in a PROG file that has been automatically converted to PROG2 format in BASIC/UX 700. (For an explanation of the new PROG2, LOAD/STORE format in BASIC/UX 700, refer to the following section, "LOAD/STORE Format," in this chapter.) The following example illustrates this:

```
100 DATA .7
110 READ X           ! X is of type REAL
120 IF X<>.7 THEN PRINT "ERROR in REAL comparison"
130 END
```

If this were STORED in a PROG file using BASIC/UX on a Series 300 or 400, then LOADED with BASIC/UX on a Series 700, it would print "Error in REAL comparison" when run. A GET/SAVE version does not print the message.

The .7 in the DATA statement is stored in textual form in the PROG file and is not converted to internal representation until RUN time. The .7 in line 120 was converted by the Series 300/400 computer and stored in the PROG file in its internal numeric representation. The two internal representations are slightly different, due to differences in number builder operation between the revisions of BASIC/UX 300/400 and BASIC/UX 700, so the error message is printed.

Math Exceptions

Math exceptions on Series 700 are handled somewhat differently than on Series 300/400. In cases where an error condition can always be determined, the old error code will be reported. However, it is not always possible (due to architectural restrictions and insufficient state information) to determine the cause of a math exception.

Therefore, a new error code is used in BASIC/UX 700 to represent non-deterministic math exceptions. This error number is 21 (Exception in math operation), and subsumes error number 22 (REAL overflow) and error number 136 (REAL underflow). This error may also occur due to other math errors in CSUBs.

Clock Resolution

The clock resolution for statements such as ON CYCLE, WAIT, and ON TIME is 10 milliseconds for BASIC/UX 700. (BASIC/UX 300/400 has a resolution of 20 milliseconds.) Also, the minimum time that can be specified for WAIT is 40 milliseconds.

New Configuration File Capabilities

The following table summarizes the new global configuration variables provided with BASIC/UX 700. For detailed information, refer to the “Creating Configuration and Autostart Files” chapter of *Using HP BASIC/UX*.

New Configuration Variables

Name of Variable	Range of Values	Default Values	Description
bind_time	load prerun run	load	Time at which to resolve references in a shared library.
csub_math_except	on, off	on	Math exception handling for CSUBs.
keep_shared_libs	on, off	on	Retain shared libraries.
selective_open	on, off	off	Indicates that only specified interfaces should be opened.
underflow_mode	error fastmode ignore	error	Specifies the behavior when floating point underflow is detected.

Changes to the Human Interface and Graphics

BASIC/UX 700 is standardized on the X Windows human interface. This provides a more consistent and robust environment, while still providing users full-screen or multi-user access. The globalized human interface driver, CRTD, is supported.

The following subsections explain the main differences between the human interface and graphics for BASIC/UX 300/400 and that of BASIC/UX 700.

CRTA Binary (Alpha CRT)

This driver is not supported on BASIC/UX 700. Instead, multi-user access for BASIC/UX 700 can be gained by using remote X Windows from other systems, or X terminals.

CRTB Binary (Bitmap CRT)

This driver is not supported on BASIC/UX 700. If you require a full-screen BASIC/UX window, you can configure BASIC/UX 700 to create its root window so that it will cover the full screen.

SOUND Statement

BASIC/UX 700 supports the SOUND statement in the same way it is supported by BASIC/UX 300/400 in the X Windows environment. This means that it only works if you are running BASIC/UX 700 on the local system. Access to the sound generator chip for remote systems is not supported.



HIL Statements

BASIC/UX 700 supports access to HP-HIL devices in the same way it is supported by BASIC/UX 300/400 in the X Windows environment. This means that these statements only work if you are running BASIC/UX 700 on the local system. Access to the HP-HIL loop for remote systems is not supported.

The affected statements are:

CDIAL
HILBUF\$
HIL SEND
ON KNOB
OFF KNOB
ON CDIAL
OFF CDIAL
ON HIL EXT
OFF HIL EXT
SET HIL MASK

Graphics Drivers

To enhance consistency and ensure timely support of new displays, all graphics code in BASIC/UX 700 uses the X Windows graphics driver, rather than the dedicated Starbase drivers. This allows better compatibility with other X applications, such as HP SharedX. However, it reduces graphics performance for some operations, such as labeling.

Changes to Mass Memory

The changes in the mass memory system primarily reflect discontinued support of devices and interfaces by HP-UX. There is also a major change in the LOAD/STORE format for the Series 700. The primary changes are explained in the following subsections.

SCSI/LIF Driver

This was a new driver for BASIC/UX 300/400 at version 6.3, which is also available with BASIC/UX 700. This driver supports a LIF file system on SCSI disks, and allows the use of the 3.5-inch SCSI floppy disk drives built into many Series 700 computers.

To access SCSI devices as LIF file systems, a DISC entry must be added to one of the configuration files: `/usr/lib/rmb/rmbrc` or `$HOME/.rmbrc` file. This entry is similar to the entry used to map a BASIC mass storage volume specifier to an HFS directory. However, instead of specifying a directory, you must now specify a device file.

Note that SCSI floppy and hard disks are supported. BASIC/UX 700 also supports the C1701A, but *not* the C1700A, rewriteable optical disks.

Here is an example of how to set up an internal SCSI floppy disk drive with the SCSI address set to 2:

1. Use SAM to create the device file for the floppy disk drive. For more information on how to use SAM, please refer to the online help system for SAM.

- a. Select **Disks and File Systems->**.

- b. Select **CD-ROM, Floppy, and Hard Disks**.

- c. Highlight the floppy disk drive list item by clicking on the item.

- d. Select the menu item **Actions/Add a Floppy Disk Drive ...**.

SAM will now create the device files `/dev/rfloppy/c201d2s0` and `/dev/floppy/c201d2s0`.

2. It is recommended that you link the file `/dev/floppy/c201d2s0` to `/dev/rmb/floppy2` after SAM creates it.

3. Edit `$HOME/.rmbrc` and add the following line, which defines a disk alias for the raw disk device file that was just created:

```
disk 1402 = /dev/rfloppy/c201d2s0
```

or

```
disk 1402 = /dev/rmb/floppy2 If you followed step 2, above, to link it
```

(Using `dev/rmb` as a "holding tank" will make it easier to understand and maintain its access to disks, and so forth.)

Now start BASIC/UX and insert the floppy disk into the floppy disk drive. You will be able to access the disk using the msvs 1402. For example, the statement `INITIALIZE ":",1402"` will initialize your floppy disk with a LIF file system.

Releasing Media from the Magneto-Optical Drive

In HP-UX 9.0 for Series 700, the HP magneto-optical drives (MODs) such as the C1701A and similar devices are controlled through the SCSI hard disk driver rather than the SCSI floppy disk driver. This means that the device does not notify BASIC/UX of media changes. Instead, on first access to the device, the media is locked into the drive until the device file for the drive is closed. (The push button on the drive will not eject the medium.)

Since BASIC/UX normally keeps these device files open for the full BASIC session, a new mechanism for releasing the media is required. BASIC/UX 700 has added a new statement, `RELEASE`, to force the closing of the device file, which will enable the eject push button and release the media. On the next request to the device, BASIC/UX will automatically re-open the device if a medium is inserted, and the access will again cause the media to be locked.

An example of the `RELEASE` statement is:

```
RELEASE ":",1402"
```

Where the `msvs ":",1402"` corresponds to the MOD device.

LOAD/STORE Format

The LOAD/STORE format provides a very fast mechanism for reading and writing the internal form of a program from and to disk. Because the internals of BASIC/UX 700 are significantly different from BASIC/UX 300/400, the LOAD/STORE format has changed.

The following table summarizes the different PROG-type files you can LOAD and STORE:

PROG-type Files

TYPE	Number	Compatibility
PROG	-5808	BASIC/WS can LOAD/STORE BASIC/UX 300/400 can LOAD/STORE BASIC/UX 700 can LOAD
PROG2	-12976	BASIC/UX 700 can LOAD/STORE

As noted in the table, BASIC/UX 700 can LOAD PROG files, but BASIC/UX 700 then STOREs the file in a new file format called PROG2, which has the number -12976. BASIC/UX 700 can LOAD and STORE any PROG2 file. Note that a PROG file that is LOADED into BASIC/UX 700 (and therefore is converted into a PROG2 file) will become larger in the PROG2 format.

Since BASIC/UX 300/400 and BASIC/WS cannot LOAD the new PROG2 format, programs that must be ported from BASIC/UX 700 back to BASIC/UX 300/400 or BASIC/WS must use the GET/SAVE (ASCII) format. If you try to LOAD a PROG2 file on BASIC/UX 300/400, LOAD is not performed and Error 58 (Improper file type) is reported.

BASIC/UX 300/400 and BASIC/WS are unable to report PROG2 information in CAT statements and will, instead, display their type-number (-12976).

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When you LOAD a PROG file into BASIC/UX 700, you may get warnings advising you that parts of the file could not be LOAded. These are CSUBs or BASIC Compiler subprograms and functions that are specific to BASIC on Series 200/300/400, which cannot be used in BASIC/UX 700. They must be reconstructed and, in some cases, rewritten before they can be used on BASIC/UX 700. For more information on doing this, please refer to the *Developing CSUBs for BASIC/UX 700* manual.

Note that the messages saying which parts of the PROG file could not be LOAded into BASIC/UX 700 may flash by too quickly to read. To retain these messages on the screen, turn on PRINTALL before doing the LOAD.

Finally, some SRM-related keywords are not usable in BASIC/UX 700, although they will translate correctly from PROG to PROG2 format. This is because BASIC/UX 700 does not support SRM. When the program is RUN or STEPped, these keywords will cause the error:

```
ERROR 1 in line number, Missing Binary SRM
```

These SRM-related keywords are: PROTECT with SRM syntax, and CAT with the PROTECT keyword. Examples of these syntaxes are:

```
100 PROTECT "Afile",("apassword":MANAGER)
```

```
210 CAT;PROTECT
```

Additionally, PROTECT with SRM syntax cannot be entered using the keyboard, and GET on a SAVEd program containing it will cause an error. However, PROTECT with LIF syntax (for example, PROTECT "Afile", "xy") presents no problems.

Amigo Disk Driver

HP-UX does not support Amigo disks on Series 700. Therefore, BASIC/UX 700 also does not support them.

CS80 Disk Driver

HP-UX also does not support CS80 disks on Series 700. Therefore, BASIC/UX 700 also does not support them.

SRM Driver

The Series 700 does not support an SRM interface. Therefore, BASIC/UX 700 also does not support the SRM driver. Access to SRM/UX files is still available directly on an SRM/UX server or via LAN (NFS) for remote servers. However, BASIC/UX is unable to participate in the SRM/UX locking mechanisms.

