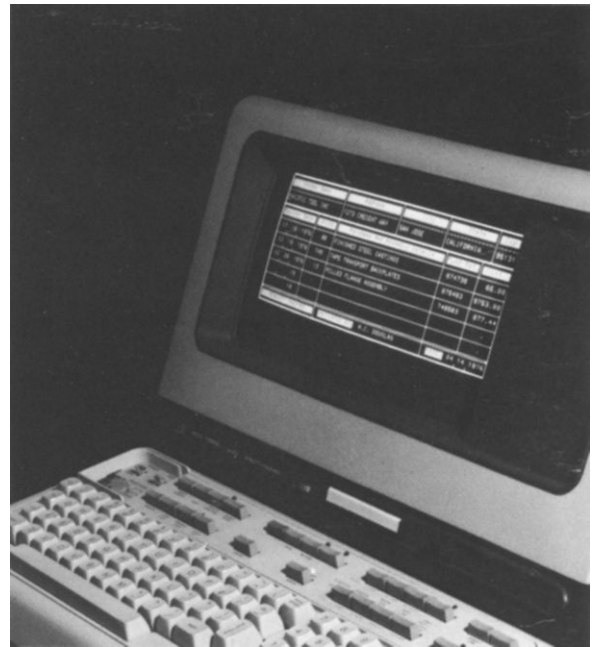


# RTE-IV

## Debug Subroutine

### Reference Manual





# **RTE-IV Debug Subroutine Reference Manual**



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## NOTICE

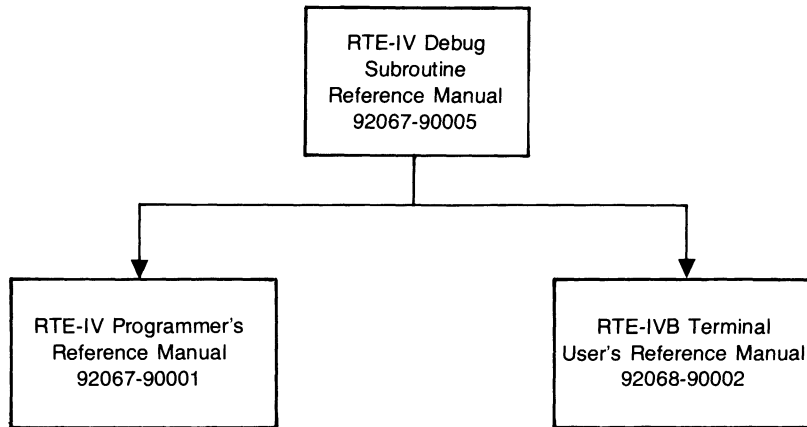
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## DOCUMENTATION MAP



See the *RTE-IV Programmer's Reference Manual* and *RTE-IVB Terminal User's Reference Manual* for complete documentation maps.



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DBUGR is a utility program for debugging programs run on HP 1000 series computers. It features:

- \* Symbolic or octal printout
- \* Symbol definition
- \* Register examination and change
- \* Paper tape loading and verification
- \* Memory search
- \* Memory clear
- \* Breakpoints
- \* Map examination.

## 1-1. OPERATING ENVIRONMENT

DBUGR runs on any HP 1000 series computer equipped with DMS and teleprinter (or CRT) running the RTE-IV operating system. DBUGR itself is approximately 3.6K words in length including symbol table and excluding the breakpoint table. The user symbol table space is fixed at 50 locations in length. Two locations are required for symbols of one or two characters, while three locations are required for symbols of three to six characters. The breakpoint table, which uses 50 words of memory, consists of 10 breakpoints of 5 words each.

Paper tape operations are configured to dump to LU4 and read from LU5.

## 1-2. LOADING AND USING DBUGR

To use DBUGR it must be relocated with the program to be debugged. This may be done in one of two ways. The first is to use the DB format in the loader. LOADR will set the primary entry point of the program to DBUGR and save the program's actual start address in DBUGR. For example:

```
*RU,LOADR,,%PROG,,DB
```

Note that this is the only way that segment breakpoint can be utilized.

## Introduction

The second method is for the program to call DBUGR directly by the following calling sequence:

Assembly	Fortran
EXT DBUGR	CALL DBUGR(lu#-optional
JSB DBUGR	parameter)
DEF RTN	
DEF lu# of console (optional)	
RTN EQU *	

When the user's program begins execution, DBUGR takes control and prints START DBUGR on the optional console logical unit or, if not included, on the logical unit passed to DBUGR through the system subroutine LOGLU. At this point the user can initiate a debug operation. All debug operations are conducted at the Assembly Language level. A load map of the program is essential. If debugging a program written in a higher level language, a mixed listing of source and assembly is required.

DBUGR has 10 breakpoints available which reside in a relocatable module named %SGBPT. If the user desires to change the number of available breakpoints, the user may write his own SGBPT module and load the new code in place of the system library routine SGBPT. This can be done by using the loader LI,%SGBPT command to search %SGBPT file before the system library.

The routine looks like:

```
ASMB,R,Q
    ENT SGBPT,SGBPE
SGBPT DEF *+1      start of table points
    REP 10         determines number of breakpoints (10)
    OCT 0,0,0,0,0
SGBPE DEF *        end of table pointer
    END
```

### 1-3. ELEMENTS OF DBUGR AND TEXT CONVENTIONS

Input to DBUGR consists of controls and expressions.

#### 1-4. CONTROLS

Controls, consisting of special characters and letters preceded with escape or ALTMODE, act as directives to DBUGR. In the text that follows, escape will be denoted by \, carriage return by CR, control by CTRL, tab by TAB and line feed by LF. (CTRL-J is optional LF on 264x terminals.) Escape prints as a backslash (\) on a TTY or CRT. Some controls are:

```

/
!
\S
=
+

```

For multipoint terminals or terminals using driver DVR07, refer to Appendix D.

#### NOTE

Some terminals do not print the first backslash after an escape (e.g., the 2640). The control "\U" will cause DBUGR to print two backslashes for each escape.

### 1-5. EXPRESSIONS

An expression, which will be denoted in the text by the letter n, consists of one or more terms, combined by operators as in the following:

AA+10

### 1-6. TERMS

A term may be a symbol (denoted in the text by the letter s), a number, or a special notation called a mark. The following are terms:

BB A symbol is defined as a letter or a period followed by any number of letters, digits or periods. Only the first six characters are significant. For example:

ABC	A5	.B
A.ZZZZZ	.4	...

Each symbol may be assigned a value. The symbol and its value are equated by entries in the DBUGR symbol table. Values for symbols lie in the range of -32768 through 32767.

3775 An octal number.

386. A decimal number. The decimal point is used to characterize the number as decimal rather than octal. A decimal point in a number other than as the last character is not meaningful.

. and \* Period and Asterisk are marks. When used as terms in an expression their value is equal to that of the current value of DBUGR's location counter.

## Introduction

\Q Esc-Q is a mark. It refers to the last quantity typed.

### 1-7. OPERATORS

Legal operators are:

- + Add terms
- Space Add terms (this is manually faster than shifting and depressing the + key.)
- Subtract term
- , Inclusive OR terms (inclusive OR is used to selectively set individual bits within a word).

Operators are discussed in more detail in Appendix A.

### 1-8. CONVENTIONS FOLLOWED IN THE TEXT

1. What you input to DBUGR is underlined.  
---
2. Use of a control that does not cause print-out is denoted by brackets ([]). These will not be underlined.
3. All values referenced in the text are octal unless otherwise noted.
4. Vertical and horizontal spacing shown in the examples is not exactly as it appears on a teletype or CRT printout.

### 1-9. LIMITATIONS

DBUGR reads and interprets each character as it is entered so that many commands may be invoked by a single keystroke. Since one character is read at a time, it is possible for the user to get ahead of DBUGR and get a system prompt. When this happens the user should increase the priority of the program being debugged with the PR command. Alternatively, through use of the \\U command, DBUGR can accept a continuous string or line of characters as would be sent from a 264x terminal by a soft key, cartridge tape unit, or a Multipoint 264x terminal using driver DVR07.

Information can be displayed to us in one of four modes:

1. Symbolic instructions
2. Numeric constants
3. Address pointers
4. ASCII characters

Although a printing mode normally remains in effect until changed, it is possible to either:

- a. momentarily invoke a different mode for the display of only one number, or
- b. temporarily invoke a different mode for a series of examinations until a carriage return is entered.

## 2-1. PRINTOUT AS SYMBOLIC INSTRUCTIONS

DBUGR is in symbolic mode when it is loaded.

In symbolic mode the contents of a memory location are printed as symbolic instructions; the operation codes are represented as mnemonics. The address field of one-word memory reference instructions will be printed as octal numbers with the page number merged with the page offset. Only the first word of multi-word instructions will be interpreted.

## Output Modes

It is important to note that in symbolic mode every location is printed as a symbolic instruction whether that location contains an instruction, data or an address. The bit pattern in memory is simply interpreted as an instruction. For example, the octal value 1767 would appear in memory as:

```
bit 15                6                0
+-----+-----+
| 0 0 0 0 0 1 0 0 1 1   1 1 1 0 0 0 |
+-----+-----+
```

Notice that bits 6 through 15 correspond to the bit pattern for the ALF instruction. The lower 6 bits are similarly treated as instructions. The printout appears as:

```
ALF,CLE,ALF
```

Also notice that not all shift rotate instructions are defined. In those cases DBUGR will print the valid opcodes merged with the remaining bits. For example, the octal value 1747 will be printed as ALF,CLE,7.

DBUGR's symbol table does not contain instructions referencing the overflow register, therefore overflow instructions will be printed as I/O instructions with a select code of 1.

The operand field for I/O and double shift instructions will be printed correctly except when the operand is zero, in which case a blank is printed instead of a zero. Therefore STF 0 will be printed as STF, and RRL 16 (actual operand is 0) will be printed as RRL.

"I" and "C" are special symbols in DBUGR's symbol table with the octal values of 100000 and 1000 respectively. Therefore 100000 and 1000 will be reverse assembled as I and C.

From this discussion, it is obvious that we must know whether we are looking at data or instructions. It is also obvious that it is desirable to be able to print data or address words as octal numbers. DBUGR provides this capability.

## 2-2. PRINTOUT AS NUMERIC CONSTANTS

We can either momentarily change the printing mode to octal so the last item printed will be reprinted as octal, with subsequent printouts continuing in the master mode; or we can change the master mode to octal so that all subsequent printouts will be in octal.



Conversely, if we change the master mode to octal, we have the capability of momentarily switching back to symbolic; it works both ways. The examples below demonstrate printing modes. In these examples the following controls are used:

- n/      Prints the contents of memory location n. These contents can be modified at this point, but that is discussed later.
- \C      Set master print mode to numeric constant. Remember, C means constant.
- =        Print the last quantity (typed by either us or DBUGR) as a numeric constant. This is a momentary mode change.
- \=      Same as =, except constant mode remains in effect until a carriage return. This is a temporary mode change.
- \S      Set master print mode to symbolic instruction. Remember, S means symbolic.
- !        Print the last quantity typed as a symbolic instruction. This is a momentary mode change.
- \!      Same as !, except symbolic mode remains in effect until a carriage return. This is a temporary mode change.

### 2-3. CHANGING THE RADIX OF NUMERIC PRINTOUT

An interesting feature of DBUGR is that the numeric output (in any mode) does not have to be octal. The radix of output values can be from 2 to 33. Thus, it is possible to print data as a decimal value or examine memory in hexadecimal. If the radix is decimal, numbers are followed by a period. You can change the output radix by using the control. DBUGR interprets all values as 16-bit unsigned numbers, regardless of radix.

- n\R     where n can be any decimal value from 2 to 33 (or octal value from 2 to 41. Remember, R means radix.

## Output Modes

For example:

```
2420/  ADA 2745  \C [LF]          Select numeric constant
-----  --
2421/  3004 2\R  [LF]          Select binary output
          ---
10100010010/ 10000010000 10\R [CR]  Select octal output*
          -----
\S  [LF]          Select symbolic master
--
2423/  JMP 2714,I  [LF]
2424/  SZA  [LF]
2425/  JMP 2714,I  2\R  [LF]      Select binary output
          ---
.
.
.
.
```

\*The radix could have been specified in decimal as 8.\R.

```
10100010110/ JMP 10111001101,I 20\R [CR] Select hexadecimal output
          -----
\S [LF]          Select symbolic master
--
517/  JSB 331,I [LF]
518/  CLA,SSA,SLA,SZA  \C [LF]      Select constant master
          --
519/  51A  [LF]
51A/  9B3E 10\R  [CR]          Select octal output
          -----
2471/  3004 10.\R [LF]          Select decimal output
-----
1338./ 1040.  [LF]
1339./  44464. [LF]
1340./ 1026.  [LF]
```

## 2-4. ALPHANUMERIC (ASCII) PRINTOUT

It may be necessary to examine alphanumeric information. If so, DBUGR allows us to change the printing mode so that the contents of each memory location are printed as two ASCII characters. In this mode DBUGR will interpret the 16 bits as two 8-bit ASCII codes, whether the memory location contains data, an instruction, or an address. The controls are:

- \H      Sets master printing mode to ASCII characters.
- '       Prints the last quantity typed as two ASCII characters. Then prints a double quote.
- \'      Same as ', except ASCII mode remains in effect until a carriage return.

Study the following example carefully:

```

2514/ 115762                    \H [LF] Select ASCII printout
-----                         .--
2515/PV"=50126                 ' PV" [LF]
                                 -
2516/NE"=47105                 ' NE" [LF]
                                 -
2517/@."=40056                 ' @." [LF]
                                 -
2520/-"=2655                   ' -" [LF]
                                 -
2521/*"=115452                 ' *" [LF]
                                 -
2522/S"=2523                   ' S" [LF]
                                 -
2523/-0"=126660               ' -0" [LF]
                                 -
2524/ >"=115476               ' >" [LF]
                                 -
2525/+0"=25460                 ' +0" [LF]
                                 -
.
.
.
2532/-"=2655                   ' -" [LF]
                                 -
2533/ " =12                    ' " [LF]
                                 -
2534/ " =5                     ' " [LF]
                                 -
2535/ *"=115452               ' *" [CR]
                                 -

```

## Output Modes

From an examination of the octal equivalents of the printed characters, several observations can be made:

1. A character will be printed only if the upper and/or lower 8 bits of a word contain bit patterns that represent legitimate ASCII characters.
2. If either 8-bit field does not represent an ASCII character, it is not printed. There is no way to determine whether a single printed character fell in the upper or lower half of the word without looking at the octal equivalent. At location 2522 above, only the lower half of the word converts to the character S.
3. If neither half word contains an ASCII code, but does contain binary information, nothing is printed (location 2534 above). If a non-printing ASCII character is encountered, DBUGR performs the function that ASCII code represents. For example, encountering a 007 causes the bell to sound, and encountering a 012 causes a line-feed.

