HP-41 HP-IL SYSTEM DICTIONARY

Cary E. Reinstein

Corvallis Software Inc.

HP-41/HP-IL SYSTEM DICTIONARY

BY
CARY ENOCH REINSTEIN

Corvallis Software Inc. P.O. Box 1412 Corvallis, OR 97339-1412 USA

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I would like to gratefully acknowledge the help and encouragement given to me Richard Nelson, the founder of PPC, the world-wide calculator users' group, who suggested that I compile this book and pointed out the need for a reference of this type. I am grateful for the help and enthusiasm of John Dearing, of Corvallis Software, and his unfailing support. Special mention must also be made of Robert Swanson of Oregon Health Sciences University for the special effort he made to prepare the material on synthetic tones and to Roger Hill for permission to reprint his program material; to Paul Lind who contributed his key assignment routine; and, to Keith Jarett, for the use of his Hex Table. These individuals are all members of PPC, whose thousands of members, owners and users of HP programmable calculators, share their experiences and knowledge for the benefit of the user community and thereby immeasurably expand the utility, value and pleasure of owning an "HP".

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COVER PHOTOGRAPH BY THE AUTHOR.

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CONTENTS

PREFIX

PREFIX, an HP term for the first byte of a multi-byte instruction...

Just as we thought we had mastered our friendly little 41C's and CV's, HP has introduced a battalion of new functions, new peripherals and new concepts. We find ourselves referring to peripherals as devices and to devices as "Listeners" and "Talkers". No longer do we simply clear a program when we are done with it; we may CLP it, PCLPS it, PURFL it or PURGE it; we may READP it, MRG it, GETP it, RSUB it or READSUB it. We have main memory, extended storage registers and Extended Memory. There are programs and files and text files and Extended Memory Directories and Mass Storage Directories, DIR's and EMDIR's. CATALOG positions the calculator to a program but EMDIR does not. However, we must "point" to a register before we can recall it, or GET it, or READ it. We CREATE data files and SEEK data registers on the "medium".

And, with the notable exception of the TIME Module*, all are accompanied by thin manuals, devoid of examples and comparisms with not an application program in sight. To further assure that countless 41C owners will be committed to the State Home for the Perplexed, HP has acknowledged that possibly the most interesting and powerful 41C functions are not hinted at in any of their manuals and handbooks, namely, Synthetic instructions. Richard Nelson, editor of PPC Calculator Journal and founder of the world's first and largest calculator user's group has commented "...today's hardware is so powerful and physically small that the machine fits into a pocket or small corner of a brief case, but the software fills a filing cabinet." Thus it was that Richard called me in February, 1982, and suggested that I compile a syntax dictionary for the 41C. I began the project and soon found myself behind a pile of over a thousand file cards with 41C functions and their parameters! A truly complete dictionary would include every Application Module program and a wealth of examples. Of course, this would have made an expensive 200 - 300 page book. To stay within reasonable bounds, we decided to include the most used functions with an outline of how to use them, a sort of glossary/quick reference guide to the 41C system and some of the new HP-IL devices.

An attempt has been made to include reference material that is new, such as Robert Swanson's graphic TONE table and musical scale and four pages of function timing, an invaluable aid to any programmer who needs to get the most out of their machine. Richard Nelson has generously permitted us to reprint his article on the "Byte Grabber" where he outlines a simple technique that will take any user into the land of the 41C's undocumented (by HP) mysteries and yield practical results. Also included is a short Key Assignment program that has passed through the hands of programmers on three continents and an article on a function whose name sounds like an April Fool's joke but which can "assign" every Printer and Interface function to a single key!

In the near future, the author and Corvallis Software will be attempting to fill the gaps in published HP-IL documentation with practical applications and examples, and, rather than merely lament the paucity of manufacturer published support material, accept it as a challenge and an opportunity.

Cary Enoch Reinstein

* The TIME Module Owner's Manual is an outstanding example of complete documentation and includes short routines that can get the user started as well as abundant and clear explanation of all TIME functions and their formats. The Petroleum Application Module and TIME Module manuals should certainly set the example for future documentation and be regarded as benchmarks. At this point, however, they stand alone.

A WORD OF EXPLANATION

Following are representative dictionary entries and their formats.

41C Terminology:

CONTROL WORD A formatted number in the stack or a data register used by various functions to define parameters. ISG, for example, uses a typical control word of the form iiiii.fffcc where iiiii is the current value, fff is the test value and cc is the increment value. GETRX (XFUNCTION) uses a word of the form bbb.eee where bbb specifies the beginning register number and eee the ending register number. Examples of word formats are given with all functions that require them. See the particular function.

how and where to input parameters

XROM number Type of function general purpose

A peripheral function:

CREATE HP-IL xrom 28,01 Mass Storage function to allocate data file registers.
|||X: number of registers in file||| |||ALPHA: file name (=7 characters) |||
Possible error: DUP FL NAME. CREATE does not replace an existing file of the same name as do other mass storage functions. See CRFLAS, CRFLD, WRITING DATA, ZERO.

limits and possible errors cross references or similar sounding functions

Subroutine levels left to user

DR DELETE RECORD, PPC ROM 20,38, SIZE 010, Subr. levels: 5. To delete the nth record (adjacent group of data registers in main memory), input n, xeq DR. The following parameters must be pre-stored: R07 = 1st register of entire file
R08 = number of registers per record
R09 = number of records in the file.

inputs, prior to use

See BLOCK OPERATIONS - PPC, DELCHR, DELREC.

where related routines may be found

CHECKSUM CHECKSUM ERR CHECKSUM ERROR CHKSUM ERR

Different peripherals spell similar terms and messages differently. In this example "Checksum" is spelled by the Card Reader, HP-IL and XFUNCTION Module.

READING XFUNCTION: ARCLREC, GETAS, GETP, GETR, GETREC, GETRX, GETSUB, GETX. MASS STORAGE: READA etc.

Groups of functions are listed as an aid to the reader

|||Z: year YYYY||| |||Y: month MM||| |||X: day of month DD|||

When several parameters must be entered they are separated by ||| for clarity.

XROM and Execute are spelled in lower case to distinguish them from function names.

A

a REGISTER A 41C status register containing subroutine return addresses 4 - 6 and part of 3. Absolute address 00B. See Appendix The Status Registers.

A? ASSIGNMENT REGISTER FINDER, PPC ROM 10,02, SIZE 012, Subr. levels: 3. Returns the number of assignment registers used to X. Caution: may alter or delete pending Timer Alarms. See KEY ASSIGNMENTS - PPC.

Ab ALPHA STORE b, PPC ROM 10,61, SIZE 000, Subr. levels: 0. Used to provide ROM entry at arbitrary points by moving the program pointer, for example, at a local label or a Microcode routine. See b REGISTER, PROGRAM POINTER - PPC.

ABS ABSOLUTE VALUE or magnitude of a number, also useful for storing positive numbers temporarily in L such as control numbers for ISG or DSE.

ABSOLUTE ADDRESS Refers to a register number referenced to the T register, R000; the X register, R003; e register, R015; key assignments, R192; to the highest data register in main memory, R511. See Appendix The Status Registers.

ACA ACCUMULATE ALPHA, Printer 82143A and HP-IL xrom 29,01. Printer: appends entire Alpha register to the print buffer. Converter: sends the numeric codes of the Alpha register characters to the Converter followed by End-of-Line. To use: MANIO, Converter address in X, SELECT, ("ALPHA CHARACTERS"), ACA. |||ALPHA: text line or characters||| PRINT BUFFER.

ACCHR ACCUMULATE CHARACTER, Printer 82143A or HP-IL xrom 29,02. Printers: appends a single character whose number is in X to the print buffer. Converter: sends the character whose number is in X to the Converter. Used to send non-standard characters such as Escape (27) or Bell (7). Characters 10, 13 and 126 are not permitted. Prior to use: MANIO, Converter address in X, SELECT. Video: sends Backspace, Line-Feed, Carriage Return and Escape. |||X: Character code 0 - 127||| See PRINT BUFFER.

ACCOL ACCUMULATE COLUMN, Printer 82143A or HP-IL xrom 29,03. Accumulates a column of dots into the print buffer. |||X: Column Print Number||| See COLUMN PRINT NUMBERS, PRINT BUFFER.

ACCURACY FACTOR To compensate for the moderate variations of quartz crystals, an accuracy factor may be set from the keyboard or by a program. One pulse of 10,240/second may be added or deleted every nn.n seconds between the limits of .1 and 99.9 seconds (to nearest tenth). To calculate manually:

$$\frac{1}{\dfrac{1}{\text{PRESENT ACCURACY FACTOR}} - \dfrac{1024}{8640} \times \text{ERROR IN SECONDS PER DAY}}$$

See CORRECT, RCLAF, SETAF.

ACOS ARC COSINE, |||X: angle in decimal degrees||| Check DEG, RAD or GRAD mode.

ACSPEC ACCUMULATE SPECIAL CHARACTER, Printer 82143A or HP-IL xrom 29,04. Accumulates the special character data in X, created by BLDSPEC, into the print buffer. When BLDSPEC characters have been made with synthetic text lines (normally saving gtr. 20 Bytes), the code takes the form: RCL M, ACSPEC. See BL, BLDSPEC, PRINT BUFFER.

ACTIVATED PAST-DUE ALARM TIME Module. An alarm remaining in 41C memory resulting from an alarm that either was acknowledged with the STO key or not acknowledged at all. See ALMCAT.

ACX ACCUMULATE X, Printer 82143A or HP-IL xrom 29,05. Printer: accumulates X into the print buffer, |||X: data to be transferred to the print buffer|||. Converter: sends the character codes of the displayed digits in X to the Converter. Prior to use (Converter only): MANIO, Converter address in X, SELECT. See CHARACTER CODES, PRINT BUFFER.

AD ALPHA DELETE LAST CHARACTER, PPC ROM 10,18, SIZE 000, Subr. levels: 6. Deletes the rightmost character from the Alpha register. See ALPHA REGISTER - PPC, AROT, ATOX.

ADATE APPEND DATE TO ALPHA, TIME xrom 26,01. Appends a number to Alpha formatted with diagonals (/) or periods (.) according to the date format, MDY or DMY. The number of characters appended depends upon the display format. FIX 1 or 2: appends 2 characters; FIX 3 or 4: 4 characters (the year, YYYY portion shows the 2 least significant digits); FIX 5 or 6: 6 characters. For example: X contains 1.281977 in FIX 2, 1.28; Alpha displays 1/28/77. See ATIME, ATIME24, DATE FORMATTING.

ADDRESS In general, refers to a group of digits that identify a register or other data location. In the HP-IL system, ADDRESS means the sequence number, counting outward from the 41C (as Controller) from 1 - 31. See ABSOLUTE ADDRESS, ROM ADDRESS, Appendix The Status Registers.

ADR ERR ADDRESS ERROR, HP-IL error message. LISTEN data <1 or >31
SELECT data <1 or >30

ADV ADVANCE Printer one line. Prints the contents of the print buffer right-justified; ignored if there is no Printer in the system. See PRINT BUFFER.

AL ALPHABETIZE X AND Y, PPC ROM 10,37, SIZE 000, Subr. levels: 4. Sorts 2 alpha strings in X and Y and places the lowest value in X. To sort data in 2 registers, place register numbers in X and Y prior to call. Sets Flag 10 if interchange performed. See ALPHA REGISTER - PPC.

↑ ALARM or ↑↑ALARM See CONTROL ALARMS, XYZALM, also Appendix Alarms.

ALARM CONDITION This condition exists when an alarm comes due or a past-due Control Alarm activates while the Clock is displayed. See PAST-DUE ALARMS.

ALENG ALPHA LENGTH, XFUNCTION xrom 25,01. Returns the number of characters in Alpha.

ALMCAT ALARM CATALOG, TIME xrom 26,02. Displays all alarms in 41C memory. To print, set TRACE mode on the Printer. When halted by R/S, the keyboard is redefined; only the listed keys are active:

D	Displays the date of the alarm, MM/DD/YY DOW
M	Displays the alarm message, (ALPHA...) press again if message longer than 12 characters
R	Displays the reset interval, HH:MM:SS.t
[ ] R	Advances the alarm to the next reset interval
T	Displays the alarm time, HH:MM:SS.t (AM or PM in 12-hour mode)
[ ] T	Displays the current time
[ ] c	Purges the alarm. This is the only way to delete an alarm. Reset alarms may also be silenced by acknowledging with the STO key, but they will remain in memory.
(←)	Exits ALMCAT mode.
SST	Advances display to the next alarm.

This mode causes a higher than normal current drain. Programmable.
See I/O BUFFER, RE-DEFINED KEYBOARD, XYZALM, also Appendix Alarms.

ALMNOW ALARM NOW, TIME xrom 26,03. Activates all past-due Control Alarms sequentially from the keyboard or in a running program. See CONTROL ALARMS, PAST-DUE ALARMS, Appendix Alarms.

ALMREL Program in the TIME Module Owner's Manual to set an XYZALM relative to the current clock time. The program is self-prompting and appears in Appendix C. Program uses only the stack and Alpha register but is not subroutineable due to I/O halts.

ALPHA DATA Error Message generated when alpha characters are in a register that requires numeric data, such as COS or SELECT. TIME: refers to X or Y for DATE+ or DDAYS, to X, Y or Z for XYZALM, or X for other functions requiring numeric data. See specific functions.

ALPHA REGISTER A group of 4 registers, M, N, O and P, that are "coupled" by the 41C to hold up to 28 alpha characters (24 are displayable). The rightmost 7 bytes are in register M and the leftmost 7 bytes are in register P. See Appendix The Status Registers.

ALPHA REGISTER - PPC Routines in the PPC ROM that manipulate the Alpha register:

AD: Alpha Delete Last Character	NC: Nth Character
AM: Alpha to Memory	SU: Substitute Character
MA: Memory to Alpha	VA: View Alpha

Refer to the above listed routines for details.

ALPHA STRING A sequence of bytes preceded by the text (superscript T) prefix. The HEX code for the text indicator is F1 - FF (decimal 241 - 255). For example the alpha string "ABCDEF" is preceded by F6 and shown in program memory as ⁻ABCDEF.
Programming Note. Analyze alpha strings when programming, keeping in mind these lengths:
6: 6 characters can be stored in a numeric or stack register;
9: 9 characters will show in a 2-digit line number (01 - 99) when in PRGM mode without

ALPHA STRING (Con't)
scrolling; 9 characters can be appended to a 15-character string without losing characters on the left.
12: 12 characters will display with a PROMPT without scrolling (not counting punctuation).
15: 15 characters will fit in 1 line of a program.
24: 24 characters will fill the Alpha register (including punctuation).

ALTERNATE CHARACTER SET HP82162A Printer's enhanced set of 128 characters. Opposite of ASCII Set (96 characters). See ASCII CHARACTER SET, Appendix Hex Table and Appendix Print Characters.