Changes to I/O

There are many significant changes in the support of I/O devices for BASIC/UX 700. Most of these are due to the differences in the interface cards supported on Series 700 and the use of a different I/O library (SICL instead of DIL). The differences are explained in the following subsections.

SICL I/O

BASIC/UX 700 was ported to a new I/O library: HP SICL (Standard Instrument Control Library). To enable the operation of the BASIC/UX 700 I/O statements, SICL must be properly configured. The SICL run-time filesets are included with BASIC/UX 700 to accommodate this. Please refer to the *Installing and Maintaining HP BASIC/UX* manual for more information on configuring SICL.

Changes to the rmbrc Configuration File

Select code aliasing and selective open were new features of BASIC/UX 300/400 at version 6.3 that are also available with BASIC/UX 700. You can enable these capabilities in the BASIC/UX 700 `rmbrc` configuration file (`/usr/lib/rmb/rmbrc` or `$HOME/.rmbrc`), as explained in the following subsections.

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Select Code Aliasing

Select code aliasing lets you alias, or map, a physical interface select code to a virtual select code for BASIC/UX use. The Series 700 does not support physical select codes. However, the SICL library provides a type of select code for interfaces that SICL supports, called logical units (LUs). You can use these logical unit numbers like select codes in BASIC/UX. Or you can use select code aliasing to remap these SICL logical units to virtual BASIC/UX select codes.

To create virtual select codes, use the new form of the **INTERFACE** statement:

```
INTERFACE vs = lu; [ NORMAL  
                    AUTOLOCK ]
```

Where:

vs = virtual select code

lu = SICL logical unit

Note that the original form of the **INTERFACE** statement is still recognized. That form is:

```
INTERFACE lu; [ mode ]
```

Since BASIC/UX can only access select codes 7 and greater, select code aliasing is useful for interfaces that have SICL LUs less than 7.

Also note that the bootscreen display (**rmb -b**) reports the results of select code aliasing. Each select code entry now has the form:

```
type at lu -> vs ...
```

Where:

lu = SICL logical unit

vs = virtual select code

This shows the mapping of logical unit numbers to virtual select codes. If an interface is not mapped, then the logical unit and virtual select code listed are the same.

Selective Open

Prior to BASIC/UX 300/400 version 6.3 and BASIC/UX 700, BASIC/UX opened every device file it found and reset some interfaces. This interfered with other users who were using those interfaces. The new **SELECTIVE_OPEN** statement lets you disable the automatic opening of device files.

The form of the statement is:

$$\text{SELECTIVE_OPEN} = \left\{ \begin{array}{l} \text{ON} \\ \text{OFF} \end{array} \right\}$$

When you specify **SELECTIVE_OPEN = ON** in the configuration file, BASIC/UX will open only those devices specified by an **INTERFACE** statement (see the previous subsection on “Select Code Aliasing”). Note that if an interface is not opened, BASIC/UX cannot access it.

If no **SELECTIVE_OPEN** statement appears in the configuration file, the default action is to open all the interfaces configured in the `/usr/pil/etc/hwconfig.cf` file.

READIO/WRITEIO

The **READIO** and **WRITEIO** statements are only supported for the pseudo-select codes 9826 and 9827. These are used to access the memory space of BASIC/UX. **READIO** and **WRITEIO** to I/O devices is not supported.

HP-IB Driver

The HP-IB driver on Series 700 is similar to the HP-IB driver on Series 300/400. The HP-IB cards that SICL supports on Series 700 are the E2070A, E2071, and the built-in Series 745 HP-IB cards. The other differences due to SICL are explained in the following subsections.

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Burst I/O Mode

Burst I/O mode (`CONTROL sc,255;3`) is not supported. However, the speed of free-field **ENTER** operations can often be increased by using Buffer Mode, as explained in the next subsection.

Buffered I/O Mode

BASIC/UX 700 can use I/O buffering for free-field ENTER statements. Buffering makes ENTER approximately an order-of-magnitude faster for large amounts of data (>200 bytes). It has a less dramatic effect for smaller amounts of data, but it never lessens I/O performance. ENTER buffering is enabled and disabled by bit 2 of register 255. For example:

```
CONTROL 7,255;4   Enable HP-IB buffering for ENTER
```

For more information, refer to the *HP BASIC Interface Reference* manual.

STATUS and CONTROL Registers

The following HP-IB STATUS and CONTROL registers are not fully supported:

Register 1: STATUS
Register 4: CONTROL
Register 6: STATUS
Register 7: STATUS
Register 255: CONTROL



For more information, refer to the *HP BASIC Interface Reference* manual.

RS-232C Driver

The BASIC/UX RS-232C driver for Series 700 also uses the SICL library. It is similar to the RS-232C driver on Series 300/400. BASIC/UX 700 supports only the built-in serial ports.

Series 300/400 Differences

The main differences between the Serial driver for BASIC/UX 700 and BASIC/UX 300/400 are:

- On the Series 700, you cannot use termio for an RS-232C port if you configure that port using SICL.
- On the Series 300/400, BASIC CONTROL statements do not actually write to the hardware. Rather, they simply save the state information, and the new values are written to the card only when it is time to move data.

In contrast, on the Series 700, CONTROL statements map directly to SICL calls that write to the hardware immediately.

- On the Series 700, you can LOCK the serial ports with CONTROL register 255. Therefore, serial ports are now subject to the same locking interactions as HP-IB interfaces. These are summarized in a subsequent section.

STATUS and CONTROL Registers

The following RS-232C STATUS and CONTROL registers are not supported:

Register 6: STATUS and CONTROL

Register 7: STATUS and CONTROL

Register 12: STATUS and CONTROL

For more information, refer to the *HP BASIC Interface Reference* manual.

GPIO Driver

The Series 700 does not support a GPIO interface. Therefore, BASIC/UX 700 does not have a GPIO driver.

VXI Driver

The Series 700 computers support access to VXI cages via the MXI bus interface card. The BASIC/UX VXI driver was only supported briefly as an external loadable binary for BASIC/UX version 5.52, and was not supported on BASIC/UX 6.2 and 6.3. In turn, this binary is not supported on BASIC/UX 700. VXI instruments are supported by the SICL library and can therefore be controlled by BASIC/UX 700 through CSUBs.

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Interface Locking Considerations

Interface locking is not new to BASIC/UX 700. Some locking capabilities existed in previous versions of BASIC/UX 300/400. However, the Series 700 version can lock more kinds of interfaces, and many locking details have changed from the Series 300/400 implementation. The key issues are explained in the following subsections. For more information, refer to the *HP BASIC Interface Reference* manual.

Who Participates in Locks?

BASIC/UX 300/400 locks applied to HP-IB and GPIO interfaces. Those locks were honored by other BASIC processes and by processes using DIL intrinsics. BASIC/UX 300/400 could not lock RS-232 interfaces (serial ports). It also could not lock HP-IB interfaces being used by the file system.

BASIC/UX 700 supports locks on RS-232 interfaces and HP-IB interfaces. Those locks are honored by other BASIC processes and by processes using SICL intrinsics. Because Series 700 HP-IB interfaces are never used by the file system, that Series 300/400 locking restriction is irrelevant.

When BASIC/UX cannot execute a statement because of another process's lock, it will block (wait) until the lock is released or an ON TIMEOUT branch is taken. If there is no ON TIMEOUT established, then BASIC will continue with normal program flow after the other process releases the lock. If you are expecting to share an interface with other processes, and you don't want indefinite wait times, then ON TIMEOUT is an effective way to determine when the interface is locked.

Locks and Boot-Time Initialization

When BASIC/UX 700 boots (starts running), it identifies and initializes all the interfaces available to it. The list of available interfaces is in the `/usr/pil/etc/hwconfig.cf` file. That list can be reduced (but not increased) by using SELECTIVE_OPEN in an `rmbrc` configuration file.

If another process has an available interface locked when BASIC/UX 700 boots, BASIC will not be able to initialize that interface. When this happens, the following message is displayed:

```
Select code N not initialized; locked by another process; RESET to recover
```

Subsequent attempts to access that interface will result in the message:

ERROR 169 I/O interface not initialized

There are two general ways to deal with this issue, depending upon your situation. One possibility is that the other process has the interface locked indefinitely. Therefore, you will not be able to access the interface now or later. In this case, you can speed up the boot process by using `SELECTIVE_OPEN` to ignore the locked interface. For more information, see the previous section “Changes to the `rmbrc` Configuration File.”

The other possibility is that the other process only locked the interface briefly. After that lock is removed, you will be able to initialize and access the interface. There are three ways to initialize an interface that was not accessible at boot time:

- Execute a `SCRATCH A` command.
- Press the **Reset** key.
- Execute an interface `RESET` statement.

In these discussions, “`RESET` statement” means either a `RESET` of the interface select code or writing a non-zero value to Control register 0 of the interface. Both actions perform the same interface initialization sequence. A `RESET` statement can be executed in a program or as a command from the keyboard.

A few selected operations are allowed for uninitialized interfaces to assist in programmatic initialization. The operations allowed are `TIMEOUT` specifications, the `RESET` statement, access to Control/Status register 0 (for ID and resetting), and access to Control/Status register 255 (for lock control). Any other operations on an uninitialized interface will cause error 169.

Note that BASIC/UX's boot-time initialization includes a reset of each available interface. This can be "unfriendly" in some multi-user situations. For example, assume two users on the same computer. User A runs an I/O intensive program, and User B runs a graphics program containing no I/O. User A boots first and starts some I/O. Then User B boots. User B's `rmb` process finds and resets all the interfaces that User A is depending upon. User A is no longer happy.

This is the reason for using `SELECTIVE_OPEN` in your `$HOME/.rmbrc` file to reduce the list of available interfaces. It promotes thoughtful cooperation in a multi-user environment. In our example, User B should specify `SELECTIVE_OPEN=ON` and include no `INTERFACE` statements. Then the boot-time initialization of the graphics program will not interfere with the I/O program.

SCRATCH A Initialization

The `SCRATCH A` command performs the same interface identification and initialization that is done at boot time. The preceding description applies equally to boot time and `SCRATCH A`.

The Reset Key and Initialization

The action of the `(Reset)` key depends upon the state of the interface. The possibilities are:

- If the boot-time initialization has succeeded, and the interface is *not* locked by another process, the `(Reset)` key performs an initialization similar to the `RESET` statement.
- If the boot-time initialization has succeeded, and the interface is *locked* by another process, the `(Reset)` key does nothing to the interface or its state.
- If the boot-time initialization has not succeeded, the `(Reset)` key attempts to perform the boot-time initialization. The preceding section "Locks and Boot-Time Initialization" describes this process.