## 2-5. ADDRESS POINTERS

There is one more printing mode, It allows DBUGR to print a 16-bit memory location as an address pointer. Keep in mind that in HP 1000 computer programming, many words are set up to contain a full 15-bit address plus a bit to indicate direct or indirect use of that address. In the following code:

```

          3000          LDA          POINT,I
          .
          .
          .
          3010 POINT    DEF          DATA
          .
          .
          .
          7000 DATA    BSS          1000

```

the DEF pseudo operation generates a full 15-bit address at location 3010. The address generated is that of the symbol DATA; i.e., 7000, and this address is used as a pointer by instructions such as the LDA at 3000 to access the data stored at DATA. The contents of location 3010 look like:

```

bit 15
+-----+
|0 0 0 0 1 1 1 0 0 0 0 0 0 0 0| =7000
+-----+
                                     8

```

Memory locations containing address words can easily be examined in numeric constant mode. In fact, if we switch to the printing mode that allows us to print the contents of memory locations as addresses, there appears to be no difference in output. The example below demonstrates the apparent identity. The control <- (left arrow or underline on some CRTs) is used to print the last quantity typed in address pointer mode.

```

\C      [CR]
--
1510/  60247  <- 60247  [LF]
-----
1511/  3004   <- 3004   [LF]
--
1512/ 102000 <- 2000,I  [LF]
--

```

The two modes return almost identical results! What then is the use of address pointer mode?

Printing in address pointer mode is useful only in conjunction with another feature of DBUGR; i.e., the capability of associating symbols with numeric addresses.

## 2-6. DEFINING SYMBOLIC ADDRESSES IN DBUGR

Remember that when a program is in memory for execution, all symbols associated with program locations at assembly time have been converted to absolute addresses; they are gone! As DBUGR maintains its own symbol table, we can associate arbitrary symbols with specific locations. This is useful because we may wish to see locations and address references printed as symbols rather than words.

Before we see how symbols are manipulated, it is necessary to learn how DBUGR sequences through a program. For example, to begin debugging at location 2500, we would type:

```
2500/  
-----
```

DBUGR will respond by typing the contents of location 2500 (assume we are in numeric constant print mode). The output would look like:

```
2500/ 171572  
-----
```

If we strike LF or CTRL-J on a 264x, the next sequential location in memory is displayed:

```
2500/ 171572 [LF]  
-----  
2501/      723 [LF]  
2502/      5241
```

Although it was not explicitly mentioned, in all previous examples advancing to the next line of print was accomplished by LF.

Obviously, DBUGR maintains a location counter similar to the P-register of the computer, and LF is the control for sequentially examining memory. Later we will see that the contents of the memory location just printed can be changed before executing the LF.

If we wish to associate a symbol with the address 2500, we can type the following:

```
n<s: where n is an expression resulting in a 16-bit value and s  
      is a symbol. The symbol is then said to be defined.
```

Thus, "less than" (<) is a control to designate a value, and "colon" (:) is a control to define a symbol.

```
2500<SYM:
```

will associate the symbol SYM with the address 2500.

In the following example, notice how symbols replace numeric notation after location 2500. Assume we are in numeric constant mode, and SYM has been defined as above.

```

2476/ 126720 [LF]
-----
2477/ 115476 [LF]
SYM/ 2734 [LF]
SYM+1/ 115471 [LF]
SYM+2/ 25460 [LF]
SYM+3/ 126666 [LF]
.
.
.
.
.
.

```

A strange thing happens after location SYM+10:

```

SYM+10/ 165715 [LF]
2511/ 7004 [LF]
2512/ 77113

```

Addresses are associated relative to a particular symbol for 10 octal locations. If we wish to continue using symbolic addressing, we have to define another symbol:

```

SYM+130/ 165715 [LF]
-----
2631/ 7004 [CR]
2631/ SYM2: [LF]
-----
SYM2+1/ 77113

```

Notice the use of CR above. Unlike LF it only returns us to the next print line; the location counter does not change. Actually it is generally not necessary to strike a CR before typing a new address or using a new control. You can continue on the same line.

The exception to the 10 rule above is for symbols of one or two characters. For these symbols, the numeric offset has no limit. Thus:

```

2631<S: [CR]
-----
S+5000/ 7004 [LF]
-----
S+5001/ 165715 [LF]
.
.
.

```

## Output Modes

This mode is useful with relocatable code where we might define a symbol for the origin of each module. The offsets would then be the same as those printed on the assembly listings.

Another form of symbol definition that would have been more efficient at location 2631 above is illustrated below:

```

SYM+130/ 165715 [LF]
-----
2631/    7004  SYM2: [LF]
                -----
SYM2+1/   77113
    
```

When no value is explicitly designated for a symbol definition, the current value of the location counter is used.

Now let us look more closely at the printout in symbolic instruction mode (Column A of Figure 2-1). Notice that we may specify the address at which to begin printing by using its symbolic form:

	A	B	C
	SYMBOLIC INSTRUCTION	ADDRESS POINTER	OCTAL CONSTANT
	SYM+1/ JSB 1471,I	<-15471,I	=115471
	-----	--	-
	SYM+2/ JMP 1460	<-25460	=25460
		--	-
	SYM+3/ JMP SY+35,I	<-26666,I	=126666
		--	-
	SYM+4/ JSB 1454,I	<-15454,I	=115454
		--	-
	SYM+5/ CLA,CLE,INA,SZA,RSS	<-SYM+7	=2507
		--	-
	SYM+6/ CLE,SEZ,SSA	<-2120	=2120
		--	-
	SYM+7/ JMP 2716,I	<-26716,I	=126716
		--	-
	SYM+10/ JSB 1453,I	<-15453,I	=115453
		--	-
	SYM+11/ CLA,CLE,SSA,SZA,RSS	<-SY+13	=2513
		--	-
	SYM+12/ CLE,SEZ,SSA	<-2120	=2120
		--	-
	SYM+13/ JMP 2716,I	<-26716,I	=126716
		--	-
	SYM+14/ JSB 1762,I	<-15762,I	=115762
		--	-
	SYM+15/ CLA,CLE,SSA,RSS	<-SY+21	=2521
		--	-
	SYM+16/ 2746	<-SY+115	=2746
		--	-

Figure 2-1. COMPARISON OF SYMBOLIC, ADDRESS POINTER, AND OCTAL PRINTOUT



Notice that not only are the locations printed in symbolic form, but some addresses referenced by memory reference instructions also appear using the offset limits; i.e., 10 for multicharacter symbols or no limit (but >0) for one or two character symbols.

Referring to the octal printout in Column C, notice that the entire word is printed as an octal constant, even if that constant represents an address that can be represented symbolically, as at location SYM+7.

In symbolic instruction mode, symbolic addresses appear only if that word is a one-word memory reference instruction. Address pointers will not be printed symbolically. They will appear either as octal constants, as locations SYM+16 or as meaningless instructions as at location SYM+11.

A glance at Column B in Figure 2-1 immediately reveals that address pointer mode is the only mode that will print 15-bit addresses in symbolic form. Notice that the control <- is used to momentarily invoke address pointer mode. To set the master printing mode to address pointer, use the control:

\A Sets the master printing mode to address pointer.  
Remember A means address.

The control \ <- can be used to temporarily invoke address pointer mode until a carriage return is executed.

## 2-7. DELETING SYMBOLS FROM THE SYMBOL TABLE

Using the control \K will kill all symbol definitions that we have defined. Symbols defined by DBUGR remain. Remember K means kill.

### CAUTION

Do not use the following to define address labels:

1. Instruction mnemonics; if a symbol is redefined, the original value is lost.
2. The letters C and I; these are defined as 1000 and 100000 octal, respectively.
3. Special Register Symbols.

## Output Modes

### 2-8. ASSIGNING A SYMBOL TO AN ADDRESS JUST PRINTED BY DBUGR

In addition to being able to define a symbol equal in value to a specific address or to the current value of the location counter, we can equate a symbol equal in value to an address just printed by DBUGR:

s& Defines symbol s equal in value to the address of the last quantity typed, if an instruction.

For example:

```
1476/ JMP 305 XFER& [CR]
-----
305/   SLA+17          [CR]   The symbol XFER is defined
-----                          as location 305
XFER/  SLA+17          [LF]
-----
XFER+1/ SLA+20
```

### 2-9. HOW TO PRINT THE LAST QUANTITY TYPED IN MASTER MODE IF YOU HAVE JUST CHANGED MODES

; Prints last quantity typed in master mode.

For example:

```
1700/ HLT 77 =102077 ;HLT 77 [CR]
-----
1777/ 40502 'AB" ;40502
-----
```

# MEMORY EXAMINATION AND MODIFICATION

SECTION

III

## 3-1. CONTROLS TO EXAMINE MEMORY ONLY — LOCATION COUNTER DOES NOT CHANGE

We have already used two controls to examine memory locations:

- n/ To open and print the contents of location n.
- LF To open and print the contents of the next sequential location.

Actually these controls do more than print the contents of the memory location; they "open" the location for possible modification. Before we explore that possibility, let us look at some other controls for examining memory:

- / Opens and prints the contents of the location pointed to by the last quantity typed. The quantity typed is used as a 15-bit address, regardless of the printing mode.

For example:

```
2007/ 20602 / 67 [LF]  Opens and prints contents  
----- -           of 20602  
  
2010/ 30501 / 115723  Opens and prints contents  
- - - - - -           of 30501
```

Notice that DBUGR's location counter does not change. We can continue sequential examination of memory simply by using LF.

- ∨ Opens and prints the contents of the location pointed to by the last quantity typed. Unlike /, the last quantity typed is interpreted as a memory reference instruction and only the 11-bit address field is used as the effective address. The location counter does not change.
- \L Prints the contents of the next 16 sequential locations; the last printed location is left open.
- n\L Same as the \L, the quantity n replacing 16 as the number of locations listed.

## MEMORY EXAMINATION AND MODIFICATION

For example:

```
5010/   ELA   5\L
-----
5011/   ADA 2042
5012/   CMA,INA
5013/   SSA,RSS
5014/   JMP 3066
5015/   JSB 2076
```

### 3-2. CONTROLS THAT EXAMINE MEMORY AND SET THE LOCATION COUNTER TO A REMOTE ADDRESS

The following two controls are similar to / and \/, but notice that the location counter is set to the address of the memory location being examined.

**CTRL-I (TAB)**            Opens and prints the contents of the location pointed to by the last quantity typed. This quantity is used as a 15-bit address pointer. DBUGR's location counter is changed to contain this address.

For example:

```
2312/   2031   [CTRL-I]   Location counter
-----
2031/   126313 [CTRL-I]   change to 2031
26313/  43734                      then to 26313
```

**\CTRL-I (\ TAB)**        Same as CTRL-I except that the last quantity typed is interpreted as an instruction and only the 11-bit address field is used as the pointer.

For example:

```
5002/   JMP 5007 \ [CTRL-I] Location counter
-----
5007/   SLB+56           Changes to 5007
```

### 3-3. CONTROLS TO CHANGE THE CONTENTS OF MEMORY

To change the contents of a memory location, simply open that location, then type the quantity desired followed by one of the controls discussed below. The quantity you type is designated by n.

3-4. MEMORY CHANGE CONTROLS THAT MAINTAIN THE LOCATION COUNTER WITHIN THE CURRENT SEQUENCE

nCR n is the quantity that we want stored in the open  
nLF location. The control that follows this quantity  
n^ executes as previously described.

For example:

```
5010/ 1600 7777 [CR] Contents of 5010
-----
*/ 7777          changed to 7777. Verify by
--              re-examining 5010.
```

Note that an asterisk is used to imply an address equal in value to the current value of the location counter. A period can be used in place of an asterisk.

```
5012/ 27006 6655 [LF] Contents of 5012
-----
5013/ 2060  ^          changed to 6655. Verify
-
5012/ 6655          [CR] by sequencing backward.
5012/ 6655 44444 ^      Contents of 5012 changed
----- -
5011/ 7777 [LF]        to octal 44444. Verify
5012/ 44444          by sequencing forward.
```

IMPORTANT: The use of CR will close the currently open memory register!

For example:

```
5010/ 1600 7777 [CR] Contents of 5010 becomes
-----
3333 [CR]          7777. Attempt to change
-----
*/ 7777          again, but 5010 still con-
--              tains 7777.
```

NOTE: Note that a period is used above to refer to an address equal in value to the current value of the location counter.

DBUGR provides a control for storing one or two ASCII characters in a word. It has the form s" where s is a symbol.

## MEMORY EXAMINATION AND MODIFICATION

Type the ASCII input and the quote followed by any of the memory change controls discussed above:

```
1700/ 20532 AB" [CR]
-----
*/ 40502 'AB"
--
```

Only letters, digits, or the period, may be used; blanks and special characters are illegal.

The next two controls allow us to store a new address in an open memory location and then open and examine the contents of the location pointed to by that address.

`n%` Stores the quantity `n` in the currently open memory location; then opens and prints the contents of the location pointed to by `n`. `N` is used as a 15-bit address pointer. The location counter does not change.

Notice that this control is similar to `/` with the added capability of changing the currently open memory location.

For example:

```
5011/ 7777 55% 102055 [CR]
-----
```

The contents of 5011 are changed to contain the quantity 55; then location 55 is opened and its contents are printed.

`n\%` Same as `n%` except that `n` is interpreted as an instruction, and only the 11-bit address field is used as a pointer to the location to be opened and printed.

For example:

```
4011/ ADB 215 ADB 312\% 4445 [CR]
-----
312/ 4445 [CR]
-----
4001/ ADB 312
-----
```

The contents of 4001 are changed to point to location 312. Location 312 is then opened and its contents printed. It is then opened again for comparison. Notice that we reprint location 4001 to verify the change.

### 3-5. MEMORY CHANGE CONTROLS THAT CHANGE THE LOCATION COUNTER TO A REMOTE SEQUENCE OF CODE

The following controls allow us to store a new address in the currently opened location and then open, print and set the location counter to the address into which we have just stored.

nCTRL-I Stores n in the currently open register and then opens and prints the contents of the location pointed to by n. Remember that the quantity is interpreted as a 15-bit address. The location counter is set to this address.

For example:

```
337/ STB 1772,I / ALF+73 =1773 1660 [CTRL-I]
---- -
1660/ ISZ 126 =34126 [CR]
-
1772/ ELA+60 =1660
----- -
```

Location 337 contains an indirect reference to location 1772, which contains 1773. Before 1660 CTRL-I is typed, location 1772 is the open location. Typing 1660 CTRL-I changes the contents of 1772 to the value 1660 and then opens and prints the contents of location 1660, with the location counter set to this address.

n\CTRL-I Same as nCTRL-I except that n is interpreted as an instruction.