AM ALPHA TO MEMORY, PPC ROM 20,53, SIZE 005, Subr. levels: 5. Stores the contents of the Alpha register into data registers using a control word in X. Opposite of MA.
|||X: bbb.eeeii, beginning register. ending register increment||| |||ALPHA: ALPHA...|||
Example: X = 1.00702. Alpha will be stored in registers 01, 03, 05 and 07.
See ALPHA REGISTER - PPC.

AND Boolean logic operator. Two expressions or bits are compared; if both are true (nonzero), the result is true (1). See NOT, OR, XOR.

ANUM ALPHA TO NUMBER, XFUNCTION xrom 25,02. Converts a grouping of digits in Alpha to normalized data in X. The leftmost group of digits will be converted. Proper conversion depends upon the display mode; in most cases, Flags 28 and 29 should be set prior to conversion.
See AROT.

AOFF ALPHA MODE OFF. Takes the 41C out of Alpha mode. Opposite of AON. A typical use would be when the program stops for alpha input. Example: "INPUT ALPHA" AON STOP AOFF. (Key in alpha characters in response to prompt) R/S

AON ALPHA MODE ON. See AOFF (above).

APPCHR APPEND CHARACTERS, XFUNCTION xrom 25,03. Appends the Alpha register to the end of the ASCII File record indicated by the pointer position. Can be used for editing a record or creating a record longer than 24 characters for use by an 80-column Printer. The file must be the working file. |||ALPHA: string to be appended....||| If performed from the keyboard, xeq GETREC to view the string (in Alpha) to be edited. See APPREC, GETREC, RCLPT, SEEKPT.

APPEND (Program mode symbol: ├). To execute function, press [ ] ASN in Alpha mode. Used in program mode to create alpha strings longer than 15 characters. See APPCHR, APPREC, ARCL.

├ REGISTER 41C status register containing bit map of unshifted key assignments, absolute address 00A. See Appendix The Status Registers.

APPREC APPEND RECORD, XFUNCTION xrom 25,04. Adds the Alpha register to the end of the working file. The record pointer is maintained and updated automatically within the file itself.
|||ALPHA: text string to be placed in ASCII File||| See APPCHR, GETREC.

ARCL ALPHA RECALL. Appends a stored alpha string to the Alpha register. If more than 24 characters are ARCL'd, the leftmost alpha characters will be lost. Similar to RCL, the stack or data register is not altered. Prompts: ARCL – –. Fill prompt with a register address (00 - 99), an indirect address (press SHIFT) or a stack register (press .).
Example: Alpha register contains the character "$" and X contains the digits 1844.00.
ARCL (.) "X" Result in alpha: "$1844.00". See ALPHA STRING, APPEND, ASTO.

ARCLREC ALPHA RECALL RECORD, XFUNCTION xrom 25,05. Appends a record from the working ASCII File in Extended Memory to the Alpha register to a maximum of 24 characters. Prior to use, the record or character pointers may require positioning.
See RCLPT(A), SEEKPT(A).

AROT ALPHA ROTATE, XFUNCTION xrom 25,06. Rotates the number of alpha characters specified in X, left if positive, right if negative. Compare with ASHF which shifts - eliminates - 6 characters at once. Useful with ANUM. See ALPHA REGISTER - PPC, ASHF.

ASCII AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE. A code that represents standard characters by integers. Most of the 41C's standard characters (character codes) correspond to ASCII characters. For example 65 = A, 66 = B, etc.
See ASCII CHARACTER SET, Appendix Printer Characters

ASCII CHARACTER SET Set of 96 ASCII characters recognized by the HP-IL Printer 82162A and displayable by the Video interface 82163A. See ASCII, Appendix Printer Characters

ASHF ALPHA SHIFT. Deletes the leftmost 6 characters from the Alpha register. Required when storing (ASTO) an alpha string longer than 6 characters. Example: store the string "MOUNT CARMEL" in registers 01 and 02; ASTO 01 ASHF ASTO 02. R01 = "MOUNT " and R02 = "CARMEL". Compare with AROT, AD, or ATOX which can be used to shift (delete) the leftmost alpha characters, 1 at a time. See ALPHA REGISTER - PPC, AROT, ASTO, ATOX.

ASIN ARC SINE, |||X: angle in decimal degrees||| Check DEG, RAD or GRAD mode. Inputs must be less than 1.

ASN ASSIGN. Not programmable (note cross references, however). In USER mode any key except SHIFT may be assigned to any function or program name appearing in the Catalogs. To use: [ ] ASN (ALPHA) Function or Program Name (ALPHA) – – Fill prompt by pressing the desired key. See KEY ASSIGNMENTS - PPC, KEY CODES, PASN.

ASSEMBLY LANGUAGE A system of writing microcode programs by means of mnemonics such as AAU, Auto Address Unconfigure or machine instructions such as JIF, Jump if... Used by programmers in preference to writing in Binary. See BINARY, BCD, BYTE, MICROCODE.

ASTO ALPHA STORE. [ ] ASTO in Alpha mode prompts: ASTO – –. Fill prompt with a register address (00 - 99), an indirect address (press SHIFT) or a stack register (press .). See ASHF for example of use. Also see ALPHA REGISTER - PPC.

ATAN ARC TANGENT, |||X: angle in decimal degrees||| Check DEG, RAD or GRAD mode.

ATIME APPEND TIME TO ALPHA, TIME xrom 26,04. Appends X to Alpha formatted as time where the number of appended digits depends upon the current display mode, FIX 1 - 6. Also appends AM or PM if a 12 hour clock format is in use. Example: X contains the digits 5.1844 in FIX 4, Alpha contains the string "T=" xeq ATIME, result in Alpha: "T= 5:18:44 AM". ATIME cannot be keyed while in Alpha mode. Output format is HH:MM:SS.hh AM (or PM). See ADATE, ATIME24, ARCL, TIME FORMATTING.

ATIME24 APPEND TIME TO APLHA (independent of mode), TIME xrom 26,05. Appends X to Alpha formatted as time where the number of digits appended (2 - 6) depends upon the display format in use, FIX 1 - 6. The number is formatted with colons (:) as HH:MM:SS.hh. This format is used to display splits and elapsed times. To display the current Stopwatch time in Run mode, precede with RCLSW. Example: the Stopwatch has reached 5:23:18.44 (may be stopped or running); Alpha contains the string "ET=". To display the full elapsed time or split, FIX 6, RCLSW, ATIME24, AVIEW. Result: "ET=05:23:18.44". See ADATE, ARCL, RCLSW, SW, TIME FORMATTING.

ATOX XFUNCTION, xrom 25,07. Deletes the leftmost character in Alpha and places its character code in X, 0 - 255. May be used to interpret unintelligible characters or for Alpha register manipulations. No parameters required. Example: Alpha contains the string "MCARMEL". Xeq ATOX. X = 77, Alpha = "CARMEL". See ANUM, ASHF, CHARACTER CODE, HEX TABLE.

AUTO ADDRESS HP-IL message. The controller (41C) sends AADn to assign simple addresses to loop devices in the range 0 - 30.

AUTO ADDRESS UNCONFIGURE HP-IL message. The controller (41C) sends AAU to reset all loop devices to default addresses. Digital Cassette Drive 82161A responds with 2; Printer 82162A is set to 1. Not affected by Interface Clear.

AUTO EXTENDED PRIMARY HP-IL message. Used by (hypothetical) group of HP-IL devices that can accept secondary addresses. Allows up to 961 loop devices. Printer 82162A and Digital Cassette Drive 82161A do not respond.

AUTO MULTIPLE PRIMARY HP-IL message. Primary addresses 0 - 31 are assigned to all loop devices that can accept multiple addresses. Printer 82162A and Digital Cassette Drive 82161A ignore this message.

AUTOIO HP-IL xrom 28,27. Default (Flag 32 Clear) operating mode of HP-IL loop. In this mode the loop is searched from the SELECTed device forward for a device that can perform the re-

AUTOIO (Con't)
quested function. Compare with MANIO; see SELECT.

AVIEW ALPHA VIEW. Displays the Alpha register. If a Printer is in the system and Flag 21 is set, the displayed line will be printed. If program output is designed to be printed, PRA is preferable (faster and avoids scrolling). If AVIEW is executed by a running program (and Flag 21 is clear) the "goose" will disappear until a CLD, subsequent AVIEW, VIEW or similar display altering function is encountered. PAUSEs will not be seen during the AVIEW.
Also see CLD, FLAG 21, PROMPT, VIEW.

Random Numbers with the TIME Module

```
01♦LBL "RZ"
02♦LBL 01
03 TIME
04  E2
05 *
06 FRC
07 TIME
08 *
09  E9
10 *
11 INT
12 STO Y
13 5
14 MOD
15 X=0?
16 GTO 01
17 RCL Y
18 2
19 MOD
20 X=0?
21 GTO 01
22 R↑
23  E9
24 /
25 FRC
26 END
```

This random seed routine may be used with any pseudo-random number generator to provide an automatic seed, different every time, that will assure a long non-repetitive period. The routine takes seconds and 1/100s of seconds at the time it is called and multiplies them by the clock time to get a larger, unpredictable number. The number is increased to a large integer that will not exceed the precision of the 41C and tested to check for multiples of 2 or 5 as they would appreciably shorten the period of the random number generator. If the number passes, it is converted back to a fraction and returned to the calling routine. If it fails, the cycle is repeated with a new time until the number passes. The result will be a series of unpredictable digits, at least 7 in length, ending in 1, 3, 7 or 9. The last 6 significant digits exhibit the greatest randomness. Only the stack is used and no flags are affected. Used in conjunction with the pseudo-random number generator in the 41C Standard Pac, developed by Don Malm, it will generate at least 1 million distinct numbers between 0 and 1, regardless of the starting value and mimic the Randomize function in the HP85 computer, which also utilizes the internal clock for a seed, though to greater precision.

Lines 04, 09 and 23 show exponents in their abbreviated forms. To key normally: EEX followed by the number. The result is: 1 E2, etc. See pages 68 - 70 to see how to save a byte when keying these numbers.

Examples:

7:38:47.07 AM	358831707
7:38:51.20 AM	396891557
7:38:56.37 AM	435030629
7:39:01.49 AM	16036833
7:39:04.74 AM	61270221
7:39:10.85 AM	100153253

NOTES

b REGISTER 41C status register containing the coded position of the program pointer and subroutine returns 1 and 2 and half of 3.
See "a" REGISTER, PROGRAM POINTER - PPC, RCL b, Appendix The Status Registers.

BA BARCODE ANALYZER, PPC ROM 20,30, SIZE 019, Subr. Levels: 4. Prints tabular analysis of barcode including type, every byte in binary, hex and decimal and computes checksum to verify correct reading. To use: xeq BA. Prompts with "SCAN". See Appendix Barcode Types.

BACKSPACE 82163A Video Interface function. HP-IL ROM required. BACKSPACE moves the Cursor left by 1 column. If located at column 0, it moves to column 31 of the previous line.
|||X: 8.00||| xeq ACCHR. See ACCHR, CARRIAGE RETURN, ESCAPE, LINE-FEED. Video Functions.

BARCODE INPUT In Escape mode the print buffer can accumulate bar code data to be printed by the 82162A HP-IL Printer and read by the Wand.

BARCODE TYPES See Appendix Barcode Types.

BC BLOCK CLEAR, PPC ROM 20,43, SIZE var., Subr. levels: 5. Clears a defined block of data registers. T, Z and Y are not disturbed.
|||X: bbb.eeeii beginning register. ending register increment value||| (Increment: clears every nth register). For example: to clear registers 18 - 44, input 18.044. To clear alternate registers, input 18.04402. See CLEARING, CONTROL WORD, BLOCK OPERATIONS - PPC.

BCD BINARY CODED DECIMAL, A type of encoding where each digit is represented by 4 binary digits:

0	0000	1	0001	2	0010	3	0011	4	0100
5	0101	6	0110	7	0111	8	1000	9	1001

Example: 19 = 0001 1001. See BINARY, BIT, BYTE.

BD BASE B TO BASE DECIMAL, PPC ROM 20,17, SIZE 007, Subr. levels: 5. Converts up to 14 digits in Base B (2 <=B <=25) to Base 10. Each digit must be in the range of 0 to B-1.
|||R06: Base B||| |||ALPHA: digits to be converted|||. Inverse of TB.
See TB, also see HEXADECIMAL.

BE BLOCK EXCHANGE, PPC ROM 20,34, SIZE a/r, Subr. levels: 5. Exchanges the contents of 2 blocks of main memory data registers (need not be equal length). To use: store 2 block control words in X and Y, xeq BE. If the blocks are unequal in length, the control word in Y controls the loop. |||X, Y: bbb.eeeii beginning register. ending register increment|||
See BLOCK OPERATIONS - PPC. Compare with REGSWAP. See BC (above) for bbb.eeeii example.

BEEP Sounds 4 tones. To silence, Clear Flag 26.

BEG/END Also seen as B/E in general financial programs. A software toggle that specifies beginning or end of period payments. The sign and affected registers depend upon the program in use. Appears in 4 ROMs: FINANCE, REAL ESTATE, HOME MANAGEMENT and PPC ROM.

BENDER An industrial term applied to the piezo-ceramic transducer used to sound audible tones in the 41C. Similar to the alarm element in wrist watches.

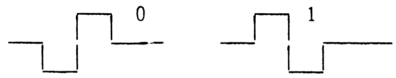
BENDER COUPLER A flat plane device usually made of copper clad circuit board that comprises a capacitive pick-up plate. The coupler allows convenient non-audio pick-up of the tone signals for control, alarm or demonstration purposes.

BEST FIT Refers to the technique and purpose of programs that fit 4 or more equations to a set of data points where the final output is the most accurate equation number and its coefficients. See CURVE FITTING, EXP, LIN, LOG, POW, r. Also see CV (ROM program).

BI BLOCK INCREMENT, PPC ROM 10,44, SIZE a/r, Subr. levels: 5. A register block storing routine that stores numeric data in a sequence, as a constant or 0.
|||Z: bbb.eeeii||| |||Y: start value||| |||X: increment value|||
For example: to load 10 data registers 00 - 10 with their own addresses, 1.010 ENTER 1 ENTER 1 xeq BI. Result: R01 = 1.00; R02 = 2.00, etc. See BLOCK OPERATIONS - PPC.

BINARY A system of representing numbers in Base 2 using only the digits 0 and 1.
See BCD, BD, BIT, BYTE.

BI-PHASE LEVEL ENCODING   The system of recording data on a digital cassette. Each bit contains 3 pulses; high (+ 1.5 v) followed by low (- 1.5 v) represents a "1". The opposite sequence represents "0".