Locks and the RESET Statement

If the specified interface has not been initialized, a RESET statement will not generate error 169. Instead, it will attempt to initialize the interface. If the initialization succeeds, the interface becomes available for use.

If the interface is locked by another process, the RESET statement will wait until that lock is removed and then proceed normally. You may use an ON TIMEOUT branch or the `(CLR I/O)` key to terminate a waiting RESET statement. If the RESET statement is terminated before it completes, the initialization state of the interface is left unchanged.

Programmatic Interface Locking and Initialization

When running in a multi-user environment, it is recommended that your program lock an interface at the start of a transaction, and unlock it when the transaction is finished. (A “transaction” is loosely defined as any block of program statements that needs undisturbed access to the interface.) This prevents other applications from accessing the interface unexpectedly during your transactions, and it releases the interface for others to share when possible. The recommended way to use locks is Control register 255.

Using AUTOLOCK in the `rmbrc` file is *not* recommended. An AUTOLOCK interface is locked by any BASIC programs which uses that `rmbrc` file. Control register 255 can be used to release an AUTOLOCK lock, However, even programs containing no I/O still do the AUTOLOCK. Also, users tend to forget that they have specified AUTOLOCK, or they may not even be aware of the specifications in the `/usr/lib/rmb/rmbrc` file.

The following is a suggested initialization programming sequence:

```
ON ERROR GOTO Err_handler
ON TIMEOUT Sc,10 GOTO Timed_out ! Setup a timeout for largest transaction
!
! Lock the interface, leaving buffering on
CONTROL Sc,255;4+1
!
! It may be useful to verify/change some of the interface configuration
! with STATUS and CONTROL statements (Bus address, baud, etc.)
RESET Sc ! (see text)
CONTROL Sc, ...
:
! Now perform I/O operations
ASSIGN @Dev to ...
OUTPUT @Dev; Cmd1$
ENTER @Dev; Data1$
:
! After completing the I/O for this application or transaction, release
! the interface lock to allow other programs to share the interface.
CONTROL Sc,255;4 ! Unlock the interface, leaving buffering on
:
:
Timed_out: !
! Interface is still locked, wait and try again later.
:
:
Err_handler: !
! If "ERROR 169 I/O interface not initialized" or
! "ERROR 731 SICL library call failed", either abort or attempt
! to initialize the interface with a RESET statement.
!
! If "ERROR 163 I/O interface/driver not present", there is no
! programmable way to recover. (see text)
```

It is common for I/O programs to begin their interface configuration with a RESET statement. On one hand, this is an effective way to guarantee that the interface is in a known initial state. On the other hand, some interfaces may do “too much” when they are RESET in a multi-user environment. A System Controller HP-IB asserts the IFC line when it is RESET. This can initialize an entire instrument cluster, not just one HP-IB interface. The recommendation is to think about what you are doing; be aware of other users on the system, as well as the needs of your application.

8

Error 163 may be caused by an interface that is not installed or configured correctly. See the *Installing and Maintaining HP BASIC/UX* manual for information about installing and configuring Series 700 interfaces. Error 163 may also be caused by significant failures of the SICL I/O subsystem. The *Installing* manual also describes the SICL installation procedure.

A **SCRATCH A** command or a restart of BASIC/UX is required to reclaim an interface that is giving error 163. However, an interface cannot be reclaimed (and reinitialized) until any underlying installation and configuration problems have been corrected.

Automatic Relocation of Locks

BASIC/UX 700 may need to move or alter an interface lock as one of the low-level details of certain commands. The best example is the **TRANSFER** statement, where the lock must be moved from the **rmb** parent process to the **rmbxfr** child process.

During these operations, the old lock must be removed before the new lock is applied. This creates a very brief instant during which BASIC has no lock on the interface. Unfortunately, the brevity of this exposure is not significant if another process has a lock request pending. It is normal for lock requests to block (wait) until the instant an interface becomes available. A blocked lock request could “steal” BASIC’s lock during one of these transition times.

In most cases, this loss of a lock is not harmful. It just means that the first process will wait until the other process releases the lock, and then it can continue. A problem exists if the other process holds its lock indefinitely. Such situations are a symptom of multi-user interactions that are combative rather than cooperative. If multiple users will be accessing the same HP-IB, it is important for all of them to understand the need for cooperation.

If you want to design multiple processes that cooperate on a high level, synchronizing blocks of activity on the same HP-IB, you should design a more robust protocol than simply locking the interface. For example, you can use a lock file as an indicator of interface ownership. Before a process uses the HP-IB, it first tries to lock the chosen file. If it succeeds in locking the file, it uses the HP-IB then unlocks the file. If it cannot get a file lock, then it knows that the HP-IB is being used by another process.

8

8-24 Porting from BASIC/UX 300/400 to BASIC/UX 700

Passing Control from a Locked HP-IB

The SICL standard specifies that interface (controller) locks and non-controller locks are independent. With this definition, locks behave as expected when the interface retains Active Control and when the interface is Non System Controller. The vast majority of HP-IB applications are in one of these two categories. However, an unexpected problem can occur in those rare applications when the interface is System Controller, but not Active Controller (it has passed control).

When control is passed to another device, the lock is changed from a controller lock to a non-controller lock. Resetting the interface (sending IFC) is allowed as a controller function. Having a non-controller lock does not prevent another process from accessing controller functions on that interface. Therefore, even when BASIC/UX 700 has the non-controller HP-IB “locked,” another process can open that interface and assert IFC. This will have significant, undesired effects on BASIC’s non-controller activities.

The solution is to use a high-level cooperation method as described in a preceding section.

Miscellaneous Changes

There have been no changes to most of the other subsystems of BASIC/UX on Series 700. The major, miscellaneous changes to note are explained in the following subsections.

Compiler Binary

BASIC/UX 300/400 includes a built-in compiler, which provides three primary advantages:

- Performance: Typical programs run faster when compiled.
- Program size: Compiled programs use only one line number for each SUB, thereby allowing for much larger programs to fit in the 32766 line numbers.
- Security: Programs can be compiled in such a way that users cannot list the source, thus protecting proprietary algorithms.

BASIC/UX 700 does not provide a compiler binary. The higher performance of the Series 700 computers and the new long line number capability alleviates many of the needs for a compiler.

CSUBs

The CSUB mechanism for BASIC/UX 700 is largely the same as for BASIC/UX 300/400. The rmbuildc program is still used, and the stream control files it uses are compatible with Series 300/400.

However, there are some differences in the way user programs must be compiled and linked. Also, there are some run-time issues for locating the code.

For more information, refer to the *Developing CSUBs for BASIC/UX 700* manual.

SIGIOT/SIGABRT Signal

Another change in BASIC/UX 700 is that the signal SIGIOT (also called SIGABRT) is no longer a valid **EXT SIGNAL**. Instead of being trappable by BASIC (or generating error 825, if an **ON EXT SIGNAL 6** is not in force), this signal now generates Error 824: SIGIOT (SIGABRT) signal received. This may be generated by the dynamic loader if a run-time binding error occurs in CSUBs.

Boot Screen

The boot screen was redefined for BASIC/UX 700 to minimize the dependence of BASIC/UX on the HP-UX kernel, which results in reduced information in the boot screen. The format of the new boot screen is:

```
Copyright 1987, 1991, 1994
Hewlett Packard Company.
All Rights Reserved.
```

```
display information line
keyboard information line
```

I/O System Configuration:

```
type at lu -> sc mode SICL:name info
SCSI      -> sc DISK
...
```

Filesystem Configuration:

```
Disk 1402, 0, 1 = DIRECTORY directory
Disk 1400, 0, 0 = DEVICE device_file
...
```

HP BASIC/UX workspace size = *size* Bytes

Node: *system* [*uname* *info*]

Where:

type = SICL device type (HP-IB or RS-232C)
lu = SICL logical unit for the device
sc = Select code used within BASIC/UX
mode = IGNORED, NORMAL, or AUTOLOCK for SICL devices
name = SICL symbolic name
info = SICL card name (if SICL)
 Error information (otherwise)
device_file = Associated device file for SCSI
directory = Directory at which the disk is to be mapped
system = The name of the system running BASIC/UX

Porting from BASIC/UX 300/400 8-27
to BASIC/UX 700

rmbconfig

BASIC/UX 700 does not support this program. The *Installing and Maintaining HP BASIC/UX* manual describes most of the system administration tasks that used to be performed by **rmbconfig**. Other tasks can be found in the system administration guide's "Using SAM" section.

Utility Programs

The utility programs that BASIC/UX 700 does not support are:

CPR

GPIO_STAT

HPIB_STAT

RS232_STAT

VERIFY

Globalization Overview

Globalization allows BASIC to process strings containing two-byte characters. This chapter contains brief, general descriptions of globalization and two-byte characters. To learn how to program with two-byte characters, read the following chapter, “Features of Globalized BASIC.”

You do not need to read this chapter unless you plan to write programs that use two-byte characters.

Globalization Support

These features are supported by BASIC/WS version 6.0 and above and BASIC/UX version 6.2 and above. BASIC/DOS/IN *does not* support globalization. The new features added to globalized BASIC do not change the way it behaves when processing one-byte characters, such as Extended US ASCII. Thus, BASIC/WS 6.0 and BASIC/UX 6.2 are backward compatible.

To use most globalized features in a meaningful way, you must purchase a localized version of BASIC with specialized language binaries. A localized version is one that supports a specific two-byte language, such as Japanese.

Note BASIC/UX 6.2 supports globalization *only* in the X-Windows environment.

Note BASIC/DOS 6.2 for the HP Measurement Coprocessor *does not* support globalization.

Related Documents

Since programming with globalized BASIC is an advanced topic, you should already be familiar with BASIC in general. In particular, you need to thoroughly understand how to input, process, and display character data using BASIC with your display and keyboard. If you think you need more background information, consider the following topics:

Topic	Suggested Reading
Programming with Character Data	See the chapter “String Manipulation” in <i>HP BASIC Programming Guide</i> . For a list of string functions, see the listing under the headings <i>String Operations</i> and <i>Globalization</i> in the appendix “Keyword Summary” of the <i>HP BASIC Language Reference</i> .
Using the Keyboard	See the “Keyboard Interface” chapter of <i>HP BASIC Interface Reference</i> . For a detailed description of all the keys available, refer to <i>Using HP BASIC</i> .
Using the Display	See the “Display Interfaces” chapter of <i>HP BASIC Interface Reference</i> .
Local Language Programming	If you purchased a localized version of BASIC, you should also have a manual titled <i>Using LanguageX with HP BASIC</i> , where <i>Language X</i> is a local language. This manual explains the details specific to your localized version such as character sets, supporting files, and keyboard entry methods.