For example:

```
330/ JMP 461 JMP 500 \[CTRL-I]
---- -
500/ JMP 207,I [CR]
330/ JMP 500
-----
```

Location 330 originally contains a JMP 461. This is changed to a JMP 500, and location 500 is opened, printed and the location counter is set to location 500.

This control is excellent for making in-core patches. For example, suppose it is necessary to insert instructions between locations 3737 and 3740:

```
3737/ ADA 200
3740/ SSA
```

The inserted code must be stored at locations remote from the in-line code, therefore, we must jump to the added instructions from location 3737 and return to location 3740.

## MEMORY EXAMINATION AND MODIFICATION

Assuming that memory is available at location 3745, we can use DBUGR as follows:

```
3737/  ADA 200 JSB 3745 \[CTRL-I]
-----
3745/  0 [LF]
3746/  0 ADA 200 [LF]
      --- ---
3747/  Inserted code
      :
      :
      :
37xx/  0 JMP 3745,I
      -----
```

Note that the ADA 200 was moved to the beginning of the inserted code to make room for the JSB instruction.

## 3-6. SPECIAL REGISTER MODIFICATION AND EXAMINATION

To examine user or system maps, modify or examine O-, E-, X-, Y-registers, or examine the DMS status as of the last breakpoint, special modes are required.

## 3-7. SPECIAL REGISTERS

\M [CR] will cause the following two lines to be displayed:

```
AREG BREG XREG YREG EOREG MASK (CBVAL-CBADDR,I) CBMASK = CBTEST
11 237 11376 5775 2 177777 7 22042 177777 SZA
```

```
AREG    A-register
BREG    B-register
XREG    X-register
YREG    Y-register
EOREG   E-, O-registers in bits 1 and 0 respectively
MASK    Search Mask
CBVAL   Conditional Breakpoint Value
CBADDR  Conditional Breakpoint Address
CBMASK  Conditional Breakpoint Mask
CBTEST  Conditional Breakpoint Test Instruction
```

The special registers are accessible by the symbol names given above, the same way user defined symbols may be accessed. The EOREG holds the extended bit status in bit 1, and the overflow bit status in bit 0. For example, EOREG = 3 means extend and overflow are set. EOREG = 1 means extend register clear and overflow register set.



Two other symbols available to the user are:

WRTLW The EXEC control word of the device for DBUGR output.  
(Refer to the RTE-IV or RTE-IVB Programmer's Reference Manual regarding EXEC calls.)

BRFLG 0 means check for break in debug loops  
1 means no check will be made for break  
(speeds up loop processing)

### 3-8. MEM STATUS SPECIAL MODE

The following special mode displays the MEM status.

\? displays the MEM status as of the last breakpoint in the following format:

MS = X15 X14 X13 X12 X11 X10 YYYY

where X15, X14, X13, X12, X11 and X10 = MEM status register bits 15, 14, 13, 12, 11, and 10 respectively. YYYY is the four digit octal number representing the base page fence.

### 3-9. MAP EXAMINATION SPECIAL MODE

The following special mode allows examination of the system and user maps and cross load.

\J puts DBUGR into this special mode and responds with a CR LF and three spaces.

UM Displays the user map.

SM Displays the system map.

XL Sets up this special mode to cross load from an address in the alternate map.

PA Displays the port A maps.

PB Displays the port B maps.

A Aborts the special mode with no change.

MEMORY EXAMINATION AND MODIFICATION

UM:

--

0 = MR0	20 = MR20
1 = MR1	21 = MR21
2 = MR2	22 = MR22
3 = MR3	23 = MR23
4 = MR4	24 = MR24
5 = MR5	25 = MR25
6 = MR6	26 = MR26
7 = MR7	27 = MR27
10 = MR10	30 = MR30
11 = MR11	31 = MR31
12 = MR12	32 = MR32
13 = MR13	33 = MR33
14 = MR14	34 = MR34
15 = MR15	35 = MR35
16 = MR16	36 = MR36
17 = MR17	37 = MR37

The system map registers routine operates the same as the user map registers routine except "UM" is replaced by "SM".

The cross load routine begins by outputting a CR, LF and six spaces with XL followed by three more spaces. The operator then enters an address and a slash to display the contents of that address in the alternate map. DBUGR will return to allow additional cross loads.

For example:

XL

--

XL ADDRESS/ (old contents)

-----

XL

An LF will also increment the address counter as in the case of examining memory locations.

### 3-10. CONTROLS TO TEMPORARILY CHANGE THE PRINT MODE OVER A SERIES OF EXAMINATIONS

There are several controls that we can use in place of `n/` and `n\/ (refer to paragraph 3-1). As with \!, \=, \' and \<- they temporarily change the print mode until we execute a carriage return, thereby returning to master mode. However, unlike \!, \=, \' and \<-, they open and print the contents of a register.`

- `n$` Same as `n/` but sets temporary print mode to symbolic instruction.
- `n#` Same as `n/` but sets temporary print mode to numeric constant.
- `n@` Same as `n/` but sets temporary print mode to address pointer.
- `n)` Same as `n/` but sets temporary print mode to ASCII.
- `n\$` Same as `n\/` but sets temporary print mode to symbolic instruction.
- `n\#` Same as `n\/` but sets temporary print mode to numeric constant.
- `n\@` Same as `n\/` but sets temporary print mode to address pointer.

These controls can be used without a preceding address expression (`n`), in which case they can be used in place of `/` and `\/`. However, the mode change will be momentary only. Below are given two examples.

MEMORY EXAMINATION AND MODIFICATION

Example #1:

```

\C                                     Begin in constant mode
--
2537/  421  [CR]
-----
2540$  LDA  2534,I  / LDA  62572 / 234 [LF]  Change to symbolic
-----                                     temporary mode
2541/  ADA  2740    [LF]
2542/  SSA                                     [LF]
2543/  JMP  2657    [LF]
2544/  CLA                                     [LF]
2545/  STA  2663    [LF]
2546/  LDB  2661    [LF]
2547/  STB  2662    [CR]                                     Return to constant mode
[LF]
2550/                                     125503 [LF]
2551/                                     46664  [LF]
2552/                                     6020   [CR]
4000$                                     SZA    [LF]                                     Change to symbolic
-----                                     temporary mode
4001/  JMP  4016    [LF]
4002/  LDA  1717    [LF]
4003/  STA  5235  / CPA  72525  / JSB  34 [LF]
-----
4004/  STA  5236    [CR]                                     Return to constant mode
[LF]
4005/  53266                                     [LF]
4006/  73237                                     [LF]
4007/  17575                                     [LF]

```

Example #2:

```

\S                                     Begin in symbolic mode
--
4012/  LDB  1717    [LF]
4013/  ADB  5273    [LF]
4014/  CLA                                     [LF]
4015/  STA  1,I     [LF]
4016/  LDA  4103    [LF]
5000#  2003 / 72053 [LF]                                     Change to constant
-----                                     temporary mode
5001/  126775                                     [LF]
5002/  73240                                     [LF]
5003/  12306                                     [LF]
5004/  73242                                     [LF]                                     Return to master mode
5005/  2400                                       [CR]
[LF]
5006/  STA  1,I     [LF]
5007/  LDA  5240    [LF]

```

# CONTROLS TO LOAD, PUNCH AND VERIFY PAPER TAPE

SECTION

IV

## 4-1. PROGRAM LOAD

DBUGR provides a control for loading absolute binary paper tape:

\Y Loads absolute binary paper tape, as prepared by the HP Assembler. Mount tape to be loaded before typing \Y. Remember, Y means yank. Loading will terminate at end of tape, or upon any attempt to load beyond the upper limit. DBUGR will report an error for any attempt to load over itself.

## 4-2. PUNCHING BINARY TAPES AND PRODUCING PATCHES

Memory locations can be changed and punched on paper tape one by one, or blocks of memory can be punched.

As the tape is punched in absolute format readable by HP absolute program loaders, we can use these controls to punch entire programs or binary patches.

n1<n2>\D Punches locations n1 and n2 inclusive

n\D Stores the value n into the open register, if any; then punches the register last opened (with the new contents, if stored).

Let's say we have discovered a bug and must make the following changes:

Location	Instruction	Change
2050	RBR	RAR
2051	SSB	SSA

Using DBUGR in symbolic instruction mode:

```
2050/ RBR RAR \D [LF]
-----
2051/ SSB SSA \D
-----
```

One record is punched for each word.

### 4-3. TAPE VERIFICATION

To verify a tape, we use the following control:

\V Verifies paper tape against memory. Remember V means verify. Mount tape prior to typing \V. Discrepancies are listed as follows:

Address/ [contents of memory] [contents of tape]

If the word on tape is zero, no discrepancy is listed. Verification will terminate at end of tape or upon any attempt to verify beyond the upper limit. DBUGR will report discrepancies within itself.

# MEMORY SEARCH AND CLEAR

SECTION

V

## 5-1. MEMORY SEARCH

We can search memory within specified addresses for words that are either equal or not equal under mask to a specified word.

Actually, memory is searched for a quantity that is equal or not equal to a quantity formed by taking the logical product (AND) between the mask and each memory location examined. This allows us to search for only a specified group of bits within each word.

## 5-2. THE SEARCH MASK

The mask is stored at a location referenced by the symbol "MASK". Initially it is set to 177777. Now let us open and print location MASK:

```
MASK/ 177777      We can now change the mask.  
-----
```

## 5-3. LOGICAL PRODUCT REVIEWED

If we take the logical product between a mask and another word, we end up with a result that saves the original value (either 0 or 1) of all bits in the word masked by 1's and clears or extracts all bits in the word masked by 0's. Suppose we wish to search on the lower eight bits in a word:

```
Mask = 000377 = 0000000011111111  
           8           2  
Word = 073123 = 0111011001010011  
           8           2  
-----  
Logical = 000123 = 0000000001010011  
Product           8           2
```

The result of the operation is to clear out all bits in which we are not interested and to save only the lower eight bits for comparison against some 8-bit value.

## Memory Search and Clear

### 5-4. SEARCH LIMITS

The following controls establish search limits:

n< Sets the lower limit to n.

n> Sets the upper limit to n.

The limiting addresses are included in the search.

### 5-5. EQUALITY SEARCH

n\W Searches within the limits specified for all words equal under mask to n. Remember, W means word.

Example #1: Search within locations 2000 and 3000 inclusive for all halt instructions (1020xx).

```
MASK/ 177777 177700 [LF] Change mask to ignore
-----          bits 0-5
```

```
2000<3000>102000\W
-----
```

```
2234/ 102002
2337/ 102002
2361/ 102011
2572/ 102002
2641/ 102002
2710/ 102002
2743/ 102002
2756/ 102002
```

Example #2: Search within locations 77700 and 77777 inclusive for all halt instructions in the Basic Binary Loader (BBL).

```
MASK/ 177700
-----
77700<77777>102000\W
-----
77715/ 102077
77740/ 102000
77747/ 102011
77751/ 102055
```

### 5-6. INEQUALITY SEARCH

n\N Searches within the limits specified for all words under mask not equal to n. Remember, N means not equal to word.



For example: Print memory within locations 2270 and 2315 inclusive.  
Do not print words equal to zero.

```

MASK/ 177777 [CR]          Verify mask
-----
2270<2315>0\N
-----
2270/ 50262
2271/ 26303
2272/ 26255
2273/ 64124
2274/ 6002
2275/ 26246
2276/ 34242
2277/ 170155
2311/ 70155
2312/ 160156
2313/ 70243
2314/ 30374
2315/ 170574

```

We infer that locations 2300 through 2310 contain zero.

#### 5-7. CLEAR OR SET MEMORY

n\\Z Zero, or set memory within the limits specified to n.  
Remember, Z means zero.

Example #1: Set memory locations 2300 to 2310 inclusive to 177777 (octal); then print these locations to verify the operation.

```

2300<2310>177777\\Z [CR]
-----
2270<2310>177777\W
-----
2300/ 177777
2301/ 177777
2302/ 177777
2303/ 177777
2304/ 177777
2305/ 177777
2306/ 177777
2307/ 177777
2310/ 177777

```

Example #2: Zero locations 2300 to 2310 inclusive.

```

2300<2310>0\\Z
-----

```

### 5-8. EFFECTIVE ADDRESS SEARCH

The effective address is the location an instruction must reference to acquire or store data. Many times in HP1000 programming addresses are referenced indirectly:

```
LDA 1772,I
```

The above instruction must further reference location 1772 to obtain an effective address from which to load the A-register. If the contents of 1772 = 02340, the LDA instruction would acquire data from location 02340.

n\E Finds all instructions within the limits specified that effectively address location n. Indirect chains are followed to a depth of 16. Normally the mask is set to all 1's, but if not, n is treated as specifying a range of addresses, and all instructions effectively referencing addresses within that range are printed. Remember, E means effective address.

Example #1: Find all instructions within 2000 and 3000 inclusive that reference location 70567.

```
MASK/ 177777 [CR]
-----
2000<3000>70567\E
-----

2050/ 165775      2050 references 70567 indirectly
                    through 1775.

1775/ 70567       Print location 1775 to verify
                    operation.
```

Example #2: Find all instructions within 2000 and 3000 inclusive that effectively address any location in the range 4060 to 4067.

```
MASK/ 177777      177770      [CR]
-----          -
2000<3000>4065\E
-----

2500/  JMP      1500,I  All instructions indirectly
2550/  JMP      1503,I  reference locations in the
2600/  ADA      1503,I  range 4060 to 4067.
2700/  JMP      1503,I
\C
--
1500/  4060      [LF]   Verify by printing the
-----          contents of the pointers.
1501/  4062      [CR]
1503/  4065
-----
```

## Memory Search and Clear

Note the effect of the mask. By placing a 0 as the lowest octal digit of the mask, no specific address is specified for this digit position, therefore the entire range of addresses from 4060 to 4067 is processed.



# BREAKPOINT/TRACE DEBUGGING

SECTION

VI

## 6-1. INTRODUCTION

Breakpoint trace debugging is simply a matter of forcing the computer to halt at a particular point in its program execution so we can look at what is happening. We can examine operational registers, dump memory and make memory patches. Of course, we must have a means of resuming execution after a breakpoint and the ability to control the number of times we actually break within a programmed loop.

Combining memory examination and change controls, search and print controls, and binary patching with the breakpoint trace capability makes DBUGR the powerful tool that it is.

To aid in the tracing operations of a program, a breakpoint may be set at most instructions. When control reaches that instruction, it is not immediately executed; DBUGR gains control and prints out the following:

ADDRESS(INSTRUCTION)    A    B    EO STATUS

1. Program location counter (P-register) (in address mode)
2. The "broken" instruction (in instruction mode)
3. Contents of the A- and B-registers (starts in constant mode may be changed - see Section 3-7)
4. As one word the extend and overflow registers (in constant mode - see Section 3-7).