BL   BLDSPEC INPUTS FOR LB, PPC ROM 10,42, SIZE 000, Subr. levels: 4. This routine converts BLDSPEC numbers into 41C memory bytes for a synthetic text line, a technique that may save 20 or more bytes. To use: input each BLDSPEC number (0 - 127), xeq BL; each decimal byte is displayed in X (0 - 255). To use LB program, start with 247, followed by the 7 decimal bytes. To print: "Text Line" RCL M, ACSPEC, PRBUF.
See ACSPEC, BLDSPEC, LOAD BYTES - PPC, M REGISTER, PRINT BUFFER, SYNTHETIC BLDSPEC. Also see COLUMN PRINT NUMBER.

BLDSPEC   BUILD SPECIAL CHARACTER. Printer 82143A or HP-IL xrom 29,06. Builds a special character in the stack that may be stored for later use in a data register or accumulated in the print buffer using ACSPEC. Prior to use, clear X and Y with CLX ENTER.
|||X: column print number||| xeq BLDSPEC up to 7 times; result left in X.
See ACSPEC, COLUMN PRINT NUMBER, PRINT BUFFER, SYNTHETIC BLDSPEC.

BLOCK   A set of contiguous registers. A generalized block is a set of registers that are uniformly spaced, such as the column or diagonal of a stored matrix. The block is usually defined by the control word bbb.eeeii in the same manner that ISG and DSE are defined.
See BLOCK OPERATIONS - PPC (below).

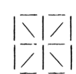
BLOCK OPERATIONS - PPC   Routines in the PPC ROM that deal with blocks of registers:

BC:	Block Clear	B :	Block Statistics
BE:	Block Exchange	DR:	Delete Record
BI:	Block Increment	IR:	Insert Record
BM:	Block Move	M1:	Matrix, Interchange 2 Rows
BR:	Block Rotate	M2:	Matrix, Multiply Row by Constant
BV:	Block View	M3:	Matrix, Add Multiple of Row to Another
BX:	Block Exchange		Refer to the above listed routines for details.

BLOCK OPERATIONS - XFUNCTION (Extended Functions): REGMOVE, REGSWAP.

BM   BLOCK MOVE, PPC ROM 20,39, SIZE a/r, Subr. levels: 5. Moves a block of consecutive registers.
|||Z: 1st register in source block|||
|||Y: 1st register in destination block|||
|||X: number of registers in source block||| xeq BM.
Compare with REGMOVE. Also see BLOCK OPERATIONS - PPC.

BOXED STAR   The display seen when all 14 segments of a 41C character are "lit". A default display that appears when any character code other than those representing the 83 standard characters is programmed.
See Appendix HEX Table.



BR   BLOCK ROTATE, PPC ROM 20,40, SIZE a/r, Subr. levels: 5. Rotates a block of consecutive registers by 1 register. If X < 0 the block shifts to lower numbered registers.
|||Y: 1st register in source block||| |||X: ± n registers in source block|||
See BLOCK OPERATIONS - PPC.

E≤   BLOCK STATISTICS, PPC ROM 20,42, SIZE a/r, Subr. levels: 5. Places statistical data from 2 blocks of registers into the defined register block. Prior to use: ≤REG - - as needed. When the 2 blocks are the same size, the order of inputs in X and Y is not important; otherwise, the control word in Y controls the loop.
|||X and Y: bbb.eeeii, beginning and ending registers of the respective blocks containing the X and Y data|||
Output is in the ≤ register block: ≤X, ≤X^2, ≤Y^2, ≤XY, n = n registers in block.
See ≤REG, ≤.

BST   BACKSTEP. Not programmable. Use to view the previous line in program memory.

BUFFER   2 groups of 1024 4-bit registers of NMOS RAM allow the Digital Cassette Drive 82161A to send and receive information and data. The first half, Buffer 0, holds data being sent to or received from the interface loop and the tape; the second half, Buffer 1, involves the loop only and not the tape. See PRINT BUFFER. Also see I/O BUFFER.

BUG An error or glitch in a program. An error in the operating system of the 41C. The 9 best known system bugs that affect 41C programming are defined in Appendix Bugs 1 - 9.

BV BLOCK VIEW, PPC ROM 20,07, SIZE a/r, Subr. levels: 5. View the non-zero contents of a block of registers according to a control word in X. Prints if possible.
|||X: bbb.eeeii beginning register. ending register increment value||| Format: "Rnn: nnn"
Pause at each register: SF 09. Stop at each register: SF 10. See PRREGX, VA.

BX BLOCK EXTREMA, PPC ROM 20,41, SIZE a/r, Subr. levels: 5.
|||X: bbb.eeeii beginning register. ending register increment value||| To treat block as non-negative, SF 10. Output: M: register number of maximum value = INT part of M
N: register number of minimum value = INT part of N
O: original block control word
Y: maximum value in block
X: minimum value in block
See M, N and O REGISTERS, Appendix The Status Registers.

BYTE A number of binary digits treated as a single word by the 41C. RAM words are 8 bits in length and can represent a single character or 2 digits (BCD). ROM words are 10 bits in length. See BCD, BIT, BYTE COUNT.

BYTE COUNT The amount of memory used by a program. There are several methods of counting bytes. If a Printer is in the system, set to TRACE mode and xeq CAT 1 to print the byte count. If the program file is in Extended Memory, input the program name in Alpha and xeq RCLPTA. To count bytes between any lines anywhere in memory, from 1 line to entire program memory, see CB. See BYTE, b REGISTER, CB, PROGRAM POINTER, RCLPTA, TRACE, Appendix The Status Registers.

BYTE GRABBER A version of the assignment "Byte Jumper" function that can be used to create any possible code in program mode. See Appendix Byte Grabber; HEX Table.

BYTE JUMPER 1 of a class of synthetic key assignments (241, 65) that advances the pointer in RUN mode. Equivalent to assigning the text character "A" to the keyboard.
See BYTE GRABBER, Appendix A, Byte Grabber; HEX Table. Also see References, "Synthetic Programming on the HP41C".

BYTE TABLE See HEX TABLE.

C

c REGISTER 41C status register, address 00D, containing the location of the statistical register block, the first data register and the last .END. Register c also contains the Hex digits 169 used by the processor to check memory validity at power on. If this constant is altered, MEMORY LOST results. See COLD START CONSTANT, Appendix The Status Registers.

C? CURTAIN FINDER, PPC ROM 10,16, SIZE 000, Subr. levels: 6. Returns the absolute decimal address of R00. R/ (Roll Up) after execution restores X and Y.
See CURTAIN - PPC, Appendix The Status Registers.

CA COMPLEX ARITHMETIC, PPC ROM 20,23, SIZE 018, Subr. levels: 4. To use: GTO "CA" and xeq 06 to initialize complex number stack. Local labels are as follows:

a: X_c Y_c	b: $Y_c^{X_c}$	c: Pop	d: LAST Z	e: e^z
A: +	B: -	C: *	D: /	E: LN(z)
		H: sin(z)	I: cos(z)	J: Push

Store call # in R06 and xeq CA. 1: + 2: - 3: * 4: / 5: ln(z) 6: init. stack 7: cosh(y),sinh(y) 8: sin(z) 9: cos(z) 10: Push 11: X<>Y 12: Y|X 13: Pop 14: LAST Z 15: e|z 16: Pop(save LAST Z).

CARD Card Reader prompt.

CARD ERROR Card Reader error message. Caused by: empty card or unrecognizable card type; wrong card accidentally mixed during a multi-track read; mixed sets of data; wrong card type for RDTA, RSUB, MRG. See specific function that caused the error message.

CARRIAGE RETURN 82163A Video Interface function. HP-IL ROM required. Returns Cursor to column 0. |||X: 13.00||| xeq ACCHR. See BACKSPACE, ESCAPE, LINE-FEED, Appendix Video Functions.

2. 41C end-of-line indicator: Carriage Return(CR), Line-feed(LF), character codes 13 and 10. If Flag 17 is clear, CR LF is sent after each sequence of data bytes (OUTA). Prints buffer if accumulated by ACX (HP-IL Printers only). See Appendix Print Characters.

CATALOG CAT 1: User program list. As each program name or END is displayed the program pointer is set to the displayed line of memory to provide a simple means of stepping to any user program. With a Printer in the system, CAT 1 will print the byte count of each user program (TRACE mode only). See DIR, EMDIR.

CAT 2: I/O Port list. Regardless of Port order, the TIME Module is always listed first, followed by HP-IL or Printer 82143A, if present. This is followed by a sequential list of the contents of each Port including peripheral functions and Application Module programs.

CAT 3: Standard function list. To slow the listing, hold any key down except R/S. The 41C searches its memory for a function in Port order. If a user program had the same name as a standard function, for example, MOD, the operation xeq MOD would always run the program and the function would not be performed.

CB COUNT BYTES, PPC ROM 10,50, SIZE 000, Subr. levels: 4. Counts bytes between any 2 lines in RAM. To use: position the program pointer with GTO . line number — — — or by using CAT 1 and press the key assigned to RCL b in RUN mode (144, 124). Allows the most efficient choice of labels and GTO instructions, 1- or 2-byte, according to distance of jump. Use RCL b at the 2 required points and xeq CB. Result left in X.
See b REGISTER, BYTE COUNT, PROGRAM POINTER, RCL b, Appendix The Status Registers.

CD CHARACTER TO DECIMAL, PPC ROM 10,35, SIZE 000, Subr. levels: 4. Decodes the rightmost character in the Alpha register into a decimal number in X. To preserve the decoded character in Alpha and up to 13 additional characters, SF 10. Decoded character is deleted if Flag 10 is clear. See ATOX, CHARACTER CODE, HEX TABLE.

CF CLEAR FLAG. Use with any Flag <30. Prompts CF — —. See IF.

CHARACTER Refers to either a display character or a memory character, a single byte in the text portion of a string or a single digit in a string. See ATOX, CHARACTER CODE, HEX TABLE.

CHARACTER CODE A number 0 - 255 that defines a displayable, printable or control character to the 41C. See HEX TABLE, Appendix Print Characters.

CHECKSUM The digits appearing after a specified number of bits on a particular medium are added during functions such as reading magnetic cards or digital cassette tapes and scanning barcode. (Checksums also exist in ROMs and Extended Memory.) If the running total does not equal the expected value, the medium is assumed by the 41C to have been mis-read.

CHECKSUM ERR Card Reader error message indicating a bad or dirty card.

CHECKSUM ERROR HP-IL status error sent by 82161A Digital Cassette Drive, binary 0001 1010. Displayed to user as DRIVE ERR or READ ERR.

CHKSUM ERR XFUNCTION error message; part of a program has been lost (GETP or GETSUB). This may have been caused by removing a module storing a portion of the file. Extended Memory files cannot be verified. See CHECKSUM ERR, CHECKSUM ERROR, VER, VERIFY.

CHS CHANGE SIGN. If digit entry CHS alters the sign of the mantissa only. Example: to key -1.5 E -4 1 . 5 CHS EEX 4 CHS.

CJ CALENDAR DATE TO JULIAN DAY NUMBER, PPC ROM 20,21, SIZE 000, Subr. levels: 5. Julian day number is returned to X. SF 10 = Julian calendar. CF 10 = Gregorian calendar. |||Z: year (YYYY)||| |||Y: month (MM)||| |||X: day|||. Day of the week is calculated by adding 1 to the result and: 7 xeq MOD. Inverse of JC. Also see DATE+, DDAYS, DOW.

CK CLEAR KEY ASSIGNMENTS, PPC ROM 10,06, SIZE 000, Subr. levels: 4. All USER mode key assignments are cleared. Global label assignments will reactivate if a program card is read. See CLKEYS. For temporary clearing, see SK and RK.

CLA CLEAR ALPHA REGISTER.

CLD CLEAR DISPLAY. Clears a VIEW'd or AVIEW'd display during a running program and returns the goose annunciator to the display. Used to allow a PSE (Pause) to be noticed.

CLEAR DEVICE HP-IL Video Interface function. HP-IL ROM required. Clears all 31 lines of Video display memory and returns a blinking Cursor to position 0,0. |||X: 27.00||| xeq ACCHR |||X: 69.00||| xeq ACCHR. See CLEAR DISPLAY.

CLEAR DISPLAY See CURSOR, CLEAR DISPLAY FROM.

CLEARING BC, CF, CLA, CLEAR DEVICE, CLEAR DISPLAY, CLFL, CLP, CLRG, CL , CLST, CLX, DEL, DELCHR. DELREC, MASTER CLEAR, PCLPS, PURFL, PURGE, ZERO. To clear alarms, see ALMCAT.

CLFL XFUNCTION xrom 25,08. Clears an ASCII or Data file without purging the file and resets the file pointer to 0. |||ALPHA: Extended Memory ASCII or Data file name||| See PURFL.

CLK12 TIME Module xrom 26,06. Switches the clock display to a 12 hour display format. This is the default mode and no Flags are affected. See CLK24. Also see ATIME, ATIME24, CLOCK.

CLK24 TIME Module xrom 26,07. Switches the clock display to a 24 hour display format. See CLK12. Also see ATIME, ATIME24, CLOCK.

CLKEYS CLEAR KEY ASSIGNMENTS, XFUNCTION xrom 25,09. Clears all key assignments including Global label assignments. See CK. For temporary clearing, see SK and RK.

CLKT TIME Module xrom 26,08. Switches the clock display to a clock-only display, updated every second. When the 41C is displaying the clock in this mode it consumes a higher than normal amount of current and the automatic 10 minute shut-off is disabled. See CLKTD, CLOCK.

CLKTD TIME Module xrom 26,09. Replaces the continuously changing clock display with a time and date display, updated every minute, example: 3:00AM 05/29. See CLKT, CLOCK.

CLOCK TIME Module xrom 26,10. VIEWs the digital clock (more conveniently done in run mode by pressing [ ] ON). If executed by a running program, the program stops and resets Flags 11-26 to their default values and displays the digital clock. See [ ]ON, TIME.

CLP CLEAR PROGRAM. Not programmable. Prompts CLP _ Press ALPHA, input program name, ALPHA. To clear the current program: CLP ALPHA ALPHA. The 82143A Printer, if present and on must be in MANUAL mode if a program longer than 233 lines is to be cleared. To CLP a program longer than 1089 lines, use DEL (delete). See DEL, EP, PCLPS, Appendix Bugs 1 - 9.

CLRG CLEAR REGISTERS. Clears all allocated data registers in main memory. See BC, CL≤ . Also see CLEARING.

CL≤ CLEAR STATISTICAL REGISTER BLOCK. Clears the block of 6 summation registers currently defined by ≤REG n n. See ≤REG.

CLST CLEAR STACK. Same effect as CLX ENTER ENTER ENTER.

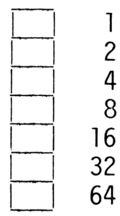
CLX CLEAR X REGISTER. Use in programs in preference to 0 (zero) where possible.
See Appendix Function Timing.