Terminology

This chapter explains the meaning of most special terms at the time they are first used. However, you need to understand the following terms before you continue:

- Globalization
- Localization



Globalization and Localization

Globalization and localization are related, but they are not the same.

Globalized BASIC is a version of BASIC that supports two-byte characters internally and displays them using the CRTD binary. Two-byte characters are used by certain non-Roman languages, such as Japanese. However, globalized BASIC does not support a specific language. For example, to use Japanese characters with BASIC, you must purchase specific Japanese FONT, LANGUAGE, and INPUT binaries from Hewlett-Packard. **Localized** BASIC is globalized BASIC into which INPUT, LANGUAGE, and FONT have been loaded.

Consider this analogy. Globalized BASIC is like a laser printer that can accept font cartridges for many fonts. The localization binaries are like font cartridges. Just as you must plug a font cartridge into the printer to print with a special font, you must load localization binaries into globalized BASIC. Most laser printers provide a default internal font that is accessible whether or not a font cartridge is installed. Similarly, globalized BASIC contains one-byte Extended ASCII and Katakana whether or not any localization binaries have been installed.

Note BASIC can only support one set of localization binaries at a time. Thus, you cannot simultaneously load INPUT, LANGUAGE, and FONT for more than one language.

Understanding One- and Two-Byte Characters

Overview

The key to understanding globalization is understanding one- and two-byte characters. Normally, BASIC assumes that each character in a string is one byte long. This applies to characters stored in memory, displayed on the screen, or entered from the keyboard.

To enable BASIC to process two-byte characters, you must:

- LOAD BIN the globalized CRTD display binary.
- LOAD BIN localized LANGUAGE, INPUT, and FONT binaries.
- Activate the CRTD binary (using CRT CONTROL register 21).

You can then use two-byte characters in the BASIC editor for variables, labels, and string literals. You can also use two-byte characters in application programs as keyboard input and screen output.

```
100   ! このプログラムは1から10の範囲の数字を表示します
110   PRINT "10までの整数:"
120   !
130   開始:   !
140   FOR 数字=1 TO 10
150     CALL 数字の表示(数字)
160   NEXT 数字
170   END
180   !
190   SUB 数字の表示(数字)
200     PRINT 数字
210   SUBEND
```

A Program Listing with Two-byte Characters



A Graphics Plot with Two-byte Characters

Globalized BASIC and localized BASIC can process and display a mixture of one-byte and two-byte characters. For example, it is possible to create a bilingual error message string containing both one-byte English and two-byte Japanese.

"Stop Test" と書かれたボタンを押してください

A Message with One- and Two-Byte Characters

The One-Byte World

The one-byte characters that non-localized BASIC recognizes are US ASCII/European display characters and Japanese Katakana display characters. Refer to the "Useful Tables" chapters of the *HP BASIC Language Reference* or the *HP BASIC Condensed Reference* for a complete listing. Each character set is a definition of 256 codes that represent letters in an alphabet, typographic symbols, control characters, and display enhancement characters.

For example, if you are using an HP series 300 computer, the codes are assigned like this:

Series 300 Extended ASCII Display Characters

Code Range		Functions
Decimal	Hexadecimal	
0-31	00-1F	Non-printable 7-bit ASCII control characters
32-64	20-40	7-bit ASCII typographic symbols and digits
65-126	41-7E	7-bit ASCII alphabet and punctuation symbols
127	7F	Delete
128-135	80-87	Alpha display enhancement characters
136-143	88-8F	Alpha display pen colors
144-160	90-A0	Reserved
161-241	A1-F1	European alphabet and punctuation characters
242-254	F2-FE	Miscellaneous
255	FF	Non-ASCII prefix

These code definitions are adequate for the one-byte world of Roman characters. However, they do not address several problems encountered with characters in non-Roman languages. In particular, these languages:

- Have alphabets of more than 256 characters
- Are more typographically complex
- Use some fundamentally different input methods

The Two-Byte World

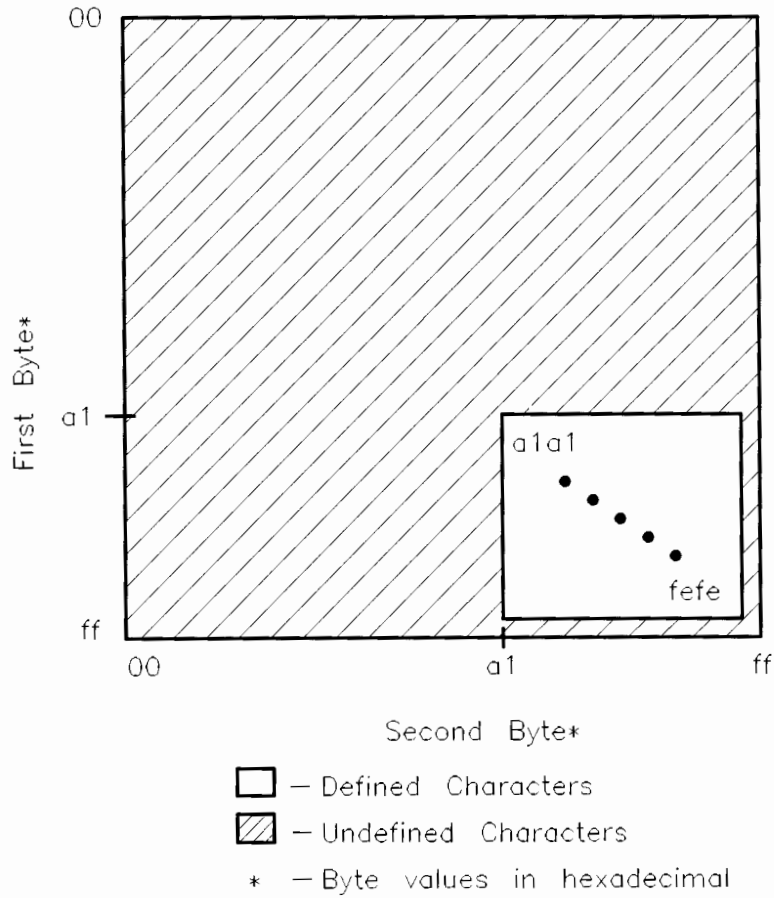
In the previous discussion, we saw how ordinary BASIC uses one-byte codes to identify each Extended ASCII character. Similarly, globalized BASIC uses two-byte codes to identify each character. Two bytes are required because of the large number of characters available in many Asian alphabets.

Two-byte characters are coded in HP-15 and HP-16. HP-15 codes are used to represent characters inside software applications, while HP-16 codes are used primarily to send characters to peripherals, such as printers. HP-15 and HP-16 are coding systems that can be used to specify characters for a variety of languages. They specify a region of code space into which characters may be mapped, but not the characters themselves.

Note that only parts of the available code space in HP-15 and HP-16 define valid two-byte codes. If either byte of a potential two-byte code falls outside the valid region, *both* bytes are treated as one-byte codes. As the last statement implies, one-byte and two-byte characters coexist inside BASIC.

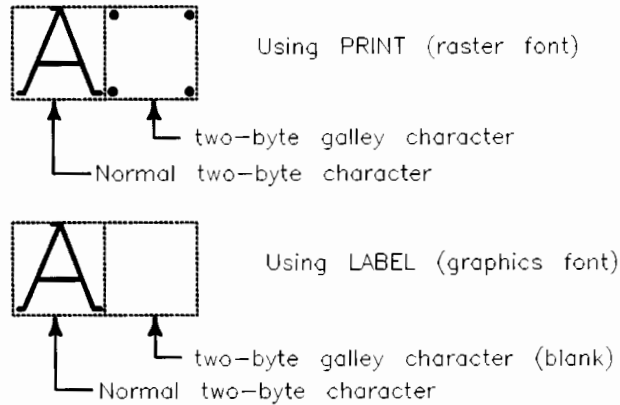
Two-Byte Languages

Different languages require different numbers of characters. For this reason, it is not possible to make any general statement about how much of the HP-15 or HP-16 code space is filled with printable characters. For example, HP-15 Korean character codes fill only about one fourth of the available code space.



HP-15 Korean Character Codes

Languages do not always provide distinct printable characters for all codes in a region. Unused codes within a region are typically filled with **galley characters**, which are essentially blank placeholders of the same physical dimensions as other printable two-byte characters.



Two-byte Galley Characters

One-Byte or Two-Byte?

Localized BASIC must frequently break character strings into ordered lists of bytes and classify them as one- or two-byte characters. As a programmer, you may need to perform the same analysis, so let's examine the algorithm:

1. Get the first byte of the string.
2. If the first byte is not in the valid range of two-byte characters, then treat it as a one-byte character. Go to step one and continue the procedure with next character.
3. If the first byte is in the valid range for two-byte characters, get the second byte. If the second byte is in the valid range for two-byte characters, treat the *pair* as a single two-byte character. If the second byte is not in the valid range for two-byte characters, treat *each* byte as a single one-byte character.

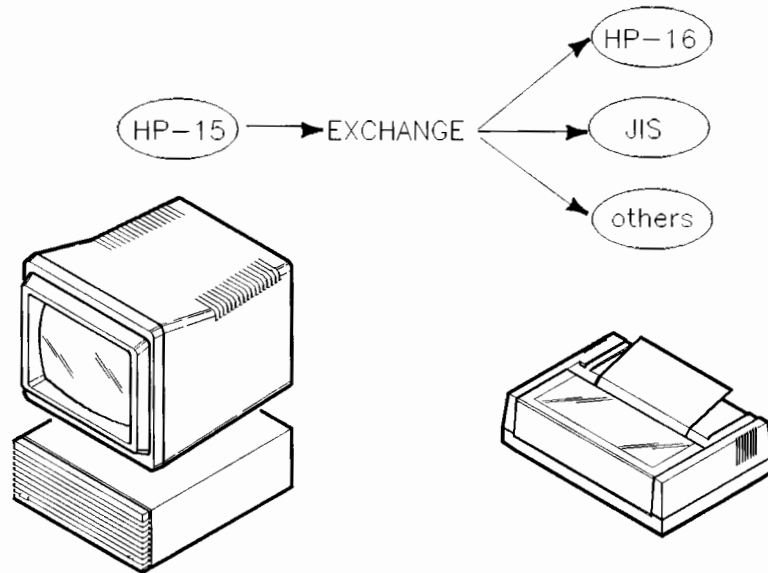
Two-Byte Character Conversions

Two-byte languages differ from one-byte languages in many ways. Most one-byte languages, such as English, have a single alphabet composed of relatively few characters. Consequently, most characters are available directly as labeled keys on the computer keyboard. In general, keyboards, displays, and printers for a particular one-byte language all use the same basic codes for the printable characters in the alphabet. Thus, one-byte languages use a single alphabet that maps directly to a single set of character codes.