Segment breakpoints exist for segmented programs with DBUGR appended to them by the RTE-IV loader. Breakpoints may be set in four different modes:

1. ["A]\B            Break at entry to ALL segments
2. ["N]\B            Break at entry to NO segments
3. [xxxxx]\B        Break at entry to a specific segment
4. n[xxxxx]\B       Break at a defined address within a specified segment.

## Breakpoint/trace debugging

A breakpoint will be set when the specified segment is loaded into memory. Thereafter, breakpoints remain in effect until a new segment is loaded. At that time breakpoints associated with the newly loaded segment will be set. At such time as the previous segment is re-loaded, the breakpoints associated with that segment will be set, and the breakpoints associated with its predecessor will become dormant.

A segment entry breakpoint displayed just after segment load would look like:

```
SEGMENT XXXXX BREAK
ADDRESS(INSTRUCTION)  A  B  X  Y  EO STATUS
```

When a segment entry breakpoint is defined, DBUGR makes no check for the validity of the segment name. Therefore, segment names should not begin with ("A) or ("N).

### 6-2. CONDITIONAL BREAKPOINT

A conditional breakpoint can be set that will only break when a particular memory location is equal (or not equal) to a particular value after being masked. Location CBVAL, CBMASK, CBADDR, and CBTEST are used to set up the conditions required for the breakpoint to occur. The conditions are set up as follows:

CBVAL Compare Value

CBMASK Mask Value

CBADDR Memory Address to be tested (A-register =0, B-register =1)

CBTEST Condition required for break. For equality enter "SZA" or 2002; for inequality enter "SZA, RSS" or 2003. Note that the comparison is logical and not arithmetical.

The conditional breakpoint may be invoked only upon an existing breakpoint. Moreover, the program must be proceeding from that breakpoint. Conditions will thereafter be tested only at that particular breakpoint.

The conditional breakpoint is invoked by the double escape P command (\\P). Each time the breakpoint is encountered, the contents of the address specified by CBADDR will be XOR'ed with the contents of CBVAL. The result will be AND'ed with CBMASK and this final result will be tested with the instruction in CBTEST (SZA or SZA,RSS). The equation for this test appears in the "\\M" display:

$$(CBVAL-CBADDR, I) \wedge CBMASK = CBTEST$$

If the test instruction "skips", the conditional breakpoint will "break". If not, DBUGR will execute the instructions and continue. The conditional breakpoint may be counted with the n\\P command. In this case the conditions will be checked before the breakpoint is counted. A count is made only if a break would have been made. Therefore, n\\P will count n breaks before printing a break message.

In order to delete a breakpoint from the breakpoint table, give the \\B command. Then the breakpoint table will be listed:

```

0          M+347      breakpoint in main memory
1 SEG1     77777,I    segment entry breakpoint
2 SEG2     BETA       breakpoint in SEG1
3 SEG3     PHI+5      breakpoint in SEG2
ENTER INDEX OF BP TO DELETE, A to END 1 [CR]
          - ----
ENTER INDEX OF BP TO DELETE, A to END A [CR]
          - ----

```

Breakpoint 1, the segment entry breakpoint for SEG1, was deleted.

A faster command for deleting breakpoints is \\B which deletes all breakpoints at once.

If an attempt is made to enter more breakpoints than the capacity of the breakpoint table, an error message will be displayed.

```
NO MORE ROOM FOR BREAKPOINTS
```

The user should either delete some breakpoints or create a larger breakpoint table module to be loaded with the DBUGR in the future.

### 6-3. RESTRICTIONS

We are, however, restricted in the instructions at which a breakpoint can be set. This is because DBUGR gains control at the breakpoint by replacing the programmed instruction with a jump to DBUGR itself. After the break has been accomplished, the instruction is either executed from its temporary location within DBUGR or execution resumes at another address we specify.

DO NOT break at the following:

1. Instruction used as a constant.
2. Instruction that is used as an address pointer in an indirect chain of an instruction.
3. Instruction that is program modified (e.g. a configured I/O instruction).
4. EIG or DMS instructions listed in Figure 6-1

CAUTION

In DBUGR, an attempt to JSB to a point below the MP fence (except in an EXEC call) as the result of a trace or proceed command causes DBUGR to reject the command and to print the break message for the violating instruction followed by "MP?". You can get around this problem with a trace. If the offending instruction is no longer a breakpoint, you can proceed. The solution then is to move the breakpoint to a point after the system call and then proceed.

Not Allowed					
DJP	DJS	SJS	SJU	UJP	
UJS	XCA	XCB	XSA	XSB	

Figure 6-1. Untraceable Instructions

## 6-4. CONTROLS

Breakpoint controls in DBUGR are:

- n\B Set a breakpoint at n. Remember, B means breakpoint.
- \B Enter remove breakpoint mode.
- \\B Remove all breakpoints.
- ["A]\B Break at entry to ALL segments.
- ["N]\B Break at entry of NO segments (remove segment breakpoint).
- [SEG1]\B Break at entry to a segment named SEG1.
- n[SEG1]\B Break at n within a segment named SEG1.
- \P Proceed with program execution after a break. Remember P means proceed.
- \\P Proceed with conditional breakpoint invoked.
- n\P Proceed; do not trap until n breaks from now. All breakpoints encountered contribute to the count.



## Breakpoint/trace debugging

- `\O` Change break point and trace register print mode to the current master print mode.
- `n\G` Go to location `n`; begin execution with flags and accumulators as they were at break. Remember, `G` means go.
- `n\X` Execute the instruction `n`, then return control to DBUGR. If the instruction is a jump, DBUGR loses control. DBUGR prints a carriage return/line-feed before and after executing the instruction. If the instruction performs a skip, DBUGR prints an additional carriage return/line-feed. Remember, `X` means execute.
- `\T` Trace one line of code. DBUGR simulates the instruction printed in the last break message and then prints a new break message with the new location, instruction and registers. Two-word instructions also print the address used by the instruction. Tracing data is unpredictable.
- `n\T` Trace `n` instructions. Causes `n` break messages to be printed.
- `\T` Trace through a subroutine call. Unlike a `\T` trace of a JSB, a one-shot breakpoint is placed at `"..+1"`. Control passes to the subroutine and is regained upon return with a break. The one-time breakpoint is thus removed. This command should not be used when the JSB is followed by an argument list. Also, it should not be used when the called subroutine may return to somewhere other than `"..+1"`.

Example #1: Break at location 77710.

```
77710\B                               Set breakpoint at 77710.
-----

77700\G                               Begin execution at 77700.
-----

77710 (CLA) 173775 13 14 0  DBUGR prints this.

EOREG/    0                               Examine EOREG for flags.
-----
```

## Breakpoint/trace debugging

Example #2: Breakpoint within a loop.

```
LOOP+15\B                Set breakpoint at LOOP+15.
-----

LOOP\G                   Begin execution at LOOP.
-----

LOOP+15 (CLE) 4324 17 0 41 3  DBUGR prints this.
-----

EOREG/                   3           Examine EOREG for flags.
-----

10\P                     Proceed
-----
LOOP +15 (CLE) 57211 5 2 24 3  DBUGR prints this
\P                         Continue execution.
--
```

## Example #3:

```

*RU,MAIN                               Execute program loaded
                                         with DBUGR
      START DBUGR
16002<M:          23456<S:  [CR] Set start address of MAIN and SEG
-----          -
S+5\B                               Set Breakpoint in Segment AREA
-----
\P
--
SEGMENT SEG1 BREAK
S (0) 17542 5608 17702 22 2
S+5 [SEG2]\B                               Set Breakpoint in SEG2
-----
\P
--
SEGMENT SEG2 BREAK
S+5 (0) 17542 5606 0 45 22
M+50\B                               Set Breakpoint in MAIN
-----
[SEG4]\B                               Set entry Breakpoint in SEG 4
-----
\P
--
M+50(LDA M+700) 0 2234 54 72 1 Break in MAIN
\P
--
SEGMENT SEG4 BREAK
S (0) 17445 5562 7422 3322 1           Break at segment load.
\P
--
S+10 (JSB 112,I) 24 0 17777 55 2
["N]\B                               Clear segment Breakpoint except
-----          for specified segments.
\P
--
END DBUGR

```

## Breakpoint/trace debugging

### Example #4:

```
:RU,PROG           Execute program loaded
                   with DBUGR

START DBUGR

34221\B           Set breakpoint
-----
\P               Proceed to breakpoint
--
34221(LDA 1) 43 243 0 77 1

CBVAL/  0      130[LF]   Set compare value
-----
CBMASK/ 177777 377[LF]   Set mask to lower byte
-----
CBADDR/  0      1 [LF]   Test address (B-register)
-----
CBTEST/  SZA   [CR]     Test for equality

\\P              Proceed with conditional break
---            invoked

34221 (LDA 1) 32562      23530 2372 0 0

                   The lower byte of B-register
                   is equal to test value.

1/23530 23400 [CR]     Change lower byte of B-register
--      -----      to 0

\\P              Proceed with conditional break
---            invoked

34221 (LDA 1) 177777 730 2372 0 0

\P               Proceed without conditions
--
34221 (LDA 1) 44      25 3372 0 0

\P
--
END DBUGR
```

## 6-5. MAGIC SYMBOLS

DBUGR has two magic symbols "." and "..". A magic symbol is one of DBUGR's working registers (variables) that is also in its symbol table. We already know about "." which is DBUGR's location counter. Normally "." is set to some value with one of the many commands that open a register, but it also may be set this way:

```
201 < .:
-----
.= 201    [LF]    verify "." was set
-----
202/  CLA
```

".." is defined, whenever DBUGR is entered or processing a break point message, to be the next instruction's address. Thus if we have just broken:

```
3011 (CLA)  10  4010  12  77  2    ..= 3011
-----
```

".." is move each trace and/or break. This provides a convenient way of opening the broken location but is even more powerful when we use it to move the trace location. Thus:

```
3011 (CLA)  10  4010  12  77  2 [CR]
..-1/  STA  3040  JMP 3022 [CR] patch previous instruction
-----
.<...:  \T                set ".." to current location
-----  --                and trace one instruction

3022 (LDA)  3045  10  4010  12  77  2    (after the jump)
```



# MORE ABOUT OPERATORS

APPENDIX

A

Now that we have used most of the controls in DBUGR let's take a closer look at the use of operators (refer to Section 1-7.) within address expressions.

## A-1. PLUS, BLANK AND MINUS

The minus sign (-) performs subtraction. The operators plus (+) or blank are used to perform addition. Suppose we wish to change the jump at location 2513:

```
2513/   JMP   2522   JMP 2522+3   Type jump address as a relative
-----                               address and verify by
                                           reexamining 2513.

./      JMP   2525
--
```

Or, let's print the contents of SYM+5, a symbol we have defined as being equal to 2500:

```
SYM+5/   INA      Type the symbolic address and verify by printing
-----                               the contents of the same address expressed in
                                           octal.

2505/    INA
-----
```

## More About Operators

### A-2. INCLUSIVE OR

Now we use the operator comma (,) to inclusive OR a CLA with an INA, thereby creating the combined register operation CLA, INA:

```
62572/  CLA  CLA,INA  [CR]  Change register 62572.
-----  -----
.        2404                               Verify new contents in octal.
--
```

or in octal:

```
\C
--
62572/  2400  002400,002004
-----  -----
```

### A-3. THE MARK \Q

Note that in the previous example we had to retype the CLA to use it in the inclusive OR expression. This is not really a lot of trouble, but we do have a mark that, when in an expression, implies the last quantity typed. Thus,

```
62572/  CLA  CLA,INA  can also be accomplished by the
-----  -----  mark, EQ:

62572/  CLA  \Q,INA
-----  -----

./      CLA,INA  =2404
--      -
```

The mark \Q implies the last quantity typed, in this instance CLA. Remember that Q means last quantity typed.

For example:

```
2050/  2004  \Q+\Q  = 4010  Q+100000 = 104010
-----  -      -      -
```

### A-4. USING DBUGR TO DO SIMPLE ARITHMETIC

We can use DBUGR to evaluate simple expressions, and to convert decimal or octal numbers to other radices. The following sections illustrate this capability.



**A-5. OCTAL ADDITION AND SUBTRACTION**

[CR]  
 234+766=1222  
 -----

5444-45=5377  
 -----

4564+567-34+125=5444  
 -----

**A-6. OTHER CONVERSIONS**

2.\R            Change to binary output  
 ----

23=1001        Convert octal to binary  
 ---

16\ R           Change to hexadecimal output  
 -----

14=C            Convert octal to hexadecimal  
 ----

78.=4E          Convert decimal to hexadecimal  
 ----

**A-7. DECIMAL ADDITION AND SUBTRACTION**

10.\R  
 -----

45.+56.=101.  
 -----

578.+9788.=10366.  
 -----

400.-45.-26.-78.=251.  
 -----

More About Operators

**A-8. OCTAL TO DECIMAL CONVERSION**

10.\R  
-----

245=165.  
-----

256+77+654-147=562.  
-----

**A-9. DECIMAL TO OCTAL CONVERSION**

89.=131  
-----

7859.=17263  
-----

78.+59.=211  
-----

998.-997.=1  
-----

# ERROR MESSAGES

APPENDIX

B

DBUGR will recognize various types of errors. The messages and their meanings are as follows:

- X        You pressed the RUB OUT key to delete a typing mistake. DBUGR will ignore any prior partial expression.
- ?        You used an unassigned control. Any prior expression is ignored. Input Error in special mode.
- U        The symbol last used was undefined and a definition was required. The entire preceding expression is ignored.
- P?      Page error: You caused a memory reference instruction to reference an address not in the current page or the base page. The expression is ignored. DBUGR's conception of the "current page" can be changed by examining any location in the desired page.
- CHK     A checksum error has occurred.
- MP?    DBUGR detected a possibly legal instruction that it cannot trace (or proceed with the break point at) without violating memory protect. Move the break point and proceed.
- IN?    An instruction that is legal in the 21XX base set but not executable by DBUGR was detected and DBUGR cannot trace (or proceed with the breakpoint at). Move the breakpoint and proceed. User attempted to set a breakpoint on an instruction DBUGR cannot proceed from. Execution of an instruction using the (instruction)EX feature of DBUGR was attempted using a two or more word instruction (not supported - only one word instructions can be executed using this feature).
- TP?    An attempt to trace, set breakpoint, or paper tape load into DBUGR. Loading, tracing, or setting of breakpoint is terminated.
- O?     Symbol table overflow.
- DM?    An attempt to access memory that is beyond the background partition.