CM COMBINATIONS, PPC ROM 20,20, SIZE 000, Subr. levels: 5. Computes the number of combinations of n objects taken k at a time, C(n,k). To use: n ENTER k xeq CM. See FACT, PM.

CODE The name of a program written by W. C. Wickes that translated Hex codes in Alpha to 41C bytes. See HN, NON-NORMALIZED NUMBERS - PPC, Also see References, "Synthetic Programming on the HP41C".

COLD START CONSTANT Hex digits 1 6 9 are the 6th, 7th and 8th digits of status register c. The 41C processor periodically checks this constant to assure that memory is valid. If not present or altered a Memory Loss results. See c REGISTER, Appendix The Status Registers.

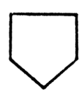
COLUMN PRINT NUMBER The number used by 41C Printers to print a single column of 1 - 7 dots in various combinations.



Add the numbers of the dots required to print in the column.
See ACCOL, BLDSPEC, GRAPHICS MODE, PRINT BUFFER.

COMPILE The operation of determining and storing the location of a GTO destination in the GTO instruction itself. Labels 00 - 14 will be compiled if the GTO distance is <112 bytes and labels 15 - 99 and a - J will be compiled regardless of the distance. See GTO, XEQ. Also see Appendices Bugs 1 - 9 and Function Timing. "Synthetic Programming on the HP41C", page 17 (References).

CONNECTOR Flowchart symbol used to carry a flowchart to another page where it continues at a matching symbol.



CONTINUOUS ON Flag 44, Set by xeq ON, prevents the 41C from automatically turning off if inactive for 10 minutes. This Flag is not saved on status cards nor by the XFUNCTION RCLFLAG. Flag 44 is ignored if the 41C is displaying the digital clock.

CONTROL ALARM A TIME Module capability that gives time control of program execution or peripheral functions. Interrupting Control Alarms cause the 41C to execute a named program regardless of the operating mode, on, off, displaying the clock or running a program. Non-interrupting Control Alarms are constrained by the current operating state and will execute a program or function only if the 41C is off or displaying the clock. The alarm becomes past due if a program is running; under any other condition the alarm activates and merely displays a program name. See Appendix Alarm Parameters.

CONTROL WORD A formatted number in the stack or a data register used by various functions to define parameters. ISG, for example, uses a typical control word of the form iiiii.fffcc where iiiii is the current value, fff is the test value and cc is the increment value. GETRX (XFUNCTION) uses a word of the form bbb.eee where bbb specifies the beginning register number and eee the ending register number. Examples of word formats are given with all functions that require them. See the particular function.

COPY Not programmable. Prompts for Alpha name of an Application Module (ROM) program and downloads that program into main memory where it can be listed, modified or TRACE'd.

CORRECT TIME Module xrom 26,11. Similar to SETIME but additionally calculates an accuracy factor according to the time drift since the last time the clock was set. This factor is stored in the module and is not affected by MEMORY LOST. CORRECT does not take into account time changes effected by T+X. |||X: HH.MMSShh|||
See ACCURACY FACTOR, RCLAF, SETAF, T+X, TIME FORMATTING.

COS COSINE. |||X: angle in decimal degrees||| Check DEG, RAD or GRAD mode.

CP COLUMN PRINT FORMATTING, PPC ROM 20,27, SIZE 007, Subr. levels: 5. Aligns numeric values for printing columns of data. To use: set display mode and the status of Flag 29; store skip index in R06, input data in X, xeq CP. The data will be added to the print buffer in the correct column position. See FMT. Also see PRINTER ROUTINES - PPC and PRINT BUFFER.

CPU CENTRAL PROCESSING UNIT. An LSI circuit consisting of timing generator, instruction processor, address, status and flag registers, data registers, arithmetic processor, conditional test logic, power control logic and keyboard interface.

CRASH A calculator condition caused by static shock, physical abuse or unusual software errors. The 41C does not respond to the keyboard and must be reset by temporarily removing the battery pack.

CREATE HP-IL xrom 28,01 Mass Storage function to allocate data file registers.
|||X: number of registers in file||| |||ALPHA: file name (<=7 characters) |||
Possible error: DUP FL NAME. CREATE does not replace an existing file of the same name as do other mass storage functions. See CRFLAS, CRFLD, WRITING DATA, ZERO.

CRFLAS CREATE ASCII FILE in Extended Memory, XFUNCTION xrom 25,10.
|||X: number of registers in file||| |||ALPHA: file name (=7 characters) |||
If the number of registers is unknown: add number of characters to number of records, add 1, divide by 7, round up 1. See CREATE, CRFLD, WRITING DATA. Also see SAVEAS.

CRFLD CREATE DATA FILE in Extended Memory, XFUNCTION xrom 25,11.
|||X: number of registers in file||| |||ALPHA: file name (<=7 characters) |||
See CREATE, CRFLAS, WRITING DATA. Also see CLFL.

CU CURTAIN UP, PPC ROM 10,34, SIZE 000, Subr. levels: 6. Adds the integer value of the contents of X to the pointer to R00 in status register c. A negative input lowers the curtain. See CURTAIN, CURTAIN - PPC and for applications, see References.

CURSOR, CLEAR DISPLAY FROM HP-IL Video Interface function. The display is cleared from the Cursor position through the bottom line. |||X: 27||| ACCHR |||X: 74||| ACCHR.

CURSOR DOWN HP-IL Video Interface function. Moves the Cursor down 1 line, though not past bottom line. |||X: 27||| ACCHR |||X: 66||| ACCHR.

CURSOR HOME HP-IL Video Interface function. Cursor returns to row 0, column 0 without otherwise affecting the display. |||X: 27||| ACCHR |||X: 72||| ACCHR.

CURSOR, INSERT HP-IL Video Interface function. Cursor displays as a blinking left arrow.
|||X: 27||| ACCHR |||X: 81||| ACCHR.

CURSOR LEFT HP-IL Video Interface function. Moves Cursor 1 position left but not past 0,0.
|||X: 27||| ACCHR |||X: 68||| ACCHR.

CURSOR OFF HP-IL Video Interface function. The Cursor will function normally but not display.
|||X: 27||| ACCHR |||X: 60||| ACCHR.

CURSOR ON HP-IL Video Interface function. Returns the Cursor to the display.
|||X: 27||| ACCHR |||X: 62||| ACCHR.

CURSOR, REPLACE HP-IL Video Interface function. Cursor displays as a blinking block.
|||X: 27||| ACCHR |||X: 82||| ACCHR.

CURSOR RIGHT HP-IL Video Interface function. Moves Cursor 1 position to the right. From line 15, column 31, Cursor returns to 0,0. |||X: 27||| ACCHR |||X: 67||| ACCHR.

CURSOR TO ADDRESS HP-IL Video Interface function. Moves Cursor to a row, column position in the display: column "m" MOD 32; row "n" MOD 16.
|||X: 27||| ACCHR |||X: 37||| ACCHR |||X: column||| ACCHR |||X: row||| ACCHR. The function can also be executed by an Escape sequence using OUTA: CLX ENTER 27 BLDSPEC [Alpha] ARCL X |- % (followed by 2 characters from the chart on the following page) OUTA
See ESCAPE, OUTA and chart on next page.

CURSOR TO ADDRESS (Con't.)

COLUMN NUMBER	ROW NUMBER	CHARACTER	COLUMN NUMBER	ROW NUMBER	CHARACTER	COLUMN NUMBER	ROW NUMBER	CHARACTER
0	0	(SPACE)	11	11	K	22	6	V
1	1	A	12	12	L	23	7	W
2	2	B	13	13	M	24	8	X
3	3	C	14	14	N	25	9	Y
4	4	D	15	15	O	26	10	Z
5	5	E	16	0	P	27	11	;
6	6	F	17	1	Q	28	12	<
7	7	G	18	2	R	29	13	=
8	8	H	19	3	S	30	14	>
9	9	I	20	4	T	31	15	?
10	10	J	21	5	U			

CURSOR UP HP-IL Video Interface function. Moves Cursor up 1 line (not past top line).
|||X: 27||| ACCHR |||X: 65||| ACCHR.

CURTAIN The dividing line between data registers and program memory. Its value is a pointer to R00 maintained in register c as an absolute register number. See CURTAIN - PPC. For applications of curtain manipulation, see References. Also see Appendix The Status Registers.

CURTAIN - PPC Routines in the PPC ROM that manipulate the "Curtain".

C?:	Curtain Finder	HD:	Hide Data Registers
CU:	Curtain Up	C:	REG Curtain Exchange
CX:	Curtain to Absolute Decimal Location	UD:	Uncover Data Registers

CURVE FITTING A method of fitting an equation to data where each pair of variables are represented by X,Y coordinates and the calculated equation equation contains 2 or more coefficients, a, b, c, etc. representing a straight line or an exponential function. For example, a Linear Curve Fit is calculated from $Y = bX + a$, where
$B = (\Sigma XY-(\Sigma X)(\Sigma Y)/n)/(\Sigma X^2-(\Sigma X)^2/n)$ and $A = (\Sigma Y-(B)(\Sigma X))/n$. Tables of data are easily condensed in program memory using Curve Fitting techniques.
See BEST FIT, CV, EXP, LIN, LOG, POW, r.

CV CURVE FIT, PPC ROM 20,08, SIZE 027, Subr. levels: 4. Fits linear, exponential, logarithmic and power curves to input data without re-inputting data for each fit. The program is designed to be used as a subroutine and does not label output. Local labels as follows:

a: X, Y delete				e: Initialize
A: X, Y input	B: Solve type n	C: $\hat{Y}$ (project)	D: $\hat{X}$ (project)	E: Solve best

Input: X ENTER Y xeq [A]. Results: R07 = curve type; R08 = b; R09 = a; R24 = n inputs; R25 = best r; R26 = best type (curve number). To call as a subroutine from another program, store call # in R06, xeq CV. R00 - 05 are available for user functions.
0: Clear/initialize, 1: X,Y input, 2: Solve type n, 3: $\hat{Y}$, 4: $\hat{X}$, 5: Solve best type,
6: Delete X,Y (Flag 10 must be set), 9: Stop in ROM.
See BEST FIT, CURVE FITTING, EXP, LIN, LOG, POW, r.

CX CURTAIN TO ABSOLUTE DECIMAL LOCATION IN X, PPC ROM 10,33, SIZE 000, Subr. levels: 5. Stores Hex translation of decimal X in register c. Values 17 - 192 MOD 1024 or greater than 512 cause MEMORY LOST. See CURTAIN - PPC and References.

D

d REGISTER   41C status register that contains the status of all 56 flags encoded in Hex. Address 00E. See HEXADECIMAL, MASS FLAG, FL, Appendix The Status Registers.

0001|1001|0000|0000|0001|0000|0010|1100|0000|0011|1101|1000|0000|0000
1 9 0 0 1 0 2 C 0 3 D 8 0 0 Hex representation.
3 4 7 19 26 28,29 38,39 40,41,43 44

DATA BYTE   The basic 11 bit units of HP-IL transmissions, coded in ASCII. See FRAME.

DATA ERROR   41C error message resulting an attempt to perform a meaningless operation such as division by 0. Digital Cassette Drive 82161A: input to NEWM >447. Printers: ACCHR, ACCOL or BLDSPEC, X >127; PRAXIS, ymin or max reversed or nnn >168; PRREGX, X >999; REGPLOT, STKPLOT, nnn = 0 or >168; SKPCHR, n 23; SKPCOL, X >167. XFUNCTION: AROT, POSA, XTOA, X<>F, X >255; PSIZE, SEEKPT(A), X >999; CRFLAS, CRFLD, X = 0; STOFLAG data not obtained by STOFLAG. TIME Module: invalid data in X, for example time data not formatted as HH.MMSShh.
For other functions or peripheral extensions, refer to the specific function.

DATA ERROR X
DATA ERROR Y
DATA ERROR Z   TIME Module error messages caused by improper parameters for XYZALM.
X: data not in HH.MMSSt form or > 24. (Also DDAYS where X contains a negative or invalid date.)
Y: date is negative or invalid. (Also DATE+, DDAYS.)
Z: improperly formatted time or input >10,000 hours.

DATA GROUP   A class of HP-IL messages including Data Bytes and End Bytes. If a Talker receives a Data Byte, an error check is performed before the next byte is sent. A Listener receives an End Byte and passes it on.

DATA PACKING   The technique of storing more than 1 independent digit or group of digits in a single register, for example: storing month, day and year as MM.DDYYYY. Although data access is slowed, storage efficiency is increased by saving space. See PR, UR.

DATE   TIME Module xrom 26,12. Places the current date in X in date format, MM.DD- or DD.MM-YYYY, according to the status of Flag 31. The display register shows the date as an alpha string. See CLKT, CLKTD, DATE+.

DATE FORMATTING   The input/display format used to represent dates by the TIME Module. Month. DayYear (U.S.) MM.DDYYYY or Day. MonthYear (International) DD.MMYYYY.
See TIME FORMATTING, also DMY, MDY.

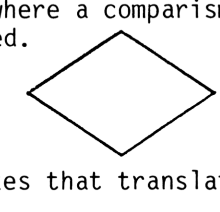
DATE+   TIME Module xrom 26,13. Calculates a past or future date from X, Y data. |||Y: date(according to date format)||| |||X: days + or -||| Limits: Oct 15, 1582 to Sept. 10, 4320. See CJ and JC, also DDAYS, DATE FORMATTING.

DC   DECIMAL TO CHARACTER, PPC ROM 10,11, SIZE 000, Subr. levels: 5. Appends to Alpha register the character corresponding to the decimal integer in X, MOD 256.
See HEX TABLE, CHARACTER CODE, XTOA.

DDAYS   TIME Module xrom 26,14. Difference in days between 2 dates in X and Y. The input dates must follow the date format in use. See DATE FORMATTING, DATE+, DMY, MDY, also CJ and JC.

DEC   OCTAL TO DECIMAL CONVERSION. X must contain an integer and may not include an 8 or 9.
Also see the inverse function, OCT. See BD, TB.

DECISION   Flowchart symbol. A point in a program where a comparism or test will be made to determine which of 2 or more paths is to be followed.



DECODE   The name of a program written by W. C. Wickes that translated a 7 byte non-normalized number in X into the Hex codes of the 41C.
See DECODE, HN, NH and references.

DEEP SLEEP An HP term that describes one of the 3 operating states of the 41C. Deep Sleep corresponds to the "off" state, characterized by a minimum power drain to maintain memory and an inactive display. See LIGHT SLEEP.

DEG DEGREES MODE. Sets the 41C to calculate trig functions in degrees mode. Input in decimal degrees is required.