In two-byte languages the situation is more complex. Many two-byte printers use character codes different from the codes used by computers. Therefore, programs must convert from one coding system to another when using certain peripherals. Two-byte languages may include more than one alphabet in their character set. Consequently, programs using two-byte characters must sometimes convert between alphabets by translating strings character-by-character. Since two-byte languages often have more characters than can fit on a keyboard, different keyboard input methods must be used.

Converting Codes

Globalized BASIC uses HP-15 to represent any two-byte characters that are stored internally. Therefore, all characters displayed on the screen, including both raster and graphics fonts, are HP-15. Since some two-byte printers use HP-16 to print two-byte characters, localized BASIC provides a way to convert between the two. In the next chapter, we will discuss how BASIC accomplishes this with EXCHANGE.



Character Conversion Using EXCHANGE

Converting Alphabets

Many two-byte languages contain several alphabets or several dialects. In addition, some two-byte languages have adopted methods for using Roman characters to express words phonetically. For example, Japanese words can be written in three different alphabets.

Japanese Alphabets in HP-15

Alphabet	Description
Katakana	Simplified phonetic alphabet
Hiragana	Phonetic alphabet
Kanji	Traditional alphabet

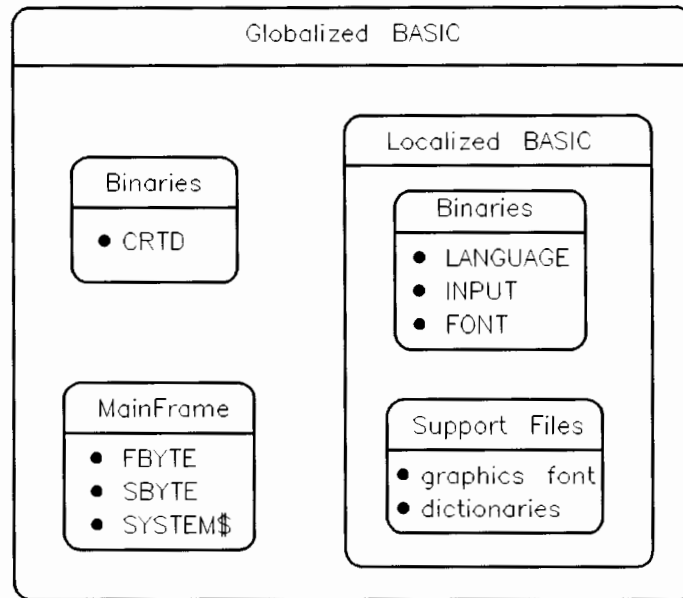
Because of the different alphabets available, Japanese localized BASIC must be able to quickly convert from one alphabet to another, character-by-character. In the next chapter, we will discuss how BASIC accomplishes this with CVT\$.

Converting Keyboard Input

Some two-byte languages use special keyboard input conversions to enter two-byte characters. An operator may type in a string phonetically and then press a conversion key to translate the string word-by-word. For example, a Japanese operator might type in a string in Hiragana and press a conversion key to automatically translate the string to Kanji. Details of these types of input procedures are outlined in the manual *Using LanguageX with HP BASIC*, where *LanguageX* is a local language, such as Japanese.

Inside Globalized BASIC

Now that you understand two-byte characters, let's look at what has been added to BASIC to handle them. Globalized BASIC contains additional binaries, mainframe keywords, and support for localization binaries.



Globalized BASIC—Additions and Enhancements

New Globalized Features

Location	Name	Description
Binary	CRTD	The new binary CRTD is a globalized display driver required for displaying two-byte characters. Note that CRTD works with bit mapped displays <i>only</i> ; it does not work with the HP 98700 graphics display station or HP Series 200 computer displays.
Mainframe	FBYTE/SBYTE	The BASIC mainframe includes two new string functions, FBYTE and SBYTE, used to determine the one/two-byte identity of character strings.
Mainframe	SYSTEM\$	Globalized BASIC can return additional system settings for GFONT IS, LANGUAGE, VERSION:, CONVERSION BUFFER, and DICTIONARY IS:. (CONVERSION BUFFER and DICTIONARY IS are <i>only supported</i> on BASIC/WS.)

New Localized Features

Location	Name	Description
Binary	INPUT	This binary supports keyboard entry of two-byte characters. Key mapping, dictionary lookup functions, and alphabet conversions are provided for keyboard entry. The DICTONARY IS statement requires this binary.
Binary	LANGUAGE	This binary supports two-byte character <i>graphics</i> fonts for the GRAPH binary. This binary also contains most localization related keywords including CVT\$, GFONT IS, EXCHANGE, SHIFT IN/OUT, and several new SYSTEM\$ extensions.
Binary	FONT	This binary provides <i>raster</i> character fonts for both one- and two-byte characters. It contains other font information required by CRTD. (Not supported on BASIC/UX.)
Files	Dictionaries, Graphics Fonts	Most localized versions of BASIC contain one or more support files. These files may include system and user defined dictionaries for alphabet and phrase conversion. A file containing graphics font data is always included.



Features of Globalized BASIC

This chapter describes how to use the two-byte character handling features of globalized BASIC. Two-byte characters are used by certain languages, such as Japanese. You should read the preceding chapter “Globalization Overview” before reading this chapter.

Using Keyboards

This section reviews the keyboard input methods available for one-byte characters and presents the enhanced two-byte methods.

Review of One-Byte Character Input

BASIC provides a variety of methods for keyboard input in the one-byte world. You need to understand these methods because they are reused and extended in globalized, two-byte BASIC. If you have difficulty understanding or using a particular method for two-byte character entry, refer back to this section. It is often easier to learn an input method in the one-byte world and then apply it in the two-byte world.

Note BASIC/UX 6.2 supports globalization *only* in the X-Windows environment.

BASIC/DOS 6.2 *does not* support globalization.

This review covers the following character input methods:

One-Byte Character Input Methods

Input Method	Description
Direct	Enter characters by pressing the labeled keys on your keyboard. In general, these are the printable letters, numbers, and punctuation symbols.
Extended	Enter characters other than the ones labeled on your keycaps using (Extend char) . In general, these characters are the printable letters, numbers, and punctuation symbols.
Any Char	Enter <i>any character</i> recognized by BASIC in the entire code range 0-255. This method can be used for printable or non-printable characters.
Non-ASCII	Simulate a keypress for a non-ASCII key using (CTRL) . This is useful for simulating keys such as (Insert char) , (Clear line) , and arrow keys.
Programmatic	Generate characters inside a BASIC program using CHR\$, VAL\$, or similar functions.

Direct Keyboard Entry

Direct keyboard entry is the input method normally associated with a keyboard. This is the method you use to type in a numbered program statement in the BASIC editor. To use this method, you simply press the key with label corresponding to character you wish to enter.

Direct Keyboard Entry Examples

To Enter ...	You Type ...
A	(A)
%	(%)
Red	(R)(e)(d)

10-2 Features of Globalized BASIC

Note that not all labeled keys generate a character. Some keys take a specific action, such as **Insert line**, **Return**, **Caps**, and **Stop**. You *cannot* use direct keyboard entry to input these keystrokes into a quoted string; refer to the following section “Non-ASCII Key Entry.”

Extended Keyboard Entry

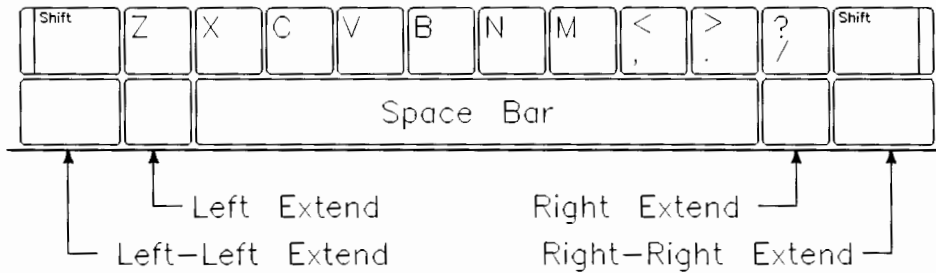
BASIC recognizes one-byte codes for US Roman, European Roman, and Japanese Katakana characters whether or not localization binaries are loaded. However, most keyboards are designed and labeled to use only one group of characters at a time. You must press **Extend char** while simultaneously pressing another key to access other characters. For example, the HP 46021A ITF keyboard is configured like a standard US typewriter. You can access the European Roman characters on the HP 46021A keyboard using the **Extend char** key.

Extended Keyboard (HP 46201A) Entry Examples

To Enter ...	You Type ...
ß	Extend char - s
ö	Extend char - u o
ñ	Extend char - i n

The native language of the keyboard determines what characters are available as direct input keys and what characters are available through **Extend char**.

Extend Keys. The mechanical design of HP keyboards makes it possible to have more than one extended character key. The generic name for this type of key is an **extend key**. The names printed on these keys varies slightly depending on the native language of the keyboard, but the *position* is the same. Such keys are located adjacent to the space bar to the right and left. In general, there can be up to four extend keys.



Extend Keys

Any Char Keyboard Entry

The direct and extended keyboard entry methods provide an easy way to input most printable characters. But some valid characters in the BASIC character set do not map to either normal or extended keys. You can enter these “keyless characters”, or any other character, using the **ANY CHAR** softkey.

To input a character using this method, simply press **ANY CHAR** followed by the three digit decimal code for that key. You can find a complete list of codes in the US/European/Katakana display codes table in the “Useful Tables” chapter of the *HP BASIC Language Reference* or in the back of the *HP BASIC Condensed Reference*.

ANY CHAR Keyboard Entry Examples

To Enter ...	You Type ...
A	ANY CHAR 065
£	ANY CHAR 175
ENQ	ANY CHAR 005
ACK	ANY CHAR 006

Non-ASCII Key Entry

Certain keys on the BASIC keyboard take immediate actions instead of generating characters. This type of key includes `(Insert char)` and `(Clear display)`. You may want to type one of these characters into a quoted string in BASIC instead of taking the action labeled on the key. You can enter `(Clear display)` within a quoted string by pressing `(CTRL)-(Clear display)`. The key appears on the screen as a two-character sequence beginning with `k`.

Non-ASCII Key Entry Examples

To Enter ...	You Type ...	The Screen Shows ...
<code>(Clear display)</code>	<code>(CTRL)-(Clear display)</code>	<code>k K</code>
<code>(Insert char)</code>	<code>(CTRL)-(Insert char)</code>	<code>k +</code>

For additional details, refer to the section titled “Second Byte of Non-ASCII Key Sequences” located in the “Useful Tables” chapter of the *HP BASIC Language Reference*.