Table C-1. Quick Reference To Frequently Used Commands

COMMAND	EXPLANATION
n/	print contents of location n
\L	list 16 locations
n\L	list n locations
n\R	set Radix to n
\S	Symbolic mode
\C	Constant mode
\H	hollerith mode
\A	address mode
n<sym:	define sym as n
n\X	execute n
n\G	Go to n
\P	proceed
\\P	proceed with conditional breakpoint
\T	trace an instruction
n\P	proceed for n breaks
n\\P	proceed with cond. breakpoint for n breaks
n\T	trace n instructions
n\B	set breakpoint at n
[x]\B	set entry breakpoint for seg x
n[x]\B	set breakpoint in seg x at n
\\B	clear all breakpoints
n1<n2>n3\W	search n1 to n2 for n3 under mask
n1<n2>n3\N	search n1 to n2 for not equal to n3 under mask
\M	display special register
\J	display map register

## C-1. MODE CONTROL

DBUGR has several basic printing modes:

- As symbolic instructions. This is the mode DBUGR is in when loaded. Controls are:

- \S Set the master printing mode to symbolic instruction.
- ! Print the last quantity typed as an instruction.
- \! Set temporary printing mode to instruction, and print the last quantity typed as an instruction.

## DBUGR At A Glance

### - As address pointer.

\A Set the master printing mode to address. If only initial symbols are defined, this is equivalent to constant.

<- Print the last quantity typed as an address pointer.

\<- Set temporary printing mode to address, and print last quantity typed as an address.

### - As constants, in a specified radix.

\C Set the master printing mode to constants, in the current radix.

= Print the last quantity typed as a constant.

\= Set the temporary printing mode to constant, and print the last quantity typed as a constant.

n\R Set the output radix to n.

### - As ASCII characters in halfwords.

\H Set the master printing mode to ASCII characters in half-words.

' Print the last quantity typed as two ASCII characters. Then print ".

\' Set the temporary printing mode to ASCII, and print the last quantity typed as ASCII.

s" The symbol s, of one or two characters right-adjusted, is taken as a term on input.

### - To print a quantity in the current master print mode:

; Print last quantity typed in current mode.

### - To change the breakpoint register print mode to current master print mode:

\0

### - To operate in character or block mode (multipoint terminals). Refer to Appendix D.

\U Switch from character to block mode or vice versa.

- To change a print mode temporarily:

- \$ Same as bar (/), but set temporary print mode to symbolic instruction. Temporary mode is in effect over a series of examinations, until carriage return is typed by you, then the master mode becomes in effect again.
- \\$ Same as escape bar, but set temporary print mode to symbolic instruction.
- @ Same as bar, but set temporary print mode to address pointer.
- \@ Same as escape bar, but set temporary print mode to address pointer.
- # Same as bar, but set temporary print mode to constant.
- \# Same as escape bar, but set temporary print mode to constant.
- ) Same as bar, but set temporary print mode to ASCII.
- \) Same as escape bar, but set temporary print mode to ASCII.

## C-2. SYMBOL MANIPULATION

- s: Define the symbol s as having value specified by the location counter.
- s& Define symbol s as having value equal to the address of the last quantity typed, if an instruction.
- \K Kill all symbol definitions other than the initial symbol table.

## C-3. LOCATION EXAMINATION

- n/ Print the contents of location n, in the current master print mode, and open the location for possible modification. The location counter is set to n.
- / Open and print the contents of the location pointed to by the last quantity typed, taken as a direct 15-bit address. The location counter is not changed.

## DBUGR At A Glance

- ✓ Open and print the contents of the location pointed to by the last quantity typed, taken as an memory reference address instruction. The location counter is not changed.
- \L Open and print the contents of the next 16 sequential locations starting with the current location. The location counter is advanced by 16.
- n\L Same as \L, except list n lines.
- [CR] Close any open location. No change is made.
- n[CR] Store the quantity n in the open location, if any.
- [LF] Open and print the contents of the next sequential location as determined by the location counter. The location counter is advanced by one.
- n[LF] Store the quantity n in the open location, if any; then open and print the contents of the next sequential location. The location counter is advanced by one.
- ^ Open and print the contents of the previous sequential register. The location counter is decremented by one.
- n^ Store the quantity n in the open location, if any; then open and print the contents of the previous sequential location. The location counter is decremented by one.
- CTRL-I (TAB) Open, set the location counter to, and print the contents of the location pointed to by the quantity typed, taken as an address pointer.
- nCTRL-I (nTAB) Store the quantity n in the open location, if any. Then open, set the location counter to, and print the contents of the location pointed to by n, taken as an address.
- \TAB Open, set the location counter to, and print the contents of the location pointed to by the last quantity typed, taken as an instruction.
- n\tAB Store the quantity n in the open location, if any. Then open, set the location counter to, and print the contents of the location pointed by n, taken as an instruction.
- n% Store the quantity n in the open location, if any. Then open and print the contents of the location pointed to by n, taken as an address. The location counter is not changed.
- n\% Store the quantity n in the open location, if any. Then open and print the contents of the location pointed to by n, taken as an instruction. The location counter is not changed.



#### C-4. PROGRAM LOAD AND VERIFY

- \Y Load absolute binary paper tape, as prepared by HP Assembler.
- \V Verify paper tape against core.

#### C-5. PUNCHING

- n\D Store n into the open location, if any. Then punch the last register (with the new contents n, if stored).
- n1<n2>\D Punch locations n1 to n2, inclusive.

#### C-6. MEMORY SEARCH AND CLEAR

- n< Set the lower limit for search or clear to n.
- n> Set the upper limit for search or clear to n.
- n1<n2>n3\W Search between the limits n1 and n2 for all words equal under mask to n3.
- n1<n2>n3\N Search between the limits n1 and n2 for all words not equal under mask to n3.
- n1<n2>n3\E Effective address search: find all instructions between the limits n1 and n2 which, under mask, effectively address location n3.
- n1<n2>n3\\Z Zero, or clear core between the limits n1 and n2, to n3. If n3 is omitted, it is taken as zero.
- \MASK Examine/modify search mask.

#### C-7. BREAKPOINTS AND PROGRAM CONTROL

- n\B Set a breakpoint at n. If n is in segment space, use last segment loaded as the associated segment name. Error if no segment loaded yet.
- \B Enter remove breakpoint mode.
- \\B Remove all breakpoints
- n[NAME]\B Set a breakpoint in segment NAME at location n.
- [NAME]\B Break at entry to Segment NAME.
- ["A]\B Break at entry to ALL Segments.

## DBUGR At A Glance

["N]\B	Break at entry to NO Segments except for those specified.
\P	Proceed with program execution after a break trap.
\\P	Proceed with conditional breakpoint invoked.
n\P	Proceed; do not trap until n breakpoints from now.
n\\P	Proceed; do not trap until n breakpoints, including conditional breakpoints.
n\G	Go to location n; begin execution with flags and accumulators as saved.
n\X	Execute the instruction n, then return control to DBUGR.
\T	Trace one instruction.
n\T	Trace n instructions.
\\T	Trace an entire subroutine call with no argument list or alternate returns.

### Trace/Breakpoint simulation:

DBUGR simulates instructions when it:

- a) Proceeds from the current breakpoint location
- b) Traces
- c) Executes an instruction

DBUGR will correctly simulate all instructions including EXEC calls in its symbol table when tracing, with the exceptions noted in Figure 6-1. A breakpoint may not be set on any of these instructions.

A method to get around instruction exceptions is to set up a subroutine containing the desired instruction(s) and execute a JSB <subroutine>\X. DBUGR will give up control to the subroutine and execute it, regaining control on the return.

**C-8. SPECIAL REGISTERS**

\M        Display contents of the special registers.  
 AREG/    Examine & Modify A-Register  
 BREG/    Examine & Modify B-Register  
 XREG/    Examine & Modify X-Register  
 YREG/    Examine & Modify Y-Register  
 EOREG/   Examine & Modify EO-Register  
 MASK/    Examine & Modify Search Mask  
 CBVAL/   Examine & Modify conditional breakpoint value  
 CBMASK/  Examine & Modify conditional breakpoint mask  
 CBADDR/  Examine & Modify conditional breakpoint address  
 CBTEST/  Examine & Modify conditional breakpoint test  
 WRTL/    EXEC control word for DBUGR output device  
 BRFLG/   Break Flag; 0= check for break, 1= no check

**C-9. MAP REGISTERS**

\J:    SM    Examine system maps.  
       UM    Examine user maps.  
       PA    Examine port A maps.  
       PB    Examine port B maps.  
       XL    Cross load A- or B-registers.  
 \?    Display MEM status register.



# APPENDIX D

APPENDIX

D

DBUGR can be operated in block mode. Multipoint (DVR07) terminals run in block mode only.

Escape, return and line feed cannot be used in block mode.

The following are the differences between character and block mode.

CHAR MODE	BLOCK MODE
-----	-----
<escape>	\
<cr>	]
<lf>	<enter for multipoint>
	<return for non-multipoint>

In order to invoke block mode operation on a non-multipoint terminal enter the following command:

```
\\U
```

When in block mode this command will set DBUGR back to character mode for non-multipoint terminals.

Since DBUGR does not receive any character until the enter or return is entered, a series of commands may be entered on one line.

For example:

```
200/201/202/<enter>
-----
   JSB 4,I   203   245
200/<enter>
-----
   JSB 4,I   <enter>
-----
201/ 203    <enter>
-----
202/ 245    ]<enter>
-----
```



**READER COMMENT SHEET**  
**RTE-IV DEBUG SUBROUTINE**  
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92067-90005

February 1980

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---

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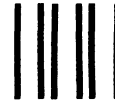
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**NORTH RYDE**, N.S.W. 2113  
Tel: 887-1611  
Telex: 21561  
Cable: HEWPARD Sydney  
A,CH,CM,CS,E,MS,P

### AUSTRIA

Hewlett-Packard Ges.m.b.h.  
Grottenhofstrasse 94  
A-8052 **GRAZ**  
Tel: (0316) 291 5 66  
Telex: 32375  
CH,E  
Hewlett-Packard Ges.m.b.h.  
Liebigasse 1  
P.O. Box 72  
A-1222 **VIENNA**  
Tel: (0222) 23 65 11-0  
Telex: 134425 HEPA A  
A,CH,CM,CS,E,MS,P

### BAHRAIN

*Green Salon*  
P.O. Box 557  
Manama  
**BAHRAIN**  
Tel: 255503-255950  
Telex: 844 19  
P

*Wael Pharmacy*

P.O. Box 648

### BAHRAIN

Tel: 256 123  
Telex: 8550 Wael BN  
E,C,M

### BELGIUM

Hewlett-Packard Belgium S.A./N.V.  
Blvd de la Woluwe, 100  
Woluwedal  
B-1200 **BRUSSELS**  
Tel: (02) 762-32-00  
Telex: 23-494 paloben bru  
A,CH,CM,CS,E,MP,P

### BRAZIL

Hewlett-Packard do Brasil I.e.C. Ltda.  
Alameda Rio Negro, 750  
Alphaville  
06400 **BARUERI SP**  
Tel: (011) 421.1311  
Telex: (011) 33872 HPBR-BR  
Cable: HEWPACK Sao Paulo  
A,CH,CM,CS,E,M,P  
Hewlett-Packard do Brasil I.e.C. Ltda.  
Avenida Epitacio Pessoa, 4664  
22471 **RIO DE JANEIRO-RJ**  
Tel: (021) 286.0237  
Telex: 021-21905 HPBR-BR  
Cable: HEWPACK Rio de Janeiro  
A,CH,CM,E,MS,P\*  
*ANAMED I.C.E.I. Ltda.*  
*Rua Bage, 103*  
04012 **SAO PAULO**  
Tel: (011) 570-5726  
Telex: 021-21905 HPBR-BR  
M



# SALES & SUPPORT OFFICES

Arranged alphabetically by country

## CANADA

### Alberta

Hewlett-Packard (Canada) Ltd.  
3030 3rd Avenue N.E.  
CALGARY, Alberta T2A 6T7  
Tel: (403) 235-3100  
A,CH,CM,E\*,MS,P\*

Hewlett-Packard (Canada) Ltd.  
11120A-178th Street  
EDMONTON, Alberta T5S 1P2  
Tel: (403) 486-6666  
A,CH,CM,CS,E,MS,P

### British Columbia

Hewlett-Packard (Canada) Ltd.  
10691 Shellbridge Way  
RICHMOND,

British Columbia V6X 2W7  
Tel: (604) 270-2277  
Telex: 610-922-5059  
A,CH,CM,CS,E\*,MS,P\*

### Manitoba

Hewlett-Packard (Canada) Ltd.  
380-550 Century Street  
WINNIPEG, Manitoba R3H 0Y1  
Tel: (204) 786-6701  
A,CH,CM,E,MS,P\*

### Nova Scotia

Hewlett-Packard (Canada) Ltd.  
P.O. Box 931  
900 Windmill Road  
DARTMOUTH, Nova Scotia B2Y 3Z6  
Tel: (902) 469-7820  
CH,CM,CS,E\*,MS,P\*

### Ontario

Hewlett-Packard (Canada) Ltd.  
3325 N. Service Rd., Unit 6  
BURLINGTON, Ontario R3A 2A3  
Tel: (416) 335-8644  
CS,M\*

Hewlett-Packard (Canada) Ltd.  
552 Newbold Street  
LONDON, Ontario N6E 2S5  
Tel: (519) 686-9181  
A,CH,CM,E\*,MS,P\*

Hewlett-Packard (Canada) Ltd.  
6877 Goreway Drive  
MISSISSAUGA, Ontario L4V 1M8  
Tel: (416) 678-9430  
A,CH,CM,CS,E,MP,P

Hewlett-Packard (Canada) Ltd.  
2670 Queensview Dr.  
OTTAWA, Ontario K2B 8K1  
Tel: (613) 820-6483  
A,CH,CM,CS,E\*,MS,P\*

Hewlett-Packard (Canada) Ltd.  
220 Yorkland Blvd., Unit #11  
WILLOWDALE, Ontario M2J 1R5  
Tel: (416) 499-9333  
CH

### Quebec

Hewlett-Packard (Canada) Ltd.  
17500 South Service Road  
Trans-Canada Highway  
KIRKLAND, Quebec H9J 2M5  
Tel: (514) 697-4232  
A,CH,CM,CS,E,MP,P\*

Hewlett-Packard (Canada) Ltd.  
Les Galeries du Vallon  
2323 Du Versant Nord  
STE. FOY, Quebec G1N 4C2  
Tel: (418) 687-4570  
CH

## CHILE

Jorge Calcagni y Cia. Ltda.  
Av. Italia 634 Santiago  
Casilla 16475  
SANTIAGO 9  
Tel: 222-0222  
Telex: Public Booth 440001  
A,CM,E,M

Olympia (Chile) Ltda.  
Av. Rodrigo de Araya 1045  
Casilla 256-V  
SANTIAGO 21  
Tel: (02) 22 55 044  
Telex: 240-565 OLYMP CL  
Cable: Olympiachile Santiagochile  
CH,CS,P