DEL DELETE. Prompts – – –. Works only in program mode (though not programmable). Fill prompt with the number of lines proceeding downward through program memory that are to be deleted. See CLP, Appendix Bugs 1 - 9 (Bug 5).

DELCHR DELETE CHARACTERS, XFUNCTION xrom 25,12. Delete characters in working ASCII file starting at the current pointer position. Use SEEKPT(A) to position the pointer if necessary. |||X: number of characters to be deleted||| See DELREC; also see CLEARING.

DELREC DELETE RECORD, XFUNCTION xrom 25,13. Deletes the record in the working ASCII file at the current pointer position. All of the following records are moved forward and the pointers are updated. See DELCHR; also see CLEARING.

DELTA SPLIT An option available only in the SW mode of the TIME Module. To set Delta Split mode, xeq SW, press CHS. Splits will be displayed and recalled as differences between successive splits rather than elapsed time. They are always stored in data registers as elapsed time splits, however. See SW.

DESTINATION The first register of a block where data will be copied. 3 digits to the right of the decimal point are used to specify the destination. See CONTROL WORD, REGMOVE, REGSWAP.

DET MATH 1 Module, xrom 01,06. A subroutinable portion of the MATRIX program file used to compute the determinant of a square matrix. No input is required prior to calling the routine if the matrix elements have already been stored. On completion, the determinant is left in Y. See MATRIX, MATRIX - PPC, INV, PVT, SIMEQ.

DEVICE CLEAR HP-IL message. The controller (41C) sets all devices on the loop that can respond to this command to a preset known state defined by the particular device. For corresponding Video Interface function, see CLEAR DEVICE.

DEVICE DEPENDENT LISTENER HP-IL message. Each HP-IL device can respond to up to 32 possible commands if they have been designed to do so, for example, DDL 2 causes the 82161A Digital Cassette Drive to be set to record continuously. See DEVICE DEPENDENT TALKER, LISTENER, TALKER.

DEVICE DEPENDENT TALKER HP-IL message. Each HP-IL device can respond to up to 32 possible pre-designed commands if they are currently addressed as Talkers. For example, DDT 2 causes the 82161A Digital Cassette Drive to read data from a tape into its buffer. See DEVICE DEPENDENT LISTENER, LISTENER, TALKER.

DEVICE ERROR HP-IL status bytes (received by INSTAT), binary 00010101 or 00010110. For example, if these status bytes are received from the 82161A Digital Cassette Drive, the Drive may require service. See INSTAT.

DF DECIMAL TO FRACTION, PPC ROM 20,13, SIZE 011, Subr. levels: 4. Store display setting, 0 - 9, in R07. To display fraction in Alpha, SF 10. |||X: decimal input||| Results: numerator in Y, denominator in X. Alpha display if Flag 10 set. See FD, MATH ROUTINES - PPC.

DIAGNOSTIC ROM(s) Assembly language modules used by HP to test the operation of the 41C and its peripherals, Card Reader, Printer and HP-IL devices. Both hardware and functional tests are performed such as key debounce, I/O Port, continuous memory and display. See ASSEMBLY LANGUAGE, RE-DEFINED KEYBOARD.

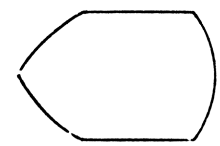
DIR MASS STORAGE DIRECTORY, HP-IL xrom 28,02. Prints regardless of Printer mode setting if Flag 21 is set. Clears Alpha and displays a sequential list of all files on the storage medium. The display does not scroll although it contains 24 characters of information and the medium is not positioned to the file as in CATalog 1. May be terminated at the desired file. Alpha mode will display the file information (useful without a Printer).

DIR, (Con't)
Output format: FILE NAME FILE TYPE REGISTERS
File types: PR, program; DA, data; KE, key assignments; ST, status; AS, ASCII; WA, write-all. Additionally, the file type may be followed by up to 3 initials: S, secured; P, private; A, auto-execution (recorded with Flag 11 set). See EMDIR, DIRECTORY.

DIR FULL HP-IL Mass Storage error message indicating that the pre-allocated directory space has been filled. Erase 1 file or initialize a new tape. See DIR, NEWM.

DIRECTORY A file on the first record of the recording medium that contains a list of user files. Information relating to file location, type and length is also stored in this sequence: file name (7 or less characters for 41C) stored as an ASCII string, file type, starting record number and length of the file in records.

DISPLAY A flow chart symbol representing output displayed by a video interface, plotter or printer.



DISPLAY - PPC Routines in the PPC ROM that control the 41C display:

DS: Display Set	RD: Recall Display Mode
DT: Display Test	SD: Store Display Mode

For details, see the specific routine listing.

DOW DAY OF THE WEEK, TIME Module xrom 26,16. Computes the day of the week and replaces the input date (input according to the date format in use) with the day number where Sunday = 0 and Saturday = 6. The stack does not lift. LASTX contains the input date. In run mode, viewed as a 3-character alpha string. See DATE FORMAT.

DOUBLE WIDE MODE Print characters double wide (10 columns), selected by SF 12 or an Escape sequence (except 82143A). Opposite of SINGLE WIDE MODE. See Appendix B, Escape Codes.

DP DECIMAL TO PROGRAM POINTER, PPC ROM 10,53, SIZE 000, Subr. levels: 5. Converts a decimal byte address in X to a program pointer. Use STO b to resume program operation where desired. Byte addresses begin with 0 - the bottom of status register memory and continue to 111. Addresses between 112 and 1343 do not exist. The addresses continue from 1344 to 3583 (7x512). See MEMORY VOID, PROGRAM POINTER - PPC; also see b REGISTER and Appendix The Status Registers.

D-R DEGREES TO RADIANS conversion. |||X: decimal degrees|||

DR DELETE RECORD, PPC ROM 20,38, SIZE: 010, Subr. levels: 5. To delete the nth record (adjacent group of data registers in main memory), input n, xeq DR. The following parameters must be pre-stored:
R07 = 1st register of entire file
R08 = number of registers per record
R09 = number of records in the file.
See BLOCK OPERATIONS - PPC, DELCHR, DELREC.

DRIVE ERR HP-IL Mass Storage error message indicating that the storage medium may be stalled or damaged.

DS DISPLAY SET, PPC ROM 10,19, SIZE 000, Subr. levels: 6. Similar to the HP67/97 DSP function which sets the number of decimal places displayed without affecting the type of display, FIX, ENG or SCI. See DSP.

DSE DECREMENT, SKIP IF EQUAL. Using a control word in the stack or a data register of the form iiiii.fffcc, DSE first decrements iiiii by cc and then tests the integer portion of the result. If less than or equal to fff x 100, the next line in program memory will be skipped. The default fff = 0 and the default cc = 1. Example: execute a loop 5 times, then skip. 5 LBL 01 TONE 9 DSE X GTO 01 STOP will sound 5 tones and stop.
See CONTROL WORD, DSZ, ISG, ISZ.

DSP DISPLAY (HP 67/97). Mnemonic for: display n digits regardless of FIX, ENG or SCI mode. When translating HP67 programs to the 41C, substitute FIX n, ENG n or SCI n.
See DS.

DSP (i) HP67/97 mnemonic for DISPLAY INDIRECT 25. (i) = indirect. When translating HP67 software without the Card Reader, substitute FIX, SCI or ENG for DSP. See 7DSPI, DS, DSZ.

DSZ or DSZ (i) HP67/97 mnemonic for Decrement and Skip if Zero. If the Card Reader is in the system when this function is used, it translates as 7DSZ; else, use DSE 25 or DSE IND 25. Seen in HP67/97 listings as "f DSZ I, f DSZ (i), f DSZ or g DSZ (i). See DSE, ISZ.

DT DISPLAY TEST, PPC ROM 10,07, SIZE 000, Subr. levels: 6. Turns on all 12 commas (,) for 1 second followed by all display segments and annunciators (except comma tails). After observing the display, press PRGM, R/S. See DIAGNOSTIC ROM.

DUP FL XFUNCTION error message. A file of the same name though a different type already exists in Extended Memory. Applies to ASCII and data files. A program file with a given name will replace one with the same name.

DUP FL NAME HP-IL error message. If the message appears after attempting the mass storage function, CREATE, it is because, unlike other file types, data files cannot be overwritten by new files of the same name. The old file must be either PURGEd, ZERO'd or RENAMEd. In the case of other file types, the message indicates that a file of a different type with the same name already exists. See CREATE, PURGE, RENAME, UNSEC, ZERO.

E

E or EEX ENTER EXPONENT. The program mode representation of EEX is E as part of a digit string. Seen by itself E = 1. For example: 2 E6 is the program representation of the keystrokes 2 EEX 6 (2,000,000) and appears as 2.00 06 in RUN mode.

e REGISTER 41C status register containing the coded locations of shifted key assignments and the current program line number (not to be confused with the program pointer). This bit map and system scratch register is at address 015 absolute. See ├ REGISTER, Appendix The Status Registers

E? END FINDER, PPC ROM 10,62, SIZE 000, Subr. levels: 5. Returns the absolute decimal address of the register containing the .END. in its last 3 bytes. See c REGISTER, MEMORY - PPC.

EDIT MATH 1 Module, xrom 01,08. Part of the MATRIX program file used to edit a stored matrix. Xeq EDIT prompts: ROW/COL=? Input: Row(I) ENTER Column(J) R/S. Output: A1,J=(old value) Input new value, R/S. R/S again if no Printer is present.
See MATRIX, PVT, SIMEQ, VCOL, VMAT. Also see MATRIX - PPC.

eGOBEEP A synthetic key assignment, Hex Table 4, 167, that can call or insert into a program any standard Printer or HP-IL function. Allows functions to be keyed into memory even without the peripheral attached. PRP gives NONEXISTENT and LIST defaults to LIST 071. All other functions operate normally. Prompts eGOBEEP – –. The inputs for mass storage and control functions correspond to their xrom numbers, 1 - 41, and the inputs for Printer functions correspond to the xrom numbers + 64, from 65 - 89.
See Appendix eGOBEEP. Also see Synthetic Key Assignments.

EIGHT-BIT MODE The mode in which the 82162A HP-IL Printer receives 41C instructions as data bytes with a decimal value of 128 - 255. Values less than 128 are interpreted as print characters or column print numbers. See ESCAPE MODE.

EMDIR EXTENDED MEMORY DIRECTORY, XFUNCTION xrom 25,14. Displays a sequential list of all files in Extended Memory, type of file and number of 7 byte registers used by the file and file headers. The list is terminated rather than interrupted by the R/S key. Holding any other key down freezes the display momentarily. To print the directory, set the Printer to TRACE mode. See DIR.

ENABLE ASYNCHRONOUS REQUESTS HP-IL message. The controller (41C) allows all capable loop devices to source their own service requests. Usually only the controller can source a message. In this way, other devices can cause the loop to be powered up. The 82161A Digital Cassette Drive does not respond. The 82162A Printer transmits a service request if the PRINT key is pressed. See SOURCE.

END Defines the end of a program file in the 41C. END statements may also contain other information about the file such as whether or not the file has been PACKed, PRIVATE, and the relative distance to the next Global Label or END. If a subroutine is located at the END of a program file, the END also functions as a RTN.

END BYTE An ASCII coded 11 bit data byte sent as overhead after all HP-IL loop messages. Similar to Carriage Return and Line-Feed.

END OF FILE HP-IL Mass Storage error message. This message appears when execution of a function would require to be positioned past the last register in a file. Refer to specific functions.

END OF FL XFUNCTION error message. An attempt to position the file pointer to delete, read or write past the end of an ASCII or data file. Some operations are partially done in spite of the error message.

END-OF-LINE Most HP-IL peripherals send an End-of-Line indicator consisting of the control characters 10 and 13, Carriage Return and Line-Feed. To suppress this indicator, CF 17. OUTA sends CR and LF automatically at the end of an ASCII string; INA accepts characters until CR and LF are received (=24 characters). See CARRIAGE RETURN, FLAG 17, LINE-FEED.

END OF REC XFUNCTION error message. The character pointer cannot be positioned past the end of the current record. See RCLPT(A), SEEKPT(A).

END OF TAPE ERROR HP-IL status message. When the 82161A Digital Cassette Drive unexpectedly reaches the end of a tape, 00010001 is sent as a Status Byte (INSTAT). Not seen in the 41C display. See INSTAT.

END OF TRANSMISSION - ERROR HP-IL message. The active talker in the loop sends this byte when error checking determines that any data byte was not received by the controller (41C) as originally sent.

END OF TRANSMISSION - OK HP-IL message. Normally this is sent as the last data byte by a Talker in the HP-IL loop when the device has determined by error checking that all data bytes were received by the controller (41C) as sent originally.

END/STALL ERROR HP-IL status message. Sent as a Status Byte (INSTAT) if the 82161A Digital Cassette Drive senses both the end of the tape and a stall. Status = 00010011. Not seen in the display. See INSTAT.

ENG ENGINEERING MODE DISPLAY. Numbers are displayed with exponents of 10 that are multiples of 3, thousand, million, milli, kilo, micro, etc.

ENTER Used to separate numbers for 2 number functions such as + or /. Copies X into Y. Conceptually, the 41C's way of saying "and", for example, add 4 and 6, 4 ENTER 6. When "and" is not required, neither is ENTER, for example, cosine of 6, 6 COS.

EP ERASE PROGRAM MEMORY, PPC ROM 10,31, SIZE 000, Subr. levels: 0. Clears all programs in main memory following a program labelled "//". LBL // RCL b END. There must be at least 6 bytes before the .END. If Flag 14 is set or LBL // does not exist, all programs will be erased. Follow with PACK. See CLEARING, CLP, PCLPS.

EPROM BOX A 41C peripheral manufactured by F. M. Weaver Associates and Dallas Development Systems that allows up to 16K (16,384 bytes) of user programmed ROM to be plugged into an I/O port. See Appendix for names and addresses of manufacturers.

ERROR = Dnn TIME Module error message seen only in the SW operating mode when the attempted Recall Split (RCL nn) is not an HH.MMSShh number or not a valid delta split. See DELTA SPLIT, SW.

ESCAPE HP-IL Video Interface. This device recognizes 14 Escape sequences to position the Cursor and scroll or clear the display. Escape sequences are initiated by the code: 27 xeq ACCHR.

ESCAPE MODE HP-IL. The mode in which the Printer and Video Interface receive special instructions ASCII coded in alpha strings. An Escape sequence for the 82162A Printer is initiated by

ESCAPE MODE (Con't)
an alpha string containing character 252 or 253 and remains in Escape mode until it receives any eight bit 41C instruction such as PRA. In Escape mode the Printer can be set to Parse Mode or Barcode printing by alpha strings.

EX EXPONENT OF X PPC ROM 10,27, SIZE 000, Subr. levels: 6. Replaces X by its exponent portion, -99 to 99. The original X is saved in LASTX. See MATHEMATICS - PPC.