Note Do not confuse the two-character sequence used to represent non-ASCII keys with the two-byte characters used by globalized BASIC.

Programmatic Character Entry

All of the character entry methods discussed previously are designed to permit humans to interactively input characters from a keyboard. The methods for generating characters within a program are somewhat different. The most common methods for generating strings programmatically are:

- CHR\$** The CHR\$ function converts a decimal number into one byte of a character. For example, on a system using US ASCII, CHR\$(65) is equivalent to "A".
- VAL\$** The functions VAL\$, DVAL\$, and IVAL\$ convert numeric values into character strings composed of digits. VAL\$ creates only decimal digits, while DVAL\$ and IVAL\$ can create binary, octal and hexadecimal digits.
- OUTPUT KBD** Sometimes it is useful to make your BASIC program send characters to the keyboard buffer using OUTPUT KBD. This accurately simulates human keystrokes. For example, OUTPUT KBD;"NO" can be provide a default response to a query. Note that the quoted string may contain *any* simulated keystrokes, including non-ASCII keys such as Insert char.

Two-Byte Character Input

This section describes the two-byte character input methods available in globalized BASIC. If you have not already done so, read the preceding section “Review of One-byte Character Input” to familiarize yourself with input terminology.

Two-Byte Character Input Methods

Input Method	Comments
Direct	Enter characters by pressing the labeled keys on your keyboard. This input method is <i>not</i> available for two-byte characters.
Extended	Enter characters other than the ones labeled on your keycaps using Extend char . This input method is <i>not</i> available for two-byte characters.
Any Char	Enter any character recognized by BASIC <i>one byte at a time</i> using Any Char . This method can be used from any keyboard to enter one- or two-byte characters.
Non-ASCII	Simulate a keypress for a non-ASCII key using CTRL . This method works for all keyboards.
Translation	Enter a phrase in one alphabet and localized BASIC translates and displays it in a different alphabet. Different versions of localized BASIC support different input methods and hardware.
Programmatic	Generate characters using BASIC string functions. These methods work for one- or two-byte characters.

Using Any Char

Note that **Any Char** can be used from any keyboard to generate either one- or two-byte characters *byte by byte*. Thus, two codes must be specified to generate a single two-byte character.

The appearance of a two-byte character typed into a quoted string on the command line may be somewhat confusing. Type in the following statement on the BASIC command line. Observe the difference between the printed character and the contents of the quoted string on the command line.

```
PRINT "Any Char 130 Any Char 096"␣
```

If you have the Japanese localization binaries loaded, and the CRTD driver is selected, this will print the two-byte letter A on the screen.

Special Key Assignments

Some localized versions of BASIC assign special functions to various key combinations. These keys are frequently in conjunction with keyboard input translators. For example, Japanese localized BASIC defines actions for many control key sequences, such as **CTRL-I**, **CTRL-N**, and others. You need to be aware of these types of key definitions if you write a program with its own keyboard handler.

Keyboard STATUS and CONTROL Registers

Globalized BASIC contains the additional keyboard STATUS/CONTROL registers 24 and 25. These registers affect two-byte character input and are inoperative unless an INPUT binary is loaded. Refer to the CONTROL/STATUS register summary in the *HP BASIC Language Reference* for details.

Some versions of localized BASIC include additional keyboard STATUS/CONTROL registers. For details, refer to the manual *Using LanguageX with HP BASIC* where *LanguageX* is your local language.

10-8 Features of Globalized BASIC

Using Displays

This section explains how to display two-byte characters using globalized BASIC.

Hardware Support

The CRTD binary used to display all two-byte characters works only with HP Series 300, 400, and 700 bit-mapped computer displays. CRTD *does not* support HP Series 200 displays, so you cannot display two-byte characters on an HP Series 200 computer. Similarly, CRTD *does not* support the HP 98546 Display Compatibility Interface for HP Series 300 computers, or the HP 98700 Graphics Display Station.

Note BASIC/UX 6.2 supports globalization *only* in the X-Windows environment.



Overview of Fonts

A **font** describes the way a printable character is displayed on the BASIC screen. BASIC uses **raster fonts** in its alpha display and **graphics fonts** in its graphics display. A raster font defines each displayed character as a matrix of pixels. A graphics font defines each displayed character as an outline traced by a graphics pen.

```
PRINT "HELLO"  raster font
LABEL "HELLO" graphics font
```

Note that raster fonts vary among different displays. This is because pixels in displays vary widely in their number, size and shape. In particular, you *cannot* assume that two arbitrary displays contain the same number of rows or columns of characters. To determine the physical characteristics of your display, use SYSTEM\$("CRT ID"), CHR_X, CHR_Y, and ALPHA HEIGHT. Refer to the *HP BASIC Interface Reference* for details.

Two-Byte Fonts

Ordinarily, BASIC uses the standard one-byte Extended ASCII or Japanese Katakana characters for graphics and raster fonts. To be able to process and display two-byte characters, you generally must load the following binaries:

- CRTD—Supports display of raster characters on the display.
- FONT—Contains raster font FONT definitions. (Not supported on BASIC/UX)
- LANGUAGE—Contains graphics FONT definitions. (Supports two-byte graphics font)
- GRAPH—Supports the LABEL command.

Two-Byte Font	Binaries Required
Raster Font	LANGUAGE FONT CRTD
Graphics Font	LANGUAGE FONT CRTD GRAPH

In addition to loading these binaries into memory, you may also need to activate the CRTD binary, depending on what other display drivers you have loaded (CRTA,CRTB). To do this, use one of the following two statements:

```
CONTROL CRT,21;4  activate CRTD, single-width characters
CONTROL CRT,21;5  activate CRTD, double-width characters
```

Note For BASIC/UX the CRTD binary acts differently, and the above two statements *both* activate CRTD with single-width characters.

Globalized BASIC supports the simultaneous display of one- and two-byte characters. For example, you can display a line of text containing one-byte Roman characters and two-byte Japanese characters.

Look-alike Characters

Note that LANGUAGE and FONT usually contain two-byte characters corresponding to Roman letters and digits. It is very important to distinguish between one-byte characters and their two-byte character look-alikes. Certain functions in BASIC require one-byte characters. Other functions behave differently depending on character length. For example, the Japanese FONT definition contains these codes for the Roman letter A:

```
One_byte$=CHR$(65)           one-byte Roman letter A
Two_byte$=CHR$(130)&CHR$(96) two-byte Roman letter A (HP-15 Japanese)
```

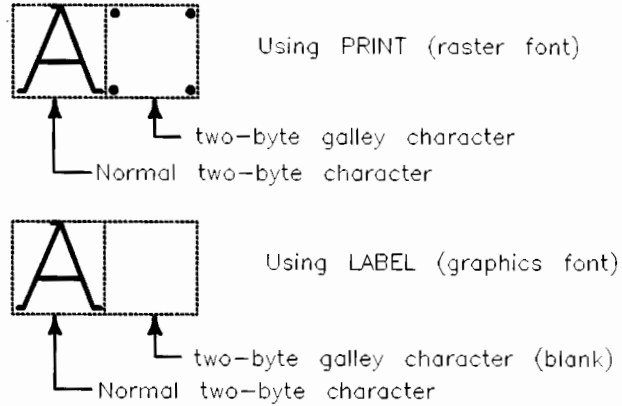
Character Size

Two-byte characters are displayed twice as wide as one-byte characters. This must be done to clearly depict complex Asian language characters. Consequently, the two-byte Roman letter A is twice as wide as the one-byte Roman letter A. One-byte characters are the same height as two-byte characters. These rules apply to both raster and graphics fonts.

Double and Single Width. When CRTD, FONT and LANGUAGE are loaded and CRTD is activated, you can set the size of raster characters to double or single width. Raster character height is unaffected. Double-width characters are intended for use primarily with 12-inch displays, although you can use them on any display. Most two-byte raster characters are not readable on 12-inch displays unless they are displayed using double width.

Galley Characters

Sometimes BASIC cannot display a character that you request. If you try to display a valid HP-15 character that has no font description, BASIC displays a **galley character** in place of the character you requested. A galley character is a blank or empty character of the same dimensions as a printable character.



Determining Display and Character Size

If your program must support different languages or different displays, you may need to determine character and display sizes. You can determine raster character size *in pixels* using `CHRX` and `CHRY`. Note that the values returned by `CHRX` and `CHRY` apply to *one-byte* raster characters.

You can use `CSIZE` to set the size and aspect ratio of graphics fonts (graphics characters), but two-byte characters are always twice as wide and the same height as one-byte characters.

`CRT STATUS` registers 9 and 13 contain the width and height of the print area respectively. The following code segment determines the size of the display area in character units (current one-byte characters):

```

100 ! X_size = Screen width in one-byte characters
110 ! Y_size = Screen height in one-byte characters
120 !
130 STATUS CRT,9;X_size
140 STATUS CRT,13;Y_size

```

Using the Print Area

Globalized BASIC allows you to intermix one- and two-byte characters on the same line of the print area of the display. The print area is the set of lines at the top of the CRT used by the PRINT command. The ability to mix one- and two-byte characters creates some unique situations when overwriting characters with TABXY.

In the following discussion and examples, lower case letters represent one-byte characters and upper case letters represent two-byte characters. Thus, the following program segment contains a sequence of alternating one- and two-byte characters:

```
10 CLEAR SCREEN
20 PRINT "AaBbCc"  a=1-byte, A=2-byte
```

It is important to distinguish the physical positions of the characters on the screen from their position in memory. In the preceding example there are six characters totalling 9 bytes. When addressing a position in the print area with TABXY, *localized* BASIC determines position on a byte-by-byte basis, *not* a character-by-character basis. Since Extended ASCII and Japanese Katakana characters are always one-byte per character, this is consistent with previous versions of BASIC.

TABXY Positions










Character	Bytes	TABXY Position
A	2	1
a	1	3
B	2	4
b	1	6
C	2	7
c	1	9
<i>Total</i>	9	

Suppose you want to overwrite a character using the secondary keyword TABXY. We can easily expand the previous example to do this:

```
10 CLEAR SCREEN
20 PRINT "AaBbCc"      a=1-byte, A=2-byte
30 PRINT TABXY(1,1),"Z" replace 2-byte A with 2-byte Z

10 CLEAR SCREEN
20 PRINT "AaBbCc"      a=1-byte, A=2-byte
30 PRINT TABXY(3,1),"z" replace 1-byte a with 1-byte z
```

These operations are simple if you replace one-byte characters with one-byte characters, and two-byte characters with two-byte characters. In each case, the new character fills the same amount of space as the old character. But what happens if you try to overwrite a one-byte character with a two-byte character, or vice versa? What happens if you try to overwrite the *second* byte of a two-byte character? The figures that follow illustrate what happens in a variety of cases.