## CHINA, People's Republic of

China Hewlett-Packard Rep. Office  
P.O. Box 418  
1A Lane 2, Luchang St.  
Beiwei Rd., Xuanwu District  
BEIJING  
Tel: 33-1947, 33-7426  
Telex: 22601 CTSHP CN  
Cable: 1920  
A,CH,CM,CS,E,P

## COLOMBIA

Instrumentación  
H. A. Langebaek & Kier S.A.  
Carrera 4A No. 52A-26  
Apartado Aereo 6287  
BOGOTA 1, D.E.  
Tel: 212-1466  
Telex: 44400 INST CO  
Cable: AARIS Bogota  
CM,E,M  
Casa Humboldt Ltda.  
Carrera 14, No. 98-60  
Apartado Aereo 51283  
BOGOTA 1, D.E.  
Tel: 256-1686  
Telex: 45403 CCAL CO.  
A

## COSTA RICA

Científica Costarricense S.A.  
Avenida 2, Calle 5  
San Pedro de Montes de Oca  
Apartado 10159  
SAN JOSÉ  
Tel: 24-38-20, 24-08-19  
Telex: 2367 GALGUR CR  
CM,E,M

## CYPRUS

Telerex Ltd.  
P.O. Box 4809  
14C Stassinou Avenue  
NICOSIA  
Tel: 62698  
Telex: 2894 LEVIDO CY  
E,M,P

## DENMARK

Hewlett-Packard A/S  
Datavej 52  
DK-3460 BIRKEROD  
Tel: (02) 81-66-40  
Telex: 37409 hpas dk  
A,CH,CM,CS,E,MS,P  
Hewlett-Packard A/S  
Rolighedsvej 32  
DK-8240 RISSKOV, Aarhus  
Tel: (06) 17-60-00  
Telex: 37409 hpas dk  
CH,E

## DOMINICAN REPUBLIC

Microprog S.A.  
Juan Tomás Mejía y Cotes No. 60  
Arroyo Hondo  
SANTO DOMINGO  
Tel: 565-6268  
Telex: 4510 ARENTA DR (RCA) P

## ECUADOR

CYEDE Cia. Ltda.  
Robles 625  
Avenida Eloy Alfaro 1749  
Casilla 6423 CCI  
QUITO  
Tel: 450-975, 243-052  
Telex: 2548 CYEDE ED  
CM,E,P

### Hospitalar S.A.

Robles 625  
Casilla 3590  
QUITO  
Tel: 545-250, 545-122  
Telex: 2485 HOSPPL ED  
Cable: HOSPITALAR-Quito  
M

## EGYPT

International Engineering Associates  
24 Hussein Hegazi Street  
Kasr-el-Aini  
CAIRO  
Tel: 23829, 21641  
Telex: IEA UN 93830  
CH,CS,E,M  
EGYPOR  
P.O.Box 2558  
42 El Zahraa Street  
CAIRO, Egypt  
Tel: 65 00 21  
Telex: 93 337  
P

## EL SALVADOR

IPESA de El Salvador S.A.  
29 Avenida Norte 1216  
SAN SALVADOR  
Tel: 26-6858, 26-6868  
Telex: 20539 IPESASAL  
A,CH,CM,CS,E,P

## FINLAND

Hewlett-Packard Oy  
Revontulentie 7  
PL 24  
SF-02101 ESPOO 10  
Tel: (90) 4550211  
Telex: 121563 hewpa sf  
CH,CM,CS,P  
Hewlett-Packard Oy  
Aatoksenkatu 10-C  
SF-40720-72 JYVASKYLA  
Tel: (941) 216318  
CH  
Hewlett-Packard Oy  
Kainvuntie 1-C  
SF-90140-14 OULU  
Tel: (981) 338785  
CH

## FRANCE

Hewlett-Packard France  
Z.I. Mercure B  
Rue Berthelot  
F-13763 Les Milles Cedex  
AIX-EN-PROVENCE

Tel: 16 (42) 59-41-02  
Telex: 410770F  
A,CH,E,MS,P\*

Hewlett-Packard France  
64, rue Marchand Saillant  
F-61000 ALENCON  
Tel: 16 (33) 29 04 42

Hewlett-Packard France  
Boite Postale 503  
F-25026 BESANCON  
28 rue de la Republique  
F-25000 BESANCON  
Tel: 16 (81) 83-16-22  
CH,M

Hewlett-Packard France  
13, Place Napoleon III  
F-29000 BREST  
Tel: 16 (98) 03-38-35

Hewlett-Packard France  
Chemin des Mouilles  
Boite Postale 162  
F-69130 ECULLY Cedex (Lyon)  
Tel: 16 (78) 833-81-25  
Telex: 310617F  
A,CH,CS,E,MP

Hewlett-Packard France  
Tour Lorraine  
Boulevard de France  
F-91035 EVRY Cedex  
Tel: 16 6 077-96-60  
Telex: 692315F  
E

Hewlett-Packard France  
Parc d'Activite du Bois Briard  
Ave. du Lac  
F-91040 EVRY Cedex  
Tel: 16 6 077-8383  
Telex: 692315F  
E

Hewlett-Packard France  
5, avenue Raymond Chanas  
F-38320 EYBENS (Grenoble)  
Tel: 16 (76) 25-81-41  
Telex: 980124 HP GRENOB EYBE  
CH

Hewlett-Packard France  
Centre d'Affaire Paris-Nord  
Bâtiment Ampère 5 étage  
Rue de la Commune de Paris  
Boite Postale 300  
F-93153 LE BLANC MESNIL  
Tel: 16 (1) 865-44-52  
Telex: 211032F  
CH,CS,E,MS

Hewlett-Packard France  
Parc d'Activités Caderea  
Quartier Jean Mermoz  
Avenue du Président JF Kennedy  
F-33700 MERIGNAC (Bordeaux)  
Tel: 16 (56) 34-00-84  
Telex: 550105F  
CH,E,MS

Hewlett-Packard France  
Immuable "Les 3 B"  
Nouveau Chemin de la Garde  
ZAC de Bois Briard  
F-44085 NANTES Cedex  
Tel: 16 (40) 50-32-22  
CH\*\*



## FRANCE (Cont'd)

Hewlett-Packard France  
125, rue du Faubourg Bannier  
F-45000 **ORLEANS**  
Tel: 16 (38) 68 01 63

Hewlett-Packard France  
Zone Industrielle de Courtaboeuf  
Avenue des Tropiques  
F-91947 Les Ulis Cedex **ORSAY**  
Tel: (6) 907-78-25  
Telex: 600048F  
A,CH,CM,CS,E,MP,P

Hewlett-Packard France  
Paris Porte-Maillot  
15, Avenue de L'Amiral Bruix  
F-75782 **PARIS CEDEX 16**  
Tel: 16 (1) 502-12-20  
Telex: 613663F  
CH,MS,P

Hewlett-Packard France  
124, Boulevard Tourasse  
F-64000 **PAU**  
Tel: 16 (59) 80 38 02

Hewlett-Packard France  
2 Allée de la Bourgonnette  
F-35100 **RENNES**  
Tel: 16 (99) 51-42-44  
Telex: 740912F  
CH,CM,E,MS,P\*

Hewlett-Packard France  
98 Avenue de Bretagne  
F-76100 **ROUEN**  
Tel: 16 (35) 63-57-66  
CH\* \*,CS

Hewlett-Packard France  
4 Rue Thomas Mann  
Boite Postale 56  
F-67033 **STRASBOURG** Cedex  
Tel: 16 (88) 28-56-46  
Telex: 890141F  
CH,E,MS,P\*

Hewlett-Packard France  
Le Péripole  
20, Chemin du Pigeonnier de la  
Cépière  
F-31083 **TOULOUSE** Cedex  
Tel: 16 (61) 40-11-12  
Telex: 531639F  
A,CH,CS,E,P\*

Hewlett-Packard France  
9, rue Baudin  
F-26000 **VALENCE**  
Tel: 16 (75) 42 76 16

Hewlett-Packard France  
Carolor  
ZAC de Bois Briand  
F-57640 **VIGY** (Metz)  
Tel: 16 (8) 771 20 22  
CH

Hewlett-Packard France  
Immeuble Péricentre  
F-59658 **VILLENEUVE D'ASCO** Cedex  
Tel: 16 (20) 91-41-25  
Telex: 160124F  
CH,E,MS,P\*

**GERMAN FEDERAL  
REPUBLIC**  
Hewlett-Packard GmbH  
Geschäftsstelle  
Keithstrasse 2-4  
D-1000 **BERLIN 30**  
Tel: (030) 24-90-86  
Telex: 018 3405 hpbln d  
A,CH,E,M,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Herrenberger Strasse 130  
D-7030 **BOBLINGEN**  
Tel: (7031) 14-0  
Telex:  
A,CH,CM,CS,E,MP,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Emanuel-Leutze-Strasse 1  
D-4000 **DUSSELDORF**  
Tel: (0211) 5971-1  
Telex: 085/86 533 hpdd d  
A,CH,CS,E,MS,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Schleefstr. 28a  
D-4600 **DORTMUND-Aplerbeck**  
Tel: (0231) 45001

Hewlett-Packard GmbH  
Vertriebszentrale Frankfurt  
Berner Strasse 117  
Postfach 560 140  
D-6000 **FRANKFURT 56**  
Tel: (0611) 50-04-1  
Telex: 04 13249 hpffm d  
A,CH,CM,CS,E,MP,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Aussenstelle Bad Homburg  
Louisenstrasse 115  
D-6380 **BAD HOMBURG**  
Tel: (06172) 109-0

Hewlett-Packard GmbH  
Geschäftsstelle  
Kapstadtring 5  
D-2000 **HAMBURG 60**  
Tel: (040) 63804-1  
Telex: 021 63 032 hphh d  
A,CH,CS,E,MS,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Heidering 37-39  
D-3000 **HANNOVER 61**  
Tel: (0511) 5706-0  
Telex: 092 3259  
A,CH,CM,E,MS,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Rosslauer Weg 2-4  
D-6800 **MANNHEIM**  
Tel: (0621) 70050  
Telex: 0462105  
A,C,E

Hewlett-Packard GmbH  
Geschäftsstelle  
Messerschmittstrasse 7  
D-7910 **NEU ULM**  
Tel: 0731-70241  
Telex: 0712816 HP ULM-D  
A,C,E\*

Hewlett-Packard GmbH  
Geschäftsstelle  
Ehhericherstr. 13  
D-8500 **NÜRNBERG 10**  
Tel: (0911) 5205-0  
Telex: 0623 860  
CH,CM,E,MS,P

Hewlett-Packard GmbH  
Geschäftsstelle  
Eschenstrasse 5  
D-8028 **TAUFKIRCHEN**  
Tel: (089) 6117-1  
Telex: 0524985  
A,CH,CM,E,MS,P

## GREAT BRITAIN

See United Kingdom

## GREECE

Kostas Karayannis S.A.  
8 Omirou Street  
**ATHENS 133**  
Tel: 32 30 303, 32 37 371  
Telex: 215962 RKAR GR  
A,CH,CM,CS,E,M,P

PLAISIO S.A.  
G. Gerardos  
24 Stournara Street  
**ATHENS**  
Tel: 36-11-160  
Telex: 221871  
P

## GUATEMALA

IPESA  
Avenida Reforma 3-48, Zona 9  
**GUATEMALA CITY**  
Tel: 316627, 314786  
Telex: 4192 TELTRO GU  
A,CH,CM,CS,E,M,P

## HONG KONG

Hewlett-Packard Hong Kong, Ltd.  
G.P.O. Box 795  
5th Floor, Sun Hung Kai Centre  
30 Harbour Road  
**HONG KONG**  
Tel: 5-8323211  
Telex: 66678 HEWPA HX  
Cable: HEWPACK HONG KONG  
E,CH,CS,P

CET Ltd.  
1402 Tung Wah Mansion  
199-203 Hennessy Rd.  
Wanchia, **HONG KONG**  
Tel: 5-729376  
Telex: 85148 CET HX  
CM

Schmidt & Co. (Hong Kong) Ltd.  
Wing On Centre, 28th Floor  
Connaught Road, C.  
**HONG KONG**  
Tel: 5-455644  
Telex: 74766 SCHMX HX  
A,M

## ICELAND

Elding Trading Company Inc.  
Hafnarvölli-Tryggvagotu  
P.O. Box 895  
**IS-REYKJAVIK**  
Tel: 1-58-20, 1-63-03  
M

## INDIA

Computer products are sold through  
Blue Star Ltd. All computer repairs and  
maintenance service is done through  
Computer Maintenance Corp.