E/X NATURAL ANTILOG. Raises e (2.718281828) to the power of the number in X. See LN.

E/X-1 NATURAL ANTILOG FOR ARGUMENTS CLOSE TO ZERO. Greater precision than E/X. See LN1+X.

EXP Mnemonic for Exponential Regression routines that determine the exponential fit ("growth curve") to a set of X, Y data points. In RPN form, the final equations are: X ENTER b * E/X a * and Y ENTER a / LN b /. Also referred to as curve fit equation no. 2. See CURVE FITTING, CV.

EXTENDED FLAGS Using the X F function in the XFUNCTION module, up to 256 combinations of Flags 00 - 07 can be set, tested or cleared. See X<>F.

EXTENDED MEMORY The area of memory provided by Extended Memory Modules (XMEMORY), up to 4221 bytes, and accessible only by Extended Functions (XFUNCTION). See Appendix Bugs 1 - 9 (Bug 2).

F

f or F HP67 prefix key, keycode 31, equivalent to SHIFT.

F? FREE REGISTER FINDER, PPC ROM 10,04, SIZE 000, Subr. levels: 3. Returns the number of available registers between the last used assignment register and the .END. See MEMORY - PPC.

FACT FACTORIAL. Inputs <=69.

FC? FLAG CLEAR? Prompts for 2 digits <=55. If false, the next program line is skipped. See IF, TOGGLE FLAG.

FC?C FLAG CLEAR? TEST AND CLEAR. Prompts for 2 digits <=29. If false, the next program line is skipped. See IF, TOGGLE FLAG.

FD FIRST DERIVATIVE, PPC ROM 20,11, SIZE 018, Subr. levels: 4. Calculates f'(a) of a user-defined function. To use: key function into program memory with a Global label <=6 characters and a RTN or END. Store the following: R10 = function Global label name; R11 = pointer to register containing X; R12 = step size. Store "a" in register pointed to by R11. SF 09 for fast approximation. SF 10 to view convergence. Result in X. See MATHEMATICS - PPC.

FI FINANCIAL CALCULATIONS, PPC ROM 10,63, SIZE 010, Subr. levels: 4. GTO "FI". The following local labels are available:

a: 12 x	b: 12 /	c: C/D?	d: B/E?	e: Clear
A: n	B: %I	C: PV	D: PMT	E: FV
		H: CF	I: PF	J: Status

Flag 08 set/clear = C/D; Flag 09 set/clear = B/E; Flag 10 set = view convergence when solving for %I. Store call # in R06 and xeq "FI". 0: clear/init, 1: solve n, 2: solve %I, 3: solve PV, 4: solve PMT, 5: solve FV, 12: stop in FI.
See B/E, I, FV, N, PMT, PV. Similar programs in FINANCE, REAL ESTATE and HOME MANAGEMENT modules. See Appendix C.

FILE User defined grouping of physically adjacent records written onto the data portion of each sector of a storage medium. 41C: the instructions between the top of program memory and an END or between 2 ENDs.

FILE POINTERS See RCLPT(A), SEEKPT(A) and SEEKR for the uses and effects of FILE POINTERS.

FINANCIAL SIGN CONVENTION In financial programs, money received is input and displayed as a positive value and money paid out is input and displayed as a negative value. See FI, FV, PMT, PV.

FINDID FIND IDENTITY. HP-IL Control Function, xrom 28,28. Search for a device and display its address. The 82161A Digital Cassette Drive and the 82162A Printer do not respond. |||ALPHA: identity string||| See SEND DEVICE ID.

FIX FIXED POINT DISPLAY. Prompts FIX – –. Specify number of places to be shown after the decimal point, 0 - 9.

FL FLAG INPUTS FOR LB, PPC ROM 10,43, SIZE 000, Subr. levels: 4. This routine computes the decimal inputs to the LB program in order to program a text string for mass flag control. Xeq FL, key each flag (of 56) in sequence. Each time a tone sounds, record the byte number. Start input to LB program with 247 followed by the bytes calculated by FL. Then key RCL M, STO d (144, 117, 145, 126). See LB, LOAD BYTES - PPC, MASS FLAG CONTROL. Also see d REGISTER.

FL NOT FOUND HP-IL and XFUNCTION error message. No file corresponding to the input name exists on the medium, or in Extended Memory.

FL SECURED HP-IL message. Files cannot be altered or deleted if SECured. Use UNSEC and try again. See SEC, UNSEC. Also see DIR, WRTPV.

FL TYPE ERROR HP-IL and XFUNCTION error message. The working file or named file in Alpha is the wrong type for the function attempted. In the case of reading and writing data, the problem may have been caused by not positioning the file pointer. See SEEKR.

FLAG 11 AUTOMATIC EXECUTION. If set when a program file is recorded on the mass storage medium or magnetic cards, the program will begin executing immediately from the first line when it is read back into the calculator. If set when the 41C is turned off, the calculator will begin running a program at the current line number when turned back on. To combine this feature with a preset time delay, place // in the Alpha register, clear the stack (CLST or CLX ENTER ENTER ENTER) and input the clock time of the desired startup. Xeq XYZALM (TIME Module). The 41C will begin running your routine at the programmed time. Be sure that it is left positioned to the desired line number. See DIR, XYZALM.

FLAG 12 PRINT DOUBLE WIDE. Affects only 82143A and 82162A Printers. Prints each column of dots that comprise a character twice for a double wide effect. Cleared at turn-on. If set while accumulating characters in the Print Buffer, it occupies 1 position.

FLAG 13 PRINT LOWER CASE. Affects all HP Printers and causes alpha characters A - Z only to be printed in lower case. Occupies 1 Print Buffer position and cleared at turn-on.

FLAG 14 CARD READER OVERWRITE. When set, a magnetic card with a clipped corner can be re-recorded. Cleared after 1 set of cards are read, by pressing back-arrow during a card-write and at turn-on. See PROTECTED.

FLAGS 15, 16 HP-IL Printer Control flags, used for 80 column Printer and Video Interface.

PRINT MODE	FLAG 15	FLAG 16
MANual	clear	clear
NORMal	clear	set
TRACE	set	clear
TRACE with STACK option	set	set

When in MANIO mode, CF 15 and CF 16 if the primary device is not a Printer type device.

FLAG 17 END-OF-LINE indicator control. When Flag 17 is set, the End-of-Line indicator is suppressed. When clear, the End-of-Line indicator, ASCII CR and LF bytes, indicates the end of a line of data. XFUNCTION: when using the GETREC function to recall ASCII file records, Flag 17 is set if the end of the record has not been reached.

FLAG 18, 19 and 20 Reserved for possible future peripheral use.

FLAG 21 PRINTER ENABLE FLAG. If clear, printing is suppressed. Automatically set at turn-on if a Printer is in the system. If a Printer is not present, AVIEW and VIEW will halt a running program when Flag 21 is set. Keyboard operations will print regardless of the status of Flag 21. See FLAG 55.

FLAG 22 NUMERIC DATA INPUT. Cleared at turn-on. Set by manual input of numeric data or by scanning data bar code. Also set by ANUM (XFUNCTION) if a number is placed in X from the Alpha register. See ANUM, Appendix Barcode Types.

FLAG 23 ALPHA DATA INPUT. Cleared at turn-on. Set when characters are keyed into the alpha register manually or by scanning alpha type bar code.

FLAG 24 RANGE ERROR IGNORE. While Flag 24 is set, the 41C ignores errors that normally produce an OUT OF RANGE error message.

FLAG 25 ERROR IGNORE. While set, the 41C will ignore 1 error of any type (except HP-IL Transmit Errors that halt loop operation) and then be cleared. SF 25 before the anticipated error such as attempting to store in a non-existent data register and when required, test FC? 25 to determine if the error occurred.

FLAG 26 AUDIO ENABLE. When cleared (set at turn-on) the calculator ignores BEEP and TONE commands. TIME Module alarms will also be inaudible.

FLAG 27 USER MODE. Used in programs to place 41C in USER mode, usually to enable key assignments or local alpha labels. Maintained by Continuous Memory.

FLAG 28 RADIX FLAG. When set (,) is used as a digit separator and (.) as the decimal point. Reversed when clear (European mode). Maintained by Continuous Memory.

FLAG 29 DIGIT GROUPING. Digit separators are used when set. Maintained by Continuous Memory.

FLAG 30 CATALOG. Set during a CATALOG and always tests clear. The code FS? 30 is useful in programs as a test value inverter. Example: ISG nn FS? 30 (next line) will skip the line containing FS? 30 when the test limit is reached and execute the next line. Prior to reaching the test value the calculator performs the FS? 30 test which is always false and skips the next line. See IF for additional applications.

FLAG 31 DMY DATE FORMAT. Used by the TIME Module to determine the desired date format. Month/Day/Year when clear-international format Day/Month/Year if set. See DATE FORMAT.

FLAG 32 MANUAL I/O. Set when the HP-IL loop is placed in MANIO mode and maintained by Continuous Memory. Defaults to Clear at MEMORY LOST. See AUTOIO.

FLAG 33 ABSOLUTE MANUAL MODE. When set, the HP-IL Module cannot control the loop. Used in diagnostics. If set by synthetic techniques, TRANSMIT ERROR results.

FLAG 47 SHIFT FLAG. Can be set synthetically by a program to ensure that the next key pressed will be a shifted key. Always tests clear.

FLAG 49 LOW BATTERY. Can be tested only. When set, digital clock does not display.

FLAG 55 PRINTER EXISTENCE. Tested by programs to determine if a Printer is in the system. Does not determine if the Printer is enabled (Flag 21).

FLSIZE FILE SIZE. XFUNCTION xrom 25,15. Places the number of registers in the named data or ASCII file in X. |||ALPHA: Extended Memory ASCII or data file name|||
See RCLPT(A) to determine the size (in bytes) of a program file.

FMT FORMAT SPECIFIER. HP-IL xrom 29,25. Printing will be centered if the specifier is in the first or last print buffer cell or justified left and right if positioned between other buffer characters. Supersedes ADV and PRBUF which respectively cause right and left justified printing. No parameters required. See PRINT BUFFER.

*FN MATH 1 module, xrom 01,46. MATH module program file called by SOLVE and other routines. LBL *FN "FUNCTION NAME?" AON PROMPT END.

FORMATTED CAPAPCITY   As used by HP, this term refers to the amount of space in bytes available on a mini data cassette for system use, directory and user files, 128K bytes (256x512).

FR   FRACTIONS, PPC ROM 20,12, SIZE 000, Subr. levels: 4. To use: GTO "FR". The following local labels are available:

a: (Random Numbers) RN	b: (Gaussian RNs) GN	c: gcd	d: (Decimal to fraction) DF	e: (Next Prime) NP
A: +	B: -	C: *	D: /	E: reduce

To display fractional forms in Alpha, SF 10, FIX 0, CF 29. Store call # in R06 and xeq FR. 1: +, 2: -, 3: *, 4: /, 5: Reduce Y/X, 6: gcd(x,y). See MATHEMATICS - PPC.
Also see RN, GN, DF and NP (other programs in the same program file).

FRAME   HP-IL information (commands, data, etc.) is transmitted around the loop in 11 bit messages called frames. Each frame consists of 8 data bits and 3 control bits and are read, passed on or checked by each device in the loop. The working RAM registers that contain these bits are in the HP-IL module itself and not in the 41C. See SOURCE.

FRC   FRACTIONAL PART. Returns the fractional part of the number in X. The contents of X are saved in LASTX. See FR, INT.

FS?   FLAG SET? Prompts for 2 digits <=55. If false, the next program line is skipped.
See IF, TOGGLE FLAG.

FS?C   FLAG SET? TEST AND CLEAR. Prompts for 2 digits <=29. If false, the next program line is skipped. Flags =30 are system flags and can only be tested. See IF, TOGGLE FLAG.

FULL MAN   The LCD display character produced by character code 1 (colloquial). Also referred to as the Hangman character.

See CHARACTER CODES, MAN CHARACTERS. Also see "Synthetic Programming" (reference).

FV   FUTURE VALUE in a general financial program, input or displayed in accordance with the financial sign convention. Usually stored in R05 and computed or entered by key E.
This function is available in the FINANCIAL, REAL ESTATE, HOME MANAGEMENT and PPC ROMS.

NOTES

A WORD ABOUT "UNIT MANAGEMENT"

"UNIT MANAGEMENT" refers to the Assembly Language routines in the Machine Design, Thermal and Transport Science and Petroleum Fluids Application Modules that allow the user to write conversion equations in the Alpha register. For example, "HR*FT2 / BTU*IN". Conversions between SI and English units are written symbolically in Alpha and the quantities to be converted in X. The Petroleum Fluids Module allows 82 units to be converted such as Acres, Bbls, Ft, Days, Gals, Ergs, HP, Mbars, Mols and Therms. Fairly complex combinations can be handled such as converting Acre ft./day to gal/min. Due to its complexity, its syntax was beyond the scope of this volume. Both the accompanying manual and the Petroleum Fluids Module itself are outstanding examples of documentation and programming. The programming style and user-considerate features of the Module commend it to anyone interested in improving their programming skills.

g HP67 prefix key, keycode 32 (one of three shift keys). Also see "f" and "h".

GE GO TO END, PPC ROM 10,60, SIZE 000, Subr. levels: 0. Execution places the program pointer at the last program in main memory, Line 000. Switch to program to see number of remaining program registers.

GENERAL PURPOSE FLAGS As strictly defined by HP's Users' Library, these are Flags 00 - 10 and may be used for any purpose. Other Flags are considered "dedicated" or reserved for use by various peripherals and devices such as Printers and the Card Reader and should be reserved for their use in shared software. See EXTENDED FLAGS.

GETAS GET ASCII FILE, XFUNCTION 25,16. Copies the named ASCII file from mass storage to Extended Memory. Prior to use, an ASCII file of equal or larger size must be created in Extended Memory. |||X: ASCII file size in registers||| |||ALPHA: ASCII file name||| xeq CRFLAS (Create ASCII file). |||ALPHA: mass storage file name, extended memory file name, if different||| xeq GETAS See CRFLAS, SAVEAS.

GETKEY XFUNCTION 25,17. Suspends program execution for 10 seconds or until any key is down. Displays keycode in X, or 0 if no key is pressed. All keys are captured, including SHIFT, ON, PRGM and R/S. See KEYCODE.

GETP GET PROGRAM, XFUNCTION 25,18. Copies the named program in Extended Memory into main memory (the original program is still in Extended Memory). The last program will be replaced unless it contains an END (not .END.). This feature can be used to chain long programs for uninterrupted execution. |||ALPHA: program file name|||
Compare with GETSUB. Similar to Card Reader functions; see MRG, RSUB.

GETR GET REGISTERS, XFUNCTION 25,19. Copies the named data file into main memory starting with R00. |||ALPHA: data file name|||
Compare with GETRX.