	Case 1	Case 2	Case 3
New			
Old			
Result			



= Any one-byte character



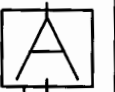
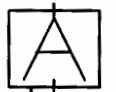
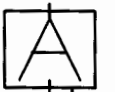
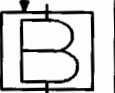
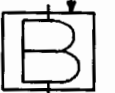
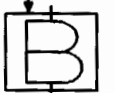
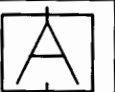


= One-byte space character



= Any two-byte character

first byte second byte

Overwriting With One-Byte Characters

	Case 1	Case 2	Case 3
New			
Old			
Result			



= One-byte space character (Blank)



= Any two-byte character

first byte second byte

Overwriting With Two-Byte Characters

The following general rules apply when overwriting print area characters with PRINT TABXY:

- Unused portions of the print area are filled with one-byte spaces. CLEAR SCREEN fills the entire print area with one-byte spaces.
- There are always the same number of bytes on a line after a TABXY overwrite as before it. Output formatted in columns remains intact.
- Any unused portion of an overwritten two-byte character is replaced by a one-byte space character.

Display Enhancement Characters

BASIC uses certain characters as **display enhancement characters**. These characters do not occupy any space on the screen, nor do they produce any immediately visible effect. Display enhancement characters change the appearance of characters that follow.

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Globalized BASIC defines both one- and two-byte display enhancement characters. The one-byte display enhancement characters are the same as those used in BASIC/WS/UX 5.x and previous versions; they are CHR\$(128)-CHR\$(143). The two-byte display enhancement characters are created by adding CHR\$(255) before the one-byte display enhancement character. For example:

```
PRINT CHR$(132);A$;CHR$(128)
```

underline on/off

```
PRINT CHR$(255)&CHR$(132);A$;CHR$(255)&CHR$(128)
```

underline on/off

Monochrome Display Enhancements

Character		Resulting Enhancement
<i>One-byte</i>	<i>Two-byte</i>	
CHR\$(128)	CHR\$(255)&CHR\$(128)	All enhancements off
CHR\$(129)	CHR\$(255)&CHR\$(129)	Inverse video on
CHR\$(130)	CHR\$(255)&CHR\$(130)	Blinking on
CHR\$(131)	CHR\$(255)&CHR\$(131)	Inverse video and blinking on
CHR\$(132)	CHR\$(255)&CHR\$(132)	Underline on
CHR\$(133)	CHR\$(255)&CHR\$(133)	Underline and inverse video on
CHR\$(134)	CHR\$(255)&CHR\$(134)	Underline and blinking on
CHR\$(135)	CHR\$(255)&CHR\$(135)	Underline, inverse video, and blinking on



Color Display Enhancements

Character		Resulting Enhancement	
<i>One-byte</i>	<i>Two-byte</i>	<i>Model 236C</i>	<i>Bit-mapped</i>
CHR\$(136)	CHR\$(255)&CHR\$(136)	White	Pen 1
CHR\$(137)	CHR\$(255)&CHR\$(137)	Red	Pen 2
CHR\$(138)	CHR\$(255)&CHR\$(138)	Yellow	Pen 3
CHR\$(139)	CHR\$(255)&CHR\$(139)	Green	Pen 4
CHR\$(140)	CHR\$(255)&CHR\$(140)	Cyan	Pen 5
CHR\$(141)	CHR\$(255)&CHR\$(141)	Blue	Pen 6
CHR\$(142)	CHR\$(255)&CHR\$(142)	Magenta	Pen 7
CHR\$(143)	CHR\$(255)&CHR\$(143)	Black	Pen 8

Display Enhancement Guidelines

For maximum portability between localized and non-localized BASIC, always use the two-byte form of display enhancement characters. Two-byte display enhancements are compatible with both one- and two-byte languages. One-byte display enhancement characters are *not* compatible with many two-byte languages.

If you have difficulty debugging a problem, you may want to use DISPLAY FUNCTIONS ON/OFF to inspect display enhancements on the screen. See the DISPLAY FUNCTIONS ON/OFF entry in the *HP BASIC Language Reference* for more details.

The Two-Byte Underline Character

When you specify underlining for displayed characters, BASIC creates the underlined image by combining the bits of the character to be underlined with a predefined underline character. More specifically, the bit patterns that define the character image and the underline image are exclusively OR'd to form the final image of the underlined character. The one-byte underline image is CHR\$(256). The two-byte underline images are defined by CHR\$(257) and CHR\$(258).

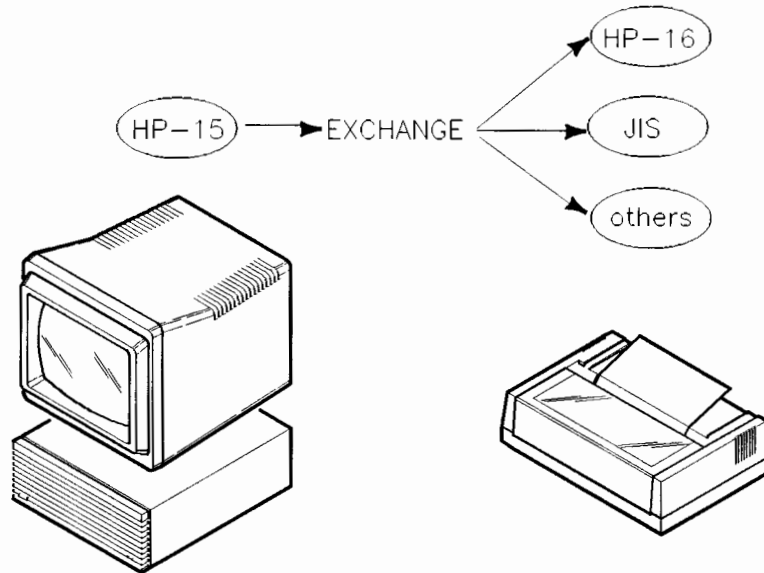
You can alter the pre-defined pattern stored in any of the underline characters using SET CHR. Refer to the SET CHR entry in the *HP BASIC Language Reference* for details.

Using Printers

Globalized BASIC supports both one-byte and two-byte printers. The secondary keywords EXCHANGE and SHIFT IN ... OUT can be used with ASSIGN, PRINTER IS, PRINTALL IS, and DUMP DEVICE IS to properly configure BASIC to communicate with two-byte printers. Once it is properly configured, BASIC will automatically send mixtures of one- and two-byte characters to the printer using the proper format and protocol for each.

Using EXCHANGE

Globalized BASIC uses HP-15 to represent any two-byte characters that are stored internally. Therefore, all characters displayed on the screen, including both raster and graphics fonts, are HP-15. Since some two-byte printers use HP-16 or other character codes to print two-byte characters, localized BASIC provides a way to convert between the two using EXCHANGE.



Character Conversion Using EXCHANGE

Note When the LANGUAGE binary is loaded, the DUMP DEVICE IS device defaults to HP-16 conversion.

Using SHIFT IN ... OUT

Some two-byte printers can shift back and forth between printing one- and two-byte characters. You must send special escape codes to tell the printer whether the bytes that follow are to be interpreted as one- or two-byte characters.

Two-Byte Printer Example

Suppose you wish to use the HP C1202A Asian Highspeed Serial Printer as the PRINTER IS device. The following code segment shows how you might use EXCHANGE and SHIFT IN ... OUT to print Japanese one- and two-byte characters:

```
100 In$=CHR$(27)&"$2@"
110 Out$=CHR$(27)&"(2@"
120 !
130 PRINTER IS 701;EXCHANGE "HP-16" SHIFT IN In$ OUT Out$
```

The EXCHANGE "HP-16" part of line 130 automatically converts characters from the HP-15 format used in BASIC memory to HP-16 for printing. The SHIFT IN In\$ part of line 130 causes BASIC to automatically send the proper escape string to the printer before printing two-byte characters. Similarly, OUT Out\$ causes BASIC to automatically send the proper escape string to the printer before printing one-byte characters.

You can use similar methods with the other printer related commands. For example:

```
ASSIGN @Asian_prt TO 701; EXCHANGE "HP-16" SHIFT IN In$ OUT Out$
DUMP DEVICE IS 701; EXCHANGE "HP-16" SHIFT IN In$ OUT Out$
PRINTALL IS 701; EXCHANGE "HP-16" SHIFT IN In$ OUT Out$
```

For more details on using printers, refer to *Using LanguageX with HP BASIC*, where *LanguageX* is your local language.

New Keywords

Globalized BASIC includes a number of new and enhanced keywords designed to handle two-byte characters and localization files. This section briefly describes how to use the new commands. For additional details and syntax diagrams, refer to the *HP BASIC Language Reference*.

Summary of Globalization/Localization Keywords

Keyword	Type	Description
CVT\$	function	Converts strings from one alphabet to another, character by character.
FBYTE	function	Returns 1 (true) if the <i>first</i> byte of the string argument is a valid <i>first</i> byte of a two-byte (HP-15) character.
SBYTE	function	Returns 1 (true) if the <i>first</i> byte of the string argument is a valid <i>second byte</i> of a two-byte (HP-15) character.
GFONT IS	statement	Specifies the file which contains graphics font data.
DICTIONARY IS	statement	Specifies the dictionary file used for translating phrases.
EXCHANGE	secondary	Used with printer or files related commands to convert internally stored HP-15 characters codes to printer compatible codes.
SHIFT IN/OUT	secondary	Used with printer files related commands to specify what control strings set the printer one-byte/two-byte mode.

Using CVT\$

Some two-byte languages, such as Japanese, use several alphabets. Therefore, it is often desirable to translate from one alphabet to another. The CVT\$ function allows you to perform this translation inside a localized BASIC program. Note that CVT\$ converts strings *character by character*. Consequently, localized BASIC will convert strings containing a mixture of both one- and two-byte characters.

To access CVT\$, you must load a localized LANGUAGE binary. LANGUAGE determines the choices that are available for source and destination alphabets. LANGUAGE also determines the character mapping between alphabets.

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Here are some CVT\$ examples using the Japanese LANGUAGE binary:

```
New$=CVT$(Old$,"ZENKAKU KATAKANA TO ZENKAKU HIRAGANA")
```

```
New$=CVT$(Old$,"HANKAKU KATAKANA TO HANKAKU HIRAGANA")
```

Using FBYTE and SBYTE

The functions FBYTE and SBYTE are generally used together to determine whether a particular character is one or two bytes long. FBYTE returns 1 (true) when the first byte of the string argument is in the valid range for the *first* byte of two-byte HP-15 characters. SBYTE returns 1 (true) when the first byte of the string argument is in the valid range for the *second* byte of two-byte HP-15 characters.