Blue Star Ltd.  
Sabri Complex II Floor  
24 Residency Rd.  
**BANGALORE 560 025**  
Tel: 55660  
Telex: 0845-430  
Cable: BLUESTAR  
A,CH\*,CM,CS\*,E

Blue Star Ltd.  
Band Box House  
Prabhadevi  
**BOMBAY 400 025**  
Tel: 422-3101  
Telex: 011-3751  
Cable: BLUESTAR  
A,M

Blue Star Ltd.  
Sahas  
414/2 Vir Savarkar Marg  
Prabhadevi  
**BOMBAY 400 025**  
Tel: 422-6155  
Telex: 011-4093  
Cable: FROSTBLUE  
A,CH\*,CM,CS\*,E,M

Blue Star Ltd.  
Kalyan, 19 Vishwas Colony  
Alkapuri, **BORODA, 390 005**  
Tel: 65235  
Cable: BLUE STAR  
A

Blue Star Ltd.  
7 Hare Street  
**CALCUTTA 700 001**  
Tel: 12-01-31  
Telex: 021-7655  
Cable: BLUESTAR  
A,M

Blue Star Ltd.  
133 Kodambakkam High Road  
**MADRAS 600 034**  
Tel: 82057  
Telex: 041-379  
Cable: BLUESTAR  
A,M

Blue Star Ltd.  
Bhandari House, 7th/8th Floors  
91 Nehru Place  
**NEW DELHI 110 024**  
Tel: 682547  
Telex: 031-2463  
Cable: BLUESTAR  
A,CH\*,CM,CS\*,E,M

Blue Star Ltd.  
15/16:C Wellesley Rd.  
**PUNE 411 011**  
Tel: 22775  
Cable: BLUE STAR  
A

Blue Star Ltd.  
2-2-47/1108 Bolarum Rd.  
**SECUNDERABAD 500 003**  
Tel: 72057  
Telex: 0155-459  
Cable: BLUEFROST  
A,E

Blue Star Ltd.  
T.C. 7/603 Poornima  
Maruthankuzhi  
**TRIVANDRUM 695 013**  
Tel: 65799  
Telex: 0884-259  
Cable: BLUESTAR  
E

Computer Maintenance Corporation  
Ltd.  
115, Sarojini Devi Road  
**SECUNDERABAD 500 003**  
Tel: 310-184, 345-774  
Telex: 031-2960  
CH\*\*



# SALES & SUPPORT OFFICES

Arranged alphabetically by country

## INDONESIA

**BERCA Indonesia P.T.**  
P.O.Box 496/Jkt.  
Jl. Abdul Muis 62  
**JAKARTA**  
Tel: 21-373009  
Telex: 46748 BERSAL IA  
Cable: BERSAL JAKARTA P

**BERCA Indonesia P.T.**  
P.O.Box 2497/Jkt  
Antara Bldg., 17th Floor  
Jl. Medan Merdeka Selatan 17  
**JAKARTA-PUSAT**  
Tel: 21-344-181  
Telex: BERSAL IA  
A,CS,E,M

**BERCA Indonesia P.T.**  
P.O. Box 174/SBY.  
Jl. Kutei No. 11  
**SURABAYA**  
Tel: 68172  
Telex: 31146 BERSAL SB  
Cable: BERSAL-SURABAYA  
A\*,E,M,P

## IRAQ

Hewlett-Packard Trading S.A.  
Service Operation  
Al Mansoor City 9B/3/7  
**BAGHDAD**  
Tel: 551-49-73  
Telex: 212-455 HEPAIRAQ IK  
CH,CS

## IRELAND

Hewlett-Packard Ireland Ltd.  
82/83 Lower Leeson Street  
**DUBLIN 2**  
Tel: 0001 608800  
Telex: 30439  
A,CH,CM,CS,E,M,P  
Cardiac Services Ltd.  
Kilmore Road  
Artane  
**DUBLIN 5**  
Tel: (01) 351820  
Telex: 30439  
M

## ISRAEL

Eldan Electronic Instrument Ltd.  
P.O.Box 1270  
**JERUSALEM 91000**  
16, Ohaliav St.  
**JERUSALEM 94467**  
Tel: 533 221, 553 242  
Telex: 25231 AB/PAKRD IL  
A

Electronics Engineering Division  
Motorola Israel Ltd.  
16 Kremenetski Street  
P.O. Box 25016  
**TEL-AVIV 67899**  
Tel: 3 88 388  
Telex: 33569 Motil IL  
Cable: BASTEL Tel-Aviv  
CH,CM,CS,E,M,P

## ITALY

Hewlett-Packard Italiana S.p.A.  
Traversa 99C  
Via Giulio Petroni, 19  
I-70124 **BARI**  
Tel: (080) 41-07-44  
M

Hewlett-Packard Italiana S.p.A.  
Via Martin Luther King, 38/III  
I-40132 **BOLOGNA**  
Tel: (051) 402394  
Telex: 511630  
CH,E,MS

Hewlett-Packard Italiana S.p.A.  
Via Principe Nicola 43G/C  
I-95126 **CATANIA**  
Tel: (095) 37-10-87  
Telex: 970291  
C,P

Hewlett-Packard Italiana S.p.A.  
Via G. Di Vittorio 9  
I-20063 **CERNUSCO SUL NAVIGLIO**  
(Milano)  
Tel: (02) 923691  
Telex: 334632  
A,CH,CM,CS,E,MP,P

Hewlett-Packard Italiana S.p.A.  
Via C. Colombo 49  
I-20090 **TREZZANO SUL NAVIGLIO**  
(Milano)  
Tel: (02) 4459041  
Telex: 322116  
C,M

Hewlett-Packard Italiana S.p.A.  
Via Nuova San Rocco a  
Capodimonte, 62/A  
I-80131 **NAPOLI**  
Tel: (081) 7413544  
Telex: 710698  
A,CH,E

Hewlett-Packard Italiana S.p.A.  
Viale G. Modugno 33  
I-16156 **GENOVA PEGLI**  
Tel: (010) 68-37-07  
Telex: 215238  
E,C

Hewlett-Packard Italiana S.p.A.  
Via Pelizzo 15  
I-35128 **PADOVA**  
Tel: (049) 664888  
Telex: 430315  
A,CH,E,MS

Hewlett-Packard Italiana S.p.A.  
Viale C. Pavese 340  
I-00144 **ROMA EUR**  
Tel: (06) 54831  
Telex: 610514  
A,CH,CM,CS,E,MS,P\*

Hewlett-Packard Italiana S.p.A.  
Via di Casellina 57/C  
I-50018 **SCANDICCI-FIRENZE**  
Tel: (055) 753863

Hewlett-Packard Italiana S.p.A.  
Corso Svizzera, 185  
I-10144 **TORINO**  
Tel: (011) 74 4044  
Telex: 221079  
CH,E

## JAPAN

Yokogawa-Hewlett-Packard Ltd.  
152-1, Onna  
**ATSUGI**, Kanagawa, 243  
Tel: (0462) 28-0451  
CM,C\*,E

Yokogawa-Helwett-Packard Ltd.  
Meiji-Seimei Bldg. 6F  
3-1 Hon Chiba-Cho  
**CHIBA**, 280  
Tel: 472 25 7701  
E,CH,CS

Yokogawa-Hewlett-Packard Ltd.  
Yasuda-Seimei Hiroshima Bldg.  
6-11, Hon-dori, Naka-ku  
**HIROSHIMA**, 730  
Tel: 82-241-0611

Yokogawa-Hewlett-Packard Ltd.  
Towa Building  
2-3, Kaigan-dori, 2 Chome Chuo-ku  
**KOBE**, 650  
Tel: (078) 392-4791  
C,E

Yokogawa-Hewlett-Packard Ltd.  
Kumagaya Asahi 82 Bldg  
3-4 Tsukuba  
**KUMAGAYA**, Saitama 360  
Tel: (0485) 24-6563  
CH,CM,E

Yokogawa-Hewlett-Packard Ltd.  
Asahi Shinbun Daiichi Seimei Bldg.  
4-7, Hanabata-cho  
**KUMAMOTO**, 860  
Tel: (0963) 54-7311  
CH,E

Yokogawa-Hewlett-Packard Ltd.  
Shin-Kyoto Center Bldg.  
614, Higashi-Shiokoji-cho  
Karasuma-Nishiiru  
Shiokoji-dori, Shimogyo-ku  
**KYOTO**, 600  
Tel: 075-343-0921  
CH,E

Yokogawa-Hewlett-Packard Ltd.  
Mito Mitsui Bldg  
4-73, Sanno-maru, 1 Chome  
**MITO**, Ibaraki 310  
Tel: (0292) 25-7470  
CH,CM,E

Yokogawa-Hewlett-Packard Ltd.  
Sumitomo Seimei 14-9 Bldg.  
Meieki-Minami, 2 Chome  
Nakamura-ku  
**NAGOYA**, 450  
Tel: (052) 571-5171  
CH,CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.  
Chuo Bldg.,  
4-20 Nishinakajima, 5 Chome  
Yodogawa-ku  
**OSAKA**, 532  
Tel: (06) 304-6021  
Telex: YHPOSA 523-3624  
A,CH,CM,CS,E,MP,P\*

Yokogawa-Hewlett-Packard Ltd.  
27-15, Yabe, 1 Chome  
**SAGAMIHARA** Kanagawa, 229  
Tel: 0427 59-1311

Yokogawa-Hewlett-Packard Ltd.  
Daiichi Seimei Bldg.  
7-1, Nishi Shinjuku, 2 Chome  
Shinjuku-ku, **TOKYO** 160  
Tel: 03-348-4611  
CH,E

Yokogawa-Hewlett-Packard Ltd.  
29-21 Takaido-Higashi, 3 Chome  
Suginami-ku **TOKYO** 168  
Tel: (03) 331-6111  
Telex: 232-2024 YHPTOK  
A,CH,CM,CS,E,MP,P\*

Yokogawa-Hewlett-Packard Ltd.  
Daiichi Asano Building  
2-8, Odori, 5 Chome  
**UTSUNOMIYA**, Tochigi 320  
Tel: (0286) 25-7155  
CH,CS,E

Yokogawa-Hewlett-Packard Ltd.  
Yasuda Seimei Nishiguchi Bldg.  
30-4 Tsuruya-cho, 3 Chome  
**YOKOHAMA** 221  
Tel: (045) 312-1252  
CH,CM,E

## JORDAN

Mouasher Cousins Company  
P.O. Box 1387  
**AMMAN**  
Tel: 24907, 39907  
Telex: 21456 SABCO JO  
CH,E,M,P

## KENYA

ADCOM Ltd., Inc., Kenya  
P.O.Box 30070  
**NAIROBI**  
Tel: 331955  
Telex: 22639  
E,M

## KOREA

Samsung Electronics HP Division  
12 Fl. Kinam Bldg.  
San 75-31, Yeoksam-Dong  
Kangnam-Ku  
Yeongdong P.O. Box 72  
**SEOUL**  
Tel: 555-7555, 555-5447  
Telex: K27364 SAMSAN  
A,CH,CM,CS,E,M,P

## KUWAIT

Al-Khaldiya Trading & Contracting  
P.O. Box 830 Safat  
**KUWAIT**  
Tel: 42-4910, 41-1726  
Telex: 22481 Areeg kt  
CH,E,M  
Photo & Cine Equipment  
P.O. Box 270 Safat  
**KUWAIT**  
Tel: 42-2846, 42-3801  
Telex: 22247 Matin kt  
P

## LEBANON

G.M. Dolmadjian  
Achrafieh  
P.O. Box 165.167  
**BEIRUT**  
Tel: 290293  
MP\*\*  
Computer Information Systems  
P.O. Box 11-6274  
**BEIRUT**  
Tel: 89 40 73  
Telex: 22259  
C

## LUXEMBOURG

Hewlett-Packard Belgium S.A./N.V.  
Blvd de la Woluwe, 100  
Woluwedal  
B-1200 **BRUSSELS**  
Tel: (02) 762-32-00  
Telex: 23-494 paloben bru  
A,CH,CM,CS,E,MP,P

## MALAYSIA

Hewlett-Packard Sales (Malaysia)  
Sdn. Bhd.  
1st Floor, Bangunan British  
American  
Jalan Semantan, Damansara Heights  
**KUALA LUMPUR** 23-03  
Tel: 943022  
Telex: MA31011  
A,CH,E,M,P\*

**MAYLAISIA (Cont'd)**

Protel Engineering  
P.O.Box 1917  
Lot 6624, Section 64  
23/4 Pending Road  
Kuching, **SARAWAK**  
Tel: 36299  
Telex: MA 70904 PROMAL  
Cable: PROTELENG  
A,E,M

**MALTA**

Philip Toledo Ltd.  
Notabile Rd.  
**MRIEHEL**  
Tel: 447 47, 455 66  
Telex: Media MW 649  
E,P

**MEXICO**

Hewlett-Packard Mexicana, S.A.  
de C.V.  
Av. Periferico Sur No. 6501  
Tepepan, Xochimilco  
16020 **MEXICO D.F.**  
Tel: 6-76-46-00  
Telex: 17-74-507 HEWPACK MEX  
A,CH,CS,E,MS,P  
Hewlett-Packard Mexicana, S.A.  
de C.V.  
Ave. Colonia del Valle 409  
Col. del Valle  
Municipio de Garza Garcia  
**MONTERREY**, Nuevo Leon  
Tel: 78 42 41  
Telex: 038 410  
CH  
ECISA  
José Vasconcelos No. 218  
Col. Condesa Deleg. Cuauhtémoc  
**MEXICO D.F. 06140**  
Tel: 553-1206  
Telex: 17-72755 ECE ME  
M

**MOROCCO**

Dolbeau  
81 rue Karatchi  
**CASABLANCA**  
Tel: 3041-82, 3068-38  
Telex: 23051, 22822  
E

Gerep  
2 rue d'Agadir  
Boite Postale 156  
**CASABLANCA**  
Tel: 272093, 272095  
Telex: 23 739  
P

**NETHERLANDS**

Hewlett-Packard Nederland B.V.  
Van Heuven Goedhartlaan 121  
NL 1181KK **AMSTELVEEN**  
P.O. Box 667  
NL 1180 AR **AMSTELVEEN**  
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Telex: 13 216 HEPA NL  
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Hewlett-Packard Nederland B.V.  
Bongerd 2  
NL 2906VK **CAPELLE A/D IJSEL**  
P.O. Box 41  
NL 2900AA **CAPELLE A/D IJSEL**  
Tel: (10) 51-64-44  
Telex: 21261 HEPAC NL  
A,CH,CS,E

Hewlett-Packard Nederland B.V.  
Pastoor Petersstraat 134-136  
NL 5612 LV **EINDHOVEN**  
P.O. Box 2342  
NL 5600 CH **EINDHOVEN**  
Tel: (040) 326911  
Telex: 51484 hepae nl  
A,CH\*,E,M

**NEW ZEALAND**

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Epsom, **AUCKLAND**  
Tel: 687-159  
Cable: HEWPACK Auckland  
CH,CM,E,P\*  
Hewlett-Packard (N.Z.) Ltd.  
4-12 Cruickshank Street  
Kilbirnie, **WELLINGTON 3**  
P.O. Box 9443  
Courtenay Place, **WELLINGTON 3**  
Tel: 877-199  
Cable: HEWPACK Wellington  
CH,CM,E,P

Northrop Instruments & Systems Ltd.  
369 Khyber Pass Road  
P.O. Box 8602  
**AUCKLAND**  
Tel: 794-091  
Telex: 60605  
A,M

Northrop Instruments & Systems Ltd.  
110 Mandeville St.  
P.O. Box 8388  
**CHRISTCHURCH**  
Tel: 486-928  
Telex: 4203  
A,M

Northrop Instruments & Systems Ltd.  
Sturdee House  
85-87 Ghuznee Street  
P.O. Box 2406  
**WELLINGTON**  
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Telex: NZ 3380  
A,M

**NORTHERN IRELAND**

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**NORWAY**

Hewlett-Packard Norge A/S  
Folke Bernadottes vei 50  
P.O. Box 3558  
N-5033 **FYLLINGSDALEN** (Bergen)  
Tel: 0047/5/16 55 40  
Telex: 16621 hpnas n  
CH,CS,E,MS

Hewlett-Packard Norge A/S  
Österndalen 16-18  
P.O. Box 34  
N-1345 **ÖSTERÅS**  
Tel: 0047/2/17 11 80  
Telex: 16621 hpnas n  
A,CH,CM,CS,E,M,P

**OMAN**

Khimjil Ramdas  
P.O. Box 19  
**MUSCAT**  
Tel: 722225, 745601  
Telex: 3289 BROKER MB MUSCAT  
P  
Suhail & Saud Bahwan  
P.O.Box 169  
**MUSCAT**  
Tel: 734 201-3  
Telex: 3274 BAHWAN MB