GETREC GET RECORD, XFUNCTION 25,20. Copies the ASCII file record at the current file pointer position to the Alpha register to a maximum of 24 characters. Flag 17 remains clear until the end of the record is reached. Successive execution of GETREC will continue the record or advance the pointer to the next record automatically. This feature is useful when output will be printed by an 80-column printer.
SEE APPREC, APPCHR, FLAG 17.

GETRX GET REGISTERS according to the control word in X. XFUNCTION 25,21. Copies the needed registers from the working data file in Extended Memory to main memory data registers. Copying begins at the current pointer position and fills data registers bbb - eee.
|||X: bbb.eee beginning and ending registers in main memory|||
|||ALPHA: data file name, if not currently the working file |||
Also see GETR.

GETSUB GET SUBROUTINE; XFUNCTION 25,22. Copies the named program in Extended Memory to main memory following the last program in main memory. |||ALPHA: program file name|||
Compare with GETP. Similar to Card Reader functions; see RSUB and MRG.

GETX X FUNCTION 25,23. Copies 1 data register in the working Extended Memory data file to X. Successive executions of GETX advance the file pointer and recall successive data registers. See GETR, GETRX, SAVEX, SAVERX.

GLOBAL LABEL A label consisting of 1 - 7 alpha characters except "," "." or ":") except the single characters A - J or a - e. Global labels may be accessed from any other program file in memory and may be assigned to the keyboard in the same manner as functions. A Global label contains a minimum of 5 bytes where the first 4 bytes represent the relative locations to the preceding and following END and Global Label in CATALOG 1, the keycode, if assigned (this byte exists in the label whether or not an assignment has been made) and the number of text characters. See Appendix E, Function Timing.

GN GAUSSIAN RANDOM NUMBER GENERATOR, PPC ROM 20,15, SIZE 001, Subr. levels: 4. Any data register may be used to hold the random number "seed". The mean and standard deviation of the random numbers are chosen by the user and stored in R06 and R07 respectively.
|||X: fractional seed||| xeq GN. Returns 2 random numbers to Y and X. See RN.

GO TO LOCAL HP-IL message. The controller causes all devices in the loop addressed as Listeners to be under the control of their front panel switches. The 82161A Digital Cassette Drive and 82162A Printer do not respond. See LOCAL.

GOOSE The symbol seen during a running program or as the register pointer in SW mode (TIME module).

GRAD GRADS MODE. Sets the 41C to calculate trig functions in grads mode. Input in decimal degrees is assumed.

GRAPHICS Mode used to create and build special characters where each print buffer cell stores one column of dots, coded 0 - 127. See COLUMN PRINT NUMBER; also see PRINT BUFFER.

GROUP EXECUTE TRIGGER HP-IL message. The controller causes all loop devices that are addressed as Listeners to begin their individual operations. With this message, the controller can start many devices at almost the same time. The 82161A Digital Cassette Drive and 82162A Printer do not respond. See TRIGGER.

GSB HP67/97 mnemonic for Go To Subroutine (41C = xeq). GSB is always followed by the keycode for an alpha label, a - e or A - E, or a number 0 - 9. If followed by the character (i), translate as XEQ IND 25 where R25 will contain a number 0 - 9 or 20 - 24. Seen in HP67/97 listings as GSBf (a-e) or GSB n.

GTO GO TO. Used to position the program pointer, either by a program (unconditional branch) or from the keyboard. Go to a line number: GTO . – – – Note that keys A - J will fill the prompt with 3 digits, 001 - 010. To position to a Global label while in PRGM mode, GTO . ALPHA (alpha characters in global name) ALPHA. The "." is not necessary if not in program mode. When GTO nn is used in a program and the jump distance is less than 113 bytes, labels 00 - 14 may be used effectively. For greater jump distances, labels 15 - 99 or local alpha labels should be used to speed execution time as the relative jump distance is stored in the second byte of the GTO instruction.
See Appendix Function Timing.

H

H HP67/97 mnemonic for HR - convert from HH.MMSS format to HH. decimal format. Also seen as "f HMS , f H , or HMS . A potential source of confusion to non HP67/97 users. See HR.

h HP67 prefix key, one of three Shift keys, keycode 35. Also see "f" and "g".

HA HIGH RESOLUTION HISTOGRAM WITH AXIS, PPC ROM 20,25, SIZE 006, Subr. levels: 5. Prints a histogram bar whose height is proportional to the input in X where X is between YMIN (R00) and YMAX (R01). The program contains numerous printing options and features.
See PRINTER ROUTINES - PPC.

HANDSHAKE Jargon for the techniques used by interfaced devices to synchronize information transfer.

HD HIDE DATA REGISTERS, PPC ROM 10,20, SIZE X + 6, Subr. levels: 6. The code n xeq HD raises the curtain by n registers and places in the former R_n (R00 after the curtain is raised) an alpha string used by the inverse routine, UD, to reinstate the curtain position when called. See CURTAIN - PPC, UD.

HEX HEXADECIMAL. Pertaining to base 16. 41C instructions are grouped by the internal operating system in a group of 16 x 16 and identified by "HEX" digits 0 - 9, A - F.
See HEX TABLE.

HEX TABLE A table of 256 instructions used by the 41C. Two HEX characters, row and column, identify a specific instruction. See HEX, Appendix The Hex Table.

HMS Converts decimal hours.minutes seconds HH.dd to a sexagesimal system useful for calculating with time and degrees, HH.MMSShh = hours . minutes seconds hundredths.
See HR.

HMS+, HMS- Hours.minutes seconds arithmetic instructions. X, Y inputs must be in HH.MMSShh form. See TIME FORMATTING. Also see HMS, HR, T+X.

HN HEX TO NNN, PPC ROM 10,41, SIZE 000, Subr. levels: 6. Converts up to 14 characters in Alpha to an NNN - non-normalized number - in X.
See NH, NON-NORMALIZED NUMBERS - PPC. Also see Appendix The Hex Table.

HP HIGH RESOLUTION PLOT, PPC ROM 20,29, SIZE 040, Subr. levels: 3. Plots from 1 - 9 user-defined functions simultaneously using 7 plot points per printed line. The program file contains numerous printing options and features. See PRINTER ROUTINES - PPC.

HP-IL REGISTER The 41C's HP-IL module contains 8 single-byte registers for sending and receiving loop data and commands (frames). See FRAME.

HR Converts a number in X assumed to be formatted as HH.MMSShh - hours.minutes seconds to decimal hours. See HMS.

HS HIGH RESOLUTION HISTOGRAM, PPC ROM 20,26, SIZE 006, Subr. levels: 5. Prints a bar-chart bar whose height is proportional to the input in X. The program file contains several printing options and features. See PRINTER ROUTINES - PPC.

I

i % INTEREST rate in a general financial program, usually stored in R02 and computed or entered by key B. The nominal rate for the period implied by the compounding and payment frequencies. Program available in FINANCE, REAL ESTATE, HOME MANAGEMENT and PPC ROM.

(i) HP67/97 mnemonic for INDIRECT referring to the "I" register, corresponding to the 41C's R25. The HP67 contained limited indirect addressing: labels 0 - 9 and 20 - 24 and data registers 0 - 25. See DSZ (i), ISZ (i).

IF INVERT FLAG, PPC ROM 10,49, SIZE 000, Subr. levels: 6. Toggles any flag 00 - 55 to its opposite state, set or clear. |||X: flag number|||. For example: to speed up any program that prints only occasionally, 55 xeq IF. Prior to printing final output: 55 xeq IF. Unique applications include random access to CATALOG 2 via control of Flag 30.
See TOGGLE FLAG, Appendix Bugs 1 - 9 (Bug 3).

IG INTEGRATE, PPC ROM 20,09, SIZE 030, Subr. levels: 4. To use key function "X" into program memory followed by RTN or END and store global name in R10. To display successive iterations, SF 10. Set display mode and input limits a ENTER b, xeq IG. Approximation to integral returned to X. Routine uses Flag 09 and R10 - 29. See MATHEMATICS - PPC.

INA INPUT ALPHA, HP-IL Control function, xrom 28,29. The 41C receives an ASCII-coded alpha string from the loop's primary (SELECTed) device. Terminated by Carriage Return and Line-Feed. To receive more than 25 characters, re-execute INA. See IND, OUTA, SELECT.

IND INPUT DECIMAL, HP-IL Control function, xrom 28,30. Copies an ASCII-coded numeric string from the primary (SELECTed) device to X. The device determines the data format. Used, for example, to receive a voltage reading from the 3468A Digital Multi-meter.
See INA, OUTA, SELECT.

INSCHR INSERT CHARACTER, XFUNCTION 25,24. An editing function for the working ASCII file in Extended Memory. Characters in Alpha are inserted ahead of the current pointer position. If not already positioned prior to use, the record.character pointer must be in the proper place: |||X: record.character = rrr.ccc, example, record 4, character 9 = 4.009|||
Use SEEKPT(A) to place pointer. |||ALPHA: characters to be inserted|||
See DELCHR, DELREC, INSREC, SEEKPT(A). Also see DR, IR.

INSERT Refer to CURSOR, INSERT (Video Interface function),

INSREC INSERT RECORD, XFUNCTION 25,25. An editing function for the working ASCII file in Extended Memory. Characters in Alpha are inserted as a new record in front of the current

INSREC (Con't)

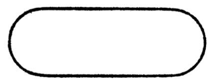
record. Note that the file pointer must first be positioned with SEEKPT(A). |||ALPHA: characters to be inserted (comprising new record)||| See DELREC, INSCHR, SEEKPT(A). Also see DR, IR.

INSTAT INPUT STATUS, HP-IL Control function, xrom 28,31. Copies 8 status bits from the primary device to the 41C by setting the corresponding Flags 00 - 07. A number representing the first 6 bits is pushed into X. See CHECKSUM ERROR, DEVICE ERROR, END OF TAPE ERROR, END/STALL ERROR for examples of INSTAT bits. Also see STATUS BYTE, X<>F.

INT INTEGER PART. Returns the integer part of the number in X. The previous contents of X are saved in LASTX. See FRC.

INTERFACE CLEAR HP-IL message. The controller sends a message to all loop devices setting them to idle condition. Auto addresses are not affected. See DEVICE CLEAR, STOPIO.

INTERRUPT Flow-chart symbol symbolizing any start, stop or delay in a program. Used at the beginning and end of a flow-chart.

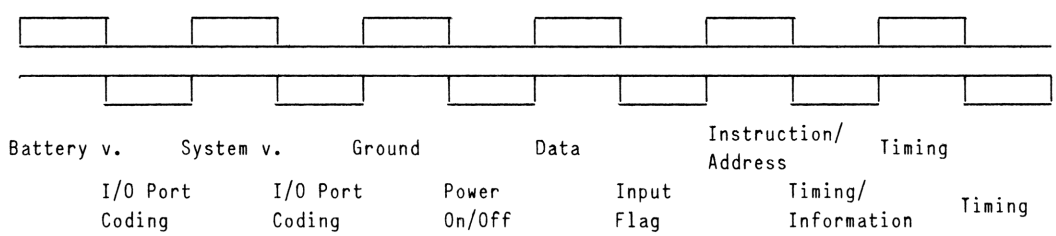


INV MATH 1 Module, xrom 01,07. A subroutineable portion of the MATRIX program file to compute the inverse of a square matrix. Execute from the keyboard as needed after the matrix elements have been stored. See MATRIX, PVT, SIMEQ. Also see MATRIX - PPC.

INVERSE VIDEO HP-IL Video Interface capability. The following sequence will display an inverse video character: CLX ENTER 1 BLDSPEC |||X: character code of character or symbol to displayed||| BLDSPEC CLA ARCL X OUTA. This sequence (omitting CLA, Clear Alpha) must be repeated for each character. When the inverse video string has been built, it is sent to the screen via OUTA. Note that it may require 32 bytes to display a 3-character word in this manner. See BLDSPEC, CHARACTER CODE, OUTA.

I/O BUFFER The memory space in the 41C reserved for key assignments, Timer alarms, diagnostics and hypothetical future peripheral use. The buffer expands as needed for alarms and keys and is automatically packed as alarms are activated and acknowledged. Under other conditions, it is conditionally packed. See PK.

I/O PORT The physical portion of the 41C used to exchange information with external devices and ROMs.



I/O PORT ADDRESSING See ROM ADDRESSING.

IP INITIALIZE PAGE, PPC ROM 10,45, SIZE 000, Subr. levels: 3. Stores data from status register c in absolute location 256 (decimal), the bottom register of a Quad Module. This data can be used later by the PS routine to switch additional Quad Modules into main memory (note that only 320 registers are in main memory at one time - these techniques, however, allow pages of 256 registers of data or program to be switched in and out). See the inverse routine, PS.

IR INSERT RECORD, PPC ROM 20,37, SIZE a/r, Subr. levels: 5. Allows the insertion of a block of data registers of pre-defined length. To insert a new nth record, input n, xeq IR. The following data must have been pre-stored. |||R07: 1st register of entire file||| |||R08: number of registers per record||| |||R09: number of records in the file||| See DR. Also see BLOCK ROUTINES - PPC.

ISG INCREMENT, SKIP IF GREATER. Using a control word in the stack or a data register of the form iiiii.fffcc, ISG first increments iiiii by cc and then tests the integer portion of the result. If greater than fff x 100, the next line in program memory will be skipped. The default cc = 1. Example: execute a loop 5 times, then skip; the loop will store data in

ISG (Con't)
alternate registers from R18 - R44. The control word would be 18.04402 (starting at R18, ending at R44, by two's. Prior to each data input: ISG nn (nn = register containing the control word) STO IND nn. See DSE, DSZ, ISZ. Also see CONTROL WORD.

ISZ or ISZ (i) HP67/97 mnemonic for Increment and Skip if Zero. If the Card Reader is in the system when this function is used, it translates as 7ISZ; else use ISG 25 or ISG IND 25. Note that ISZ is similar but not identical to ISG as it only skips at zero. R25 must contain the incrementing counter. See DSE, DSZ, ISG.

J

JC JULIAN DAY NUMBER TO CALENDAR DATE, PPC ROM 20,22, SIZE 000, Subr. levels: 5. To use: input Julian day number in X and xeq JC. Output in the stack is as follows:
|||Z: year YYYY||| |||Y: month MM||| |||X: day of month DD|||
SF 10 = Julian Calendar; CF 10 = Gregorian Calendar.
The inverse routine is CJ. Also see DDAYS, DATE+.

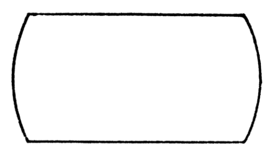
K

KEY ASSIGNMENT ROUTINES - PPC ROM
- A?: Assignment Register Finder
- CK: Clear Key Assignments
- MK: Make Key Assignments
- PK: Pack Key Assignment Registers
- RK: Restore Key Assignments
- SK: Suspend Key Assignments
- VK: View Key Assignments
- +K: Additional Key Assignments
- 1K: First Key Assignment

See specific program for details.