Note that both FBYTE and SBYTE operate on the *first byte* of their string argument. You must use substring expressions to properly test the first byte with FBYTE and the second with SBYTE.

The following program illustrates a practical application of FBYTE and SBYTE.

```
100 ! This program analyzes the byte length of each character in a string
110 DIM A$(64)
120 INTEGER L,I
130 LINPUT "Type in a string...",A$
140 L=LEN(A$)
150 I=1
160 WHILE I<=L
170   IF FBYTE(A$(I)) AND I<L THEN ! It may be a valid two-byte character
180     IF SBYTE(A$(I+1)) THEN ! It is a valid two-byte character
190       PRINT "";A$(I;2);"": 2-byte character"
200       I=I+2
210     ELSE ! Invalid 2nd byte;treat them as 2 ASCII characters
220       PRINT "";A$(I;1);"",A$(I+1;1);"": Two 1-byte characters"
230       I=I+2
240     END IF
250   ELSE
260     PRINT "";A$(I;1);"": 1-byte character"
270     I=I+1
280   END IF
290 END WHILE
300 END
```

Using GFONT IS

Localized BASIC uses a special graphics font to display graphics characters. You must specify the file that supports the graphics font using GFONT IS before using LABEL to display a character. For example:

```
GFONT IS "/users/BASIC/JPN_VECTOR"
GFONT IS "JPN_VECTOR:,700,0"
GFONT IS "/usr/lib/rmb/gfonts/JPN_VECTOR"
```

You can check the current setting of GFONT IS using SYSTEM\$. For example:

```
Old_gfont$=SYSTEM$("GFONT IS")
```

Using DICTIONARY IS (BASIC/WS only)

Some versions of localized BASIC support automatic input phrase translators. The user types a phrase into a conversion buffer and presses a special key to invoke the translator. The translator converts strings word by word, *not* character by character as CVT\$ does. The translation information is contained in a dictionary file. This file must be specified using the DICTIONARY IS command before attempting translation. For example:

```
DICTIONARY IS "JPN_SYSDCT:,700,0","SYSTEM"
DICTIONARY IS "/users/BASIC/JPN_USRDCT","USER"
```

The second string parameter is used by some versions of localized BASIC to specify additional dictionaries. For example, Japanese localized BASIC supports a standard dictionary (SYSTEM) and a user-defined dictionary (USER).

You can check the current settings of DICTIONARY IS and the contents of the conversion buffer using SYSTEM\$. For example:

```
Old_sysdct$=SYSTEM$("DICTIONARY IS:SYSTEM")
Old_ursdct$=SYSTEM$("DICTIONARY IS:USER")

Convert$=SYSTEM$("CONVERSION BUFFER")
```

Note that you can programmatically translate phrases by sending the appropriate simulated keystrokes to the keyboard buffer using OUTPUT KBD.

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Refer to the *HP BASIC Interface Reference* for information on simulating keystrokes.

Using EXCHANGE and SHIFT IN ... OUT

Localized BASIC stores all two-byte strings internally as HP-15 codes. Many printers use character codes other than HP-15. The secondary keyword EXCHANGE allows you to automatically convert HP-15 characters to an alternate character set, such as HP-16 or the Japanese Industrial Standard (JIS) or Extended UNIX Code (EUC).

The LANGUAGE binary determines the choices available for alternate character sets. You must load a LANGUAGE binary to use EXCHANGE or SHIFT IN/OUT.

The keywords that support EXCHANGE and SHIFT IN/OUT are:

- ASSIGN
- DUMP DEVICE IS
- PRINTALL IS
- PRINTER IS

Refer to the previous section “Using Printers” for more details.

Changes in String Functions

Certain string related functions in BASIC behave differently when handling one-byte characters and two-byte characters. Globalized BASIC does *not* change any of the previously existing definitions for one-byte characters—it is backward compatible. However, two-byte characters must sometimes be treated specially.

Function	Comments
&	Concatenates two strings. The strings may contain any combination of one- and two-byte characters.
CHR\$	Converts a numeric value to one byte of a character. Two-byte characters must be constructed byte by byte. For example, the two-byte Roman letter A is CHR\$(130)&CHR\$(96) (using (HP-15) Japanese).
DVAL	Converts strings representing hexadecimal, octal, and binary numbers into numeric values. The string digits <i>must</i> be one-byte characters.
DVAL\$	Converts numeric values to into strings representing hexadecimal, octal, or binary numbers. The digits in the resulting string are one-byte characters.
IVAL	Converts strings representing hexadecimal, octal, and binary numbers into INTEGER values. The string digits <i>must</i> be one-byte characters.
IVAL\$	Converts INTEGER values to into strings representing hexadecimal, octal, or binary numbers. The digits in the resulting string are one-byte characters.
LEN	Returns the number of <i>bytes</i> in a string. The string may contain any combination of one- and two-byte characters.
LEXICAL ORDER IS	Determines the collating sequence used in string comparisons. Valid only for one-byte characters.
LWC\$	Returns the lower case value of a string. Only one-byte characters are converted to lower case; two-byte characters are returned unchanged.

MAXLEN	Returns the maximum (dimensioned) length of a string in bytes.
NUM	Returns the decimal value of the first <i>byte</i> of a string. The string may contain any combination of one- and two-byte characters. You must use substrings to identify each byte of a two-byte character.
POS	Returns the <i>byte</i> position of a substring within a string. Either string may contain any combination of one- and two-byte characters.
REV\$	Reverses the order of the characters in a string expression. The operation is performed character by character on any combination of one- and two-byte characters.
RPT\$	Repeats the characters in a string a specified number of times. The repeated string may contain any combination of one- and two-byte characters.
TRIM\$	Removes leading and trailing <i>one-byte blanks</i> from a string. The string may contain any combination of one- and two-byte characters. Only CHR\$(32) (ASCII space) is trimmed from the string.
UPC\$	Returns the upper case value of a string. Only one-byte characters are converted to upper case; two-byte characters are returned unchanged.
VAL	Converts a string representing a decimal number into a numeric value. The string digits must be one-byte numeric characters.
VAL\$	Converts a numeric value into a string representing a decimal number. The string contains only one-byte numeric characters.

String Comparisons

BASIC can compare strings containing combinations of one- and two-byte characters using the comparison operators. BASIC compares characters byte by byte, without regard to two-byte character boundaries. Note that BASIC does not support LEXICAL ORDER for two-byte characters.

In general, the combined character order is:

(ASCII characters)<(two-byte characters)

Some versions of localized BASIC use a slightly modified combined character order to accommodate local custom. Refer to *Using LanguageX with HP BASIC* for details, where *LanguageX* is a local language, such as Japanese.

Porting and Globalization

This section describes how to move BASIC programs between different versions of BASIC. Specifically, this section describes how using two-byte characters affects portability.

Understanding Porting and Localization

To accurately discuss portability, we must first define porting and portability in the context of localized BASIC. There are different cases to consider:

Application Type	Description
Globalized Application	A BASIC program designed to run on a variety of different localized BASIC systems. In the general case, one or more local languages may use one-byte characters and one or more may use two-byte characters. Writing globalized applications is relatively complex; only general guidelines are presented here.
Localized Application	A single BASIC program designed to work with only one specific localized version of BASIC. This is the most common case. This section describes common problems when porting from one-byte BASIC to localized two-byte BASIC.

Cross-Reference to Portability Guidelines

Application	Portability Guidelines
Globalized Application	A B C D E F G H I J
Localized Application porting a one-byte language to a two-byte language	A B C D E F G H I
Localized Application porting a two-byte language to a one-byte language	A
Localized Application porting a two-byte language to a two-byte language	A B C D E F G H I

Globalization Portability Guidelines

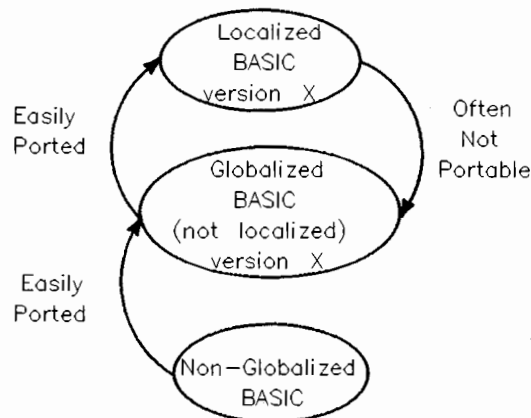
Code	Guideline
A	Use two-byte display enhancement characters and eliminate one-byte display enhancement characters. Refer to the preceding section "Display Enhancement Characters."
B	Avoid using two-byte characters, except when they are visible to the operator. For example, do not use two-byte labels or variable names.
C	Use one-byte characters for file names and eliminate two-byte characters. Avoid special characters; use letters, numbers, and the underscore character.
D	Determine the number of rows and columns on the display inside your program. In particular, note that two-byte characters are twice as wide as one-byte characters. Refer to the preceding sections "Character Size" and "Determining Display Size" for more information.
E	Avoid changing strings once they are input or defined. You must use FBYTE and SBYTE to determine the byte length of each character in a string if it contains a mixture of one- and two-byte characters. For more information on FBYTE and SBYTE, refer to the preceding section "New Keywords" and the <i>HP BASIC Language Reference</i> .
F	Use only one-byte characters as punctuation characters in BASIC statements and as data separators. For example, commas, semicolons, and quotes must be one-byte characters.
G	If you use two-byte characters in your program, you must load the proper CRTD, LANGUAGE, FONT, and INPUT binaries. Certain keywords and CONTROL/STATUS registers are not recognized until these binaries are loaded. Refer to the appropriate keyword or register entries in the <i>HP BASIC Language Reference</i> .
H	Use string functions with two-byte characters very carefully. Some string functions do not allow two-byte characters or ignore them. Other string functions treat two-byte characters byte by byte instead of character by character. Refer to the previous section "Changes in String Functions" for details.
I	Use only one-byte characters for numeric input. Use one-byte numeric characters, decimal points, plus and minus signs, and E.
J	Store message text containing two-byte characters in language specific subprograms or text files.

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Special Cases

It is important to note that if a program runs properly on a non-localized BASIC system, it will run on an equivalent localized BASIC system with very little modification. The only change required is the use of two-byte display enhancements characters. The localized and non-localized systems must be of a compatible BASIC software revision.

Conversely, a program that runs on a localized BASIC system and uses two-byte characters generally will *not* run on a non-localized system.



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Printed in U.S.A. E1293



98616-90206