**PAKISTAN**

Mushko & Company Ltd.  
1-B, Street 43  
Sector F-8/1  
**ISLAMABAD**  
Tel: 51071  
Cable: FEMUS Rawalpindi  
A,E,M  
Mushko & Company Ltd.  
Oosman Chambers  
Abdullah Haroon Road  
**KARACHI 0302**  
Tel: 524131, 524132  
Telex: 2894 MUSKO PK  
Cable: COOPERATOR Karachi  
A,E,M,P\*

**PANAMA**

Electrónico Balboa, S.A.  
Calle Samuel Lewis, Ed. Alfa  
Apartado 4929  
**PANAMA 5**  
Tel: 63-6613, 63-6748  
Telex: 3483 ELECTRON PG  
A,CM,E,M,P

**PERU**

Cía Electro Médica S.A.  
Los Flamencos 145, San Isidro  
Casilla 1030  
**LIMA 1**  
Tel: 41-4325, 41-3703  
Telex: Pub. Booth 25306  
CME,M,P

**PHILIPPINES**

The Online Advanced Systems  
Corporation  
Rico House, Amorsolo Cor. Herrera  
Street  
Legaspi Village, Makati  
P.O. Box 1510  
Metro **MANILA**  
Tel: 85-35-81, 85-34-91, 85-32-21  
Telex: 3274 ONLINE  
A,CH,CS,E,M  
Electronic Specialists and Proponents  
Inc.  
690-B Epitanio de los Santos Avenue  
Cubao, **QUEZON CITY**  
P.O. Box 2649 Manila  
Tel: 98-96-81, 98-96-82, 98-96-83  
Telex: 40018, 42000 ITT GLOBE  
**MACKAY BOOTH**  
P

**PORTUGAL**

Mundinter  
Intercambio Mundial de Comércio  
S.A.R.L.  
P.O. Box 2761  
Av. Antonio Augusto de Aguiar 138  
**P-LISBON**  
Tel: (19) 53-21-31, 53-21-37  
Telex: 16691 munter p  
M  
Soquimica  
Av. da Liberdade, 220-2  
1298 **LISBOA** Codex  
Tel: 56 21 81/2/3  
Telex: 13316 SABASA  
P

Telectra-Empresa Técnica de  
Equipamentos Eléctricos S.A.R.L.  
Rua Rodrigo da Fonseca 103  
P.O. Box 2531  
**P-LISBON 1**  
Tel: (19) 68-60-72  
Telex: 12598  
CH,CS,E,P

**PUERTO RICO**

Hewlett-Packard Puerto Rico  
Ave. Muñoz Rivera #101  
Esq. Calle Ochoa  
**HATO REY**, Puerto Rico 00918  
Tel: (809) 754-7800  
Hewlett-Packard Puerto Rico  
Calle 272 Edificio 203  
Urb. Country Club  
**RIO PIEDRAS**, Puerto Rico  
P.O. Box 4407  
**CAROLINA**, Puerto Rico 00628  
Tel: (809) 762-7255  
A,CH,CS

**QATAR**

Compute Arabia  
P.O. Box 2750  
**DOHA**  
Tel: 883555  
Telex: 4806 CHPARB  
P  
Eastern Technical Services  
P.O.Box 4747  
**DOHA**  
Tel: 329 993  
Telex: 4156 EASTEC DH  
Nasser Trading & Contracting  
P.O.Box 1563  
**DOHA**  
Tel: 22170, 23539  
Telex: 4439 NASSER DH  
M

**SAUDI ARABIA**

Modern Electronic Establishment  
Hewlett-Packard Division  
P.O. Box 22015  
Thuobah  
**AL-KHOBAR**  
Tel: 895-1760, 895-1764  
Telex: 671 106 HPMEEK SJ  
Cable: ELECTA AL-KHOBAR  
CH,CS,E,M  
Modern Electronic Establishment  
Hewlett-Packard Division  
P.O. Box 1228  
Redec Plaza, 6th Floor  
**JEDDAH**  
Tel: 644 38 48  
Telex: 4027 12 FARNAS SJ  
Cable: ELECTA JEDDAH  
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Modern Electronic Establishment  
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P.O.Box 22015  
**RIYADH**  
Tel: 491-97 15, 491-63 87  
Telex: 202049 MEERYD SJ  
CH,CS,E,M  
Abdul Ghani El Ajou  
P.O. Box 78  
**RIYADH**  
Tel: 40 41 717  
Telex: 200 932 EL AJOU  
P

**SCOTLAND**

See United Kingdom

**SINGAPORE**

Hewlett-Packard Singapore (Sales)  
Pte. Ltd.  
#08-00 Inchcape House  
450-2 Alexandra Road  
P.O. Box 58 Alexandra Rd. Post Office  
**SINGAPORE, 9115**  
Tel: 631788  
Telex: HPSGSO RS 34209  
Cable: HEWPACK, Singapore  
A,CH,CS,E,MS,P



# SALES & SUPPORT OFFICES

Arranged alphabetically by country

## SINGAPORE (Cont'd)

*Dynamar International Ltd.*  
Unit 05-11 Block 6  
Kolam Ayer Industrial Estate  
**SINGAPORE 1334**  
Tel: 747-6188  
Telex: RS 26283  
CM

## SOUTH AFRICA

Hewlett-Packard So Africa (Pty.) Ltd.  
P.O. Box 120  
Howard Place **CAPE PROVINCE 7450**  
Pine Park Center, Forest Drive,  
Pinelands

## CAPE PROVINCE 7405

Tel: 53-7954  
Telex: 57-20006  
A,CH,CM,E,MS,P

Hewlett-Packard So Africa (Pty.) Ltd.

P.O. Box 37099  
92 Overport Drive  
**DURBAN 4067**

Tel: 28-4178, 28-4179, 28-4110  
Telex: 6-22954  
CH,CM

Hewlett-Packard So Africa (Pty.) Ltd.

6 Linton Arcade  
511 Cape Road  
Linton Grange

## PORT ELIZABETH 6000

Tel: 041-302148  
CH

Hewlett-Packard So Africa (Pty.) Ltd.

P.O. Box 33345  
Glenstantia 0010 **TRANSVAAL**  
1st Floor East

Constantia Park Ridge Shopping  
Centre

Constantia Park

## PRETORIA

Tel: 982043  
Telex: 32163  
CH,E

Hewlett-Packard So Africa (Pty.) Ltd.

Private Bag Wendywood  
**SANDTON 2144**

Tel: 802-5111, 802-5125

Telex: 4-20877

Cable: HEWPACK Johannesburg

A,CH,CM,CS,E,MS,P

## SPAIN

Hewlett-Packard Española S.A.  
Calle Entenza, 321

**E-BARCELONA 29**

Tel: 322.24.51, 321.73.54

Telex: 52603 hpbee

A,CH,CS,E,MS,P

Hewlett-Packard Española S.A.

Calle San Vicente S/No

Edificio Albia II

**E-BILBAO 1**

Tel: 423.83.06

A,CH,E,MS

Hewlett-Packard Española S.A.

Ctra. de la Coruña, Km. 16, 400

Las Rozas

**E-MADRID**

Tel: (1) 637.00.11

CH,CS,M

Hewlett-Packard Española S.A.

Avda. S. Francisco Javier, S/No

Planta 10. Edificio Sevilla 2,

**E-SEVILLA 5**

Tel: 64.44.54

Telex: 72933

A,CS,MS,P

Hewlett-Packard Española S.A.

Calle Ramon Gordillo, 1 (Entlo.3)

**E-VALENCIA 10**

Tel: 361-1354

CH,P

## SWEDEN

Hewlett-Packard Sverige AB

Sunnanvagen 14K

S-22226 **LUND**

Tel: (046) 13-69-79

Telex: (854) 17886 (via Spånga

office)

CH

Hewlett-Packard Sverige AB

Östra Tullgatan 3

S-21128 **MALMÖ**

Tel: (040) 70270

Telex: (854) 17886 (via Spånga

office)

Hewlett-Packard Sverige AB

Västra Vintergatan 9

S-70344 **ÖREBRO**

Tel: (19) 10-48-80

Telex: (854) 17886 (via Spånga

office)

CH

Hewlett-Packard Sverige AB

Skalholtsgratan 9, Kista

Box 19

S-16393 **SPÅNGA**

Tel: (08) 750-2000

Telex: (854) 17886

Telefax: (08) 7527781

A,CH,CM,CS,E,MS,P

Hewlett-Packard Sverige AB

Frötällisgatan 30

S-42132 **VÄSTRA-FRÖLUNDA**

Tel: (031) 49-09-50

Telex: (854) 17886 (via Spånga

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CH,E,P

## SWITZERLAND

Hewlett-Packard (Schweiz) AG

Clarastrasse 12

CH-4058 **BASEL**

Tel: (61) 33-59-20

A

Hewlett-Packard (Schweiz) AG

7, rue du Bois-du-Lan

Case Postale 365

CH-1217 **MEYRIN 2**

Tel: (0041) 22-83-11-11

Telex: 27333 HPAG CH

CH,CM,CS

Hewlett-Packard (Schweiz) AG

Allmend 2

CH-8967 **WIDEN**

Tel: (0041) 57 31 21 11

Telex: 53933 hpag ch

Cable: HPAG CH

A,CH,CM,CS,E,MS,P

## SYRIA

*General Electronic Inc.*

Nuri Basha Ahnaf Ebn Kays Street

P.O. Box 5781

**DAMASCUS**

Tel: 33-24-87

Telex: 411 215

Cable: ELECTROBOR DAMASCUS

E

*Middle East Electronics*

P.O.Box 2308

*Abu Rummaneh*

**DAMASCUS**

Tel: 33 4 5 92

Telex: 411 304

M

## TAIWAN

Hewlett-Packard Far East Ltd.

Kaohsiung Office

2/F 68-2, Chung Cheng 3rd Road

**KAOHSIUNG**

Tel: (07) 241-2318

CH,CS,E

Hewlett-Packard Far East Ltd.

Taiwan Branch

8th Floor

337 Fu Hsing North Road

**TAIPEI**

Tel: (02) 712-0404

Telex: 24439 HEWPACK

Cable: HEWPACK Taipei

A,CH,CM,CS,E,M,P

*Ing Lih Trading Co.*

3rd Floor, 7 Jen-Ai Road, Sec. 2

**TAIPEI 100**

Tel: (02) 3948191

Cable: INGLIH TAIPEI

A

## THAILAND

*Unimesa*

30 Patpong Ave., Suriwong

**BANGKOK 5**

Tel: 235-5727

Telex: 84439 Simonco TH

Cable: UNIMESA Bangkok

A,CH,CS,E,M

*Bangkok Business Equipment Ltd.*

5/5-6 Dejo Road

**BANGKOK**

Tel: 234-8670, 234-8671

Telex: 87669-BEQUIPT TH

Cable: BUSIQUIPT Bangkok

P

## TRINIDAD & TOBAGO

*Caribbean Telecoms Ltd.*

50/A Jerningham Avenue

P.O. Box 732

**PORT-OF-SPAIN**

Tel: 62-44213, 62-44214

Telex: 235,272 HUGCO WG

CM,E,M,P

## TUNISIA

*Tunisie Electronique*

31 Avenue de la Liberte

**TUNIS**

Tel: 280-144

E,P

*Corema*

1 ter. Av. de Carthage

**TUNIS**

Tel: 253-821

Telex: 12319 CABAM TN

M

## TURKEY

*Teknim Company Ltd.*

Iran Caddesi No. 7

Kavaklidere, **ANKARA**

Tel: 275800

Telex: 42155 TKNM TR

E

E.M.A.

*Medina Eldem Sokak No.4/1/6*

*Yüksel Caddesi*

**ANKARA**

Tel: 175 622

Telex: 42 591

M

## UNITED ARAB EMIRATES

*Emitac Ltd.*

P.O. Box 2711

**ABU DHABI**

Tel: 82 04 19-20

Cable: EMITAC ABUDHABI

*Emitac Ltd.*

P.O. Box 1641

**SHARJAH**

Tel: 591 181

Telex: 68136 Emitac Sh

CH,CS,E,M,P

## UNITED KINGDOM

### GREAT BRITAIN

Hewlett-Packard Ltd.

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Navigation Road

**ALTRINCHAM**

Cheshire WA14 1NU

Tel: 061 928 6422

Telex: 668068

A,CH,CS,E,M,MS,P

Hewlett-Packard Ltd.

Elstree House, Elstree Way

**BOREHAMWOOD**, Herts WD6 1SG

Tel: 01 207 5000

Telex: 8952716

E,CH,CS,P

Hewlett-Packard Ltd.

Oakfield House, Oakfield Grove

Clifton **BRISTOL**, Avon BS8 2BN

Tel: 0272 736806

Telex: 444302

CH,CS,E,P

Hewlett-Packard Ltd.

Bridewell House

Bridewell Place

**LONDON EC4V 6BS**

Tel: 01 583 6565

Telex: 298163

CH,CS,P

Hewlett-Packard Ltd.

Fourier House

257-263 High Street

**LONDON COLNEY**

Herts. AL2 1HA, St. Albans

Tel: 0727 24400

Telex: 1-8952716

CH,CS

Hewlett-Packard Ltd.

Pontefract Road

**NORMANTON**, West Yorkshire WF6 1RN

Tel: 0924 895566

Telex: 557355

CH,CS,P

Hewlett-Packard Ltd.

The Quadrangle

106-118 Station Road

**REDHILL**, Surrey RH1 1PS

Tel: 0737 68655

Telex: 947234

CH,CS,E,P

# SALES & SUPPORT OFFICES

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B90 4BL  
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Telex: 339105  
CH,CS,E,P

Hewlett-Packard Ltd.  
West End House  
41 High Street, West End  
**SOUTHAMPTON**  
Hampshire SO3 3DQ  
Tel: 04218 6767  
Telex: 477138  
CH,CS,P

Hewlett-Packard Ltd.  
Eskdale Rd.  
Winnersh, **WOKINGHAM**  
Berkshire RG11 5DZ  
Tel: 0734 696622  
Telex: 848884  
E

Hewlett-Packard Ltd.  
King Street Lane  
Winnersh, **WOKINGHAM**  
Berkshire RG11 5AR  
Tel: 0734 784774  
Telex: 847178  
A,CH,CS,E,M,MP,P  
Hewlett-Packard Ltd.  
Nine Mile Ride  
Easthampstead, **WOKINGHAM**  
Berkshire, 3RG11 3LL  
Tel: 0344 773100  
Telex: 848805  
CH,CS,E,P

## IRELAND

### NORTHERN IRELAND

Hewlett-Packard Ltd.  
Cardiac Services Building  
95A Finaghy Road South  
**BELFAST** BT10 0BY  
Tel: 0232 625-566  
Telex: 747626  
CH,CS

### SCOTLAND

Hewlett-Packard Ltd.  
**SOUTH QUEENSFERRY**  
West Lothian, EH30 9TG  
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