KEYCODE ERR XFUNCTION error message caused by using PASN with an unassignable keycode in the X register such as 31 representing the SHIFT key.

KEYING An IBM flow chart symbol for keying or verifying.



KEYNOTES A quarterly subscription publication giving product information, programming tips and routines, and articles of interest to all owners of advanced programmable calculators.

L

L REGISTER The 5th register (004 Absolute) of 41C memory, also called LASTX. Used to store arithmetic arguments for error recovery. To address the L register for other purposes, such as VIEW, ISG, STO+, etc. key, for example, VIEW . "L"
See LASTX, Appendix The Status Registers.

L- LOAD PORTION OF LB, PPC ROM 10,23, SIZE 012, Subr. levels: 5. A subroutineable part of the LB program file used to write other programs in arbitrary portions of user memory.
See LB.

LASTX Function to recover the last value in X before the execution of a function that altered that value. May be used to recover from errors or save memory. For example, the number 5.231844 will be used 3 times in succession in a program; use LASTX to save reentry of the number: 5.231844 1/X STO 19 LASTX (recovers 5.231844) LOG LASTX (recovers again) FRC ... See L REGISTER.

LB LOAD BYTES, PPC ROM 10,22, SIZE 012, Subr. levels: 0. A unique program that enables the

LB (Con't)

user to load arbitrary bytes into program memory, to facilitate synthetic coding. To key synthetic code into memory, GTO the point in memory where the bytes are to be loaded, key LBL "++" + + + + ... xeq LB. The number of +'s must be at least n+6 where n = the smallest multiple of 7 not less than the number of required bytes. Switch to RUN mode, R/S. The program displays "HEX/DEC INPUT" (input bytes in either form via the Alpha or X register). At completion, the program prompts "SST, DEL nnn" (SST in RUN mode, DEL in PRGM mode). There may be additional +'s to be deleted as well as the line "xrom LB".
See LOAD BYTES - PPC, SYNTHETIC PROGRAMMING, Appendix The Hex Table.

LBL LABEL, 41C language permits branching only to labelled addresses (except synthetically) such as numeric labels 00 - 99, local Alpha labels a - e and A - J (characteristics similar to numeric labels plus key redefinition "soft keys") and Global labels (linked list of file names in main memory). Each type of label has its own advantages, for example, numeric label relative addresses are compiled in GTO and XEQ statements whereas Global labels are searched at each branch; Global labels may be assigned to the keyboard in USER mode and contain unique descriptive characters; numeric labels save memory and speed processing, etc.
See Appendix Function Timing.

LEFT JUSTIFY Various Printer commands and Escape codes affect the positioning of printed output. VIEW and ADV cause right-justified printing while AVIEW and PRBUF cause left-justified output. Both modes are superseded by the FMT (Format) specifier.
See ADV, PRINT BUFFER; also see FMT.

LF LOCATE FREE REGISTER BLOCK, PPC ROM 10,05, SIZE 000, Subr. levels: 4. Outputs bbb.eee (add 16.016) where bbb and eee are the absolute decimal addresses of unused registers between the last used assignment register and the register containing .END. If Flag 10 is set on completion, subtract 1/2 register. See MEMORY - PPC.

LG PPC LOGO, PPC ROM 20,24, SIZE 000, Subr. levels: 5. Used to accumulate 21 columns in the print buffer that will print the PPC Calculator Users' Group logo.

LIF LOGICAL INTERCHANGE FORMAT. Used by HP on all mass storage media to allow data from a media on one calculator/computer to be read by another HP calculator/computer.

LIGHT SLEEP HP-coined term to describe the state of the 41C when ON but not running a program, "standby". See DEEP SLEEP.

LIN Mnemonic for Linear Regression, a program to determine the linear fit to a set of X, Y data points; in RPN the equation is: X ENTER b * a + or Y ENTER a - b /. Also referred as Curve Fitting equation number 1. The a and b coefficients are calculated by the program. See CV, CURVE FITTING, EXP, LOG, POW, r; also see BEST FIT.

LINE FEED HP82162A character code 10, part of the END OF LINE instruction sent by various HP-IL peripherals: Carriage Return/Line-Feed. Affected by the status of Flag 17.
Video Interface: Causes the Cursor to move down 1 line. If the Cursor is on line 15, the display will roll up 1 line and the top line will be erased from display memory.
|||X: 10.00||| xeq ACCHR. See CARRIAGE RETURN, END-OF-LINE.
Also see Appendix B, Print Characters.

LIST Printer 82143A and HP-IL xrom 29,07. A prompting, non-programmable function to list nnn lines of a program forward from the current line number. The printed output is similar to PRP and follows the front panel selection, MAN, NORM or TRACE, or the status of Flags 15 and 16 for non-portable Printers and the Video Interface. See PRP.

LISTEN HP-IL Control function, xrom 28,32. Makes the specified device a Listener - able to receive data and commands. Except for OUTA and TRIGGER, most HP-IL operations cancel this mode. |||X: address of device||| See LISTEN ADDRESS, TALK ADDRESS, UNLISTEN.

LISTEN ADDRESS HP-IL message. The HP-IL controller causes devices to actively receive messages from other devices in the loop. Valid addresses are 0 - 30. Address 31 is interpreted as UNLISTEN. The HP82161A Digital Cassette Drive and 82162A Printer become listeners if their addresses match. See LISTEN, UNLISTEN.

LISTENER HP-IL. Refers to the device in the loop that is prepared to receive data sent by the active Talker. See LISTEN, TALKER, UNLISTEN.

LN NATURAL LOG. Log of X to base e, 2.718281828. See E/X, LN1+X.

LN1+X NATURAL LOG FOR ARGUMENTS CLOSE TO 1. Yields greater precision than the LN function when X is close to 1; outputs answer in Scientific notation. See E/X-1.

LOAD BYTES - PPC Routines in the PPC ROM that are part of the LB program file and utilities.

-B: Store Part of LB
BL: BLDSPEC inputs for LB
FL: Flag Inputs for LB
L-: Load Part of LB
LB: Load Bytes
XL: Xrom Inputs for LB

See the specific program definition.

LOCAL HP-IL Control function, xrom 28,33. Sets the primary (SELECTed) device to be controlled manually (front panel switches). See REMOTE.

LOCAL LABEL Labels 00 - 99, a - e and A - J are local, that is, they cannot be accessed from another program file. See GLOBAL LABEL, GTO: also see Appendix E, Function Timing.

LOCAL LOCKOUT HP-IL message. The controller causes all devices on the loop to not respond to their front panel switches to prevent accidental changing of a control setting. The 82161A Digital Cassette Drive and 82162A Printer do not respond to this message.

LOG COMMON LOG, BASE 10. Calculates $\log_{10}$ of X. See 10/X.

LOG Mnemonic for Logarithmic Regression, a program to determine the logarithmic fit (base_e) to a set of X, Y data points; in RPN the final equation is X LN b * a + and Y ENTER a - b / E/X. Also referred to as Curve Fitting equation number 3. See BEST FIT, CURVE FITTING, EXP, LIN, POW, r.

LOOP POWER DOWN HP-IL message. The controller places all devices in the loop in a power down condition but remains ON itself (41C = "light sleep"). If set to ON, the 82161A Digital Cassette Drive and 82162A Printer are inaccessible for .7 second; if set to STANDBY, the devices will be turned off until any loop message is received. See PWRDN, STANDBY.

LR LENGTHEN RETURN STACK, PPC ROM 20,02, SIZE 002, Subr. levels: (unlimited). Routine to allow subroutine depth as deep as data storage permits provided that successive calls to LR are separated by no more than 5 levels of subroutine nesting. See the inverse routine: SR.

NOTES

M1 MATRIX, INTERCHANGE 2 ROWS, PPC ROM 20,33, SIZE a/r, Subr. levels: 4. To interchange rows i and j of a stored matrix, input: i ENTER j xeq M1.
|||R07: start register of matrix||| |||R08: number of columns in matrix|||

M2 MATRIX, MULTIPLY ROW BY CONSTANT, PPC ROM 20,31, SIZE a/r, Subr. levels: 4. To multiply row j of a stored matrix by a constant, K, input: K ENTER j xeq M2.

M3 MATRIX, ADD MULTIPLE OF ROW TO ANOTHER, PPC ROM 20,32, SIZE a/r, Subr. levels: 4. To add k times row i to row j, input: j ENTER ENTER k xeq M3. Row j changes; row i does not.

M4 MATRIX, REGISTER ADDRESS TO (i, j), PPC ROM 20,35, SIZE a/r, Subr. levels: 4. Input register r, xeq M4. Row number is returned to Y; column number j is returned to X. See M5.

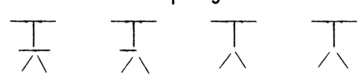
M5 MATRIX, (i, j) TO REGISTER ADDRESS, PPC ROM 20,36, SIZE a/r, Subr. levels: 5. Input: i ENTER j xeq M5. Returns register number r to X. See M4.

M REGISTER The first register of the Alpha register group, normally holding 6 alpha characters. The M register can be used to save program pointers, normal data and strings representing synthetic BLDSPEC or flag register inputs. See Appendix The Status Registers.

MA MEMORY TO ALPHA, PPC ROM 20,54, SIZE 005, Subr. levels: 5. Recalls to alpha (ARCL) the contents of a block of data registers using a control word in X of the form bbb.eeeii.
See the inverse routine, AM.

MAIN MEMORY The firmware limited memory area of a 41C/41CV, 336 registers (including status registers). Programs may be run via "xeq 'NAME'" and registers accessed by RCL or RCL INDIRECT. Decimal addresses 3584. See EXTENDED MEMORY.

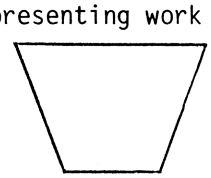
MAN CHARACTERS The LCD display characters represented by character codes 1, 4, 3 and 6.



MANIO HP-IL Control function, xrom 28,34. Manual input/output mode (sets Flag 32, a system Flag). For an example of use, if more than 1 mass storage device is in the interface loop, use MANIO to ensure that only the desired device performs the designated function.

MANUAL Printer mode, applicable to all peripheral Printers and Video Interface. Printers other than the 82143A and 82162A are set to MANUAL mode when Flags 15 and 16 are clear. In this mode, input and output are not printed except by explicit Print commands in a program or from the keyboard. Program listings are printed left-justified.
See NORMAL, TRACE, FLAGS 15, 16.

MANUAL OPERATION Flowchart symbol representing work to be performed by humans such as entering numbers or loading cards.



MASS FLAG CONTROL The technique used by synthetic programmers to set 56 Flags with 3 lines of memory - 12 bytes. A 7 byte text line representing the Flags is created in Alpha and transferred to the Flag register by RCL M STO d. For example, the contents of the Flag register shown on page 14, require a text line comprised of the character codes 247, 25, 0, 16, 44, 3, 216 and 0 (Hex: 19 00 10 00 2C 03 D8 00). See d REGISTER, SYNTHETIC INSTRUCTION, Appendix - The Status Registers, References.

MASTER CLEAR The solution to any 41C problem when all else fails. To clear all 41C memory and reset all Flags to default status, turn off the 41C, remove any Extended Memory Modules, including the XFUNCTION module (but NOT THE TIME MODULE) and while holding down the back-arrow key, press ON. The message MEMORY LOST should appear. Turn off the 41C and reinsert the Extension Modules. Their contents will be undisturbed if the process took less than approximately 30 seconds. The TIME Module is unaffected by MASTER CLEAR and does not reset unless physically removed. This procedure is normally performed to recover from a crash when other techniques are ineffective.
See ML.

MATHEMATICS ROUTINES - PPC Routines in the PPC ROM that relate to mathematics.

BD: Base B to Base Decimal
BX: Block Extrema
B≤: Block Statistics
CA: Complex Arithmetic
CJ: Calendar Date to Julian Day Number
CM: Combinations
CV: Curve Fit
DF: Decimal to Fraction
EX: Exponent of X
FD: First Derivative
FI: Financial Calculations
FR: Fractions
GN: Gaussian Random Number Generator
IG: Integrate
JC: Julian Day Number to Calendar Date
M1: Matrix, Interchange 2 Rows
M2: Multiply Row by Constant
M3: Add Multiple of Row to Another
M4: Register Address to (i, j)
M5: (i, j) to Register Address
MT: Mantissa of X
NP: Next Prime
PM: Permutations
PR: Pack Register
QR: Quotient Remainder
RN: Random Number Generator
SE: Selection Without Replacement
SV: Solve
TB: Base 10 to Base B
UR: Unpack Register
VM: View Mantissa

MATRIX MATH 1 Module, xrom 01,01. Subroutineable matrix operations program file calculates determinants and inverses of up to 16 x 16 square matrices and solves systems of equations with 16 unknowns. Matrix order = N; single element, A(I,J) in reg. N(I-1) + J+14.
SIZE: $N^2 + 2N + 15$
Register location: 00 - $N^2 + 2N + 14$
Matrix location: 15 - $N^2 + 14$
Pivot location: $N^2 + 15$ to $N^2 + N + 14$
Column location: $N^2 + N + 15$ to $N^2 + 2N + 14$
Data to record: 13 to $N^2 + N + 14$ (13.eee WDTAX, or WRTRX or SAVERX).
See EDIT, INV, PVT, VCOL, VMAT. Also see SIMEQ and M1 - M5.

MATRIX ROUTINES - PPC Routines in the PPC ROM that perform matrix manipulations.
M1 - M5 See MATHEMATICS ROUTINES - PPC for routine names.
BX: Block Extrema
B : Block Statistics

MDY MONTH.DAY YEAR FORMAT, TIME Module xrom 26,17. Default display and I/O mode of the TIME Module (Clears Flag 31). Results in a date format of MM/DD/YYYY in the display and MM.DDYYYY in X. All inputs are expected in this format for date calculations.
See DATE FORMATTING, DMY.

MEAN Returns to Y and X the arithmetic average of the accumulated values in the statistical register block. Statistical block initialized by REG -- and CL≤ . The 1st register = the sum of the X values, 2nd register = sum of the squares of the X values, 3rd register = sum of Y values, 4th register = sum of the squares of the Y values, 5th register = sum of the products of the X and Y values and 6th register = number of inputs. Xeq MEAN. Press X<>Y to see mean of Y values. See SDEV.

MEDM ERR HP-IL mass storage error message: possibly worn or damaged medium.

MEDM FULL HP-IL mass storage error message: storage space remaining on the medium is in sufficient for the file.

MEMORY ROUTINES - PPC Routines in the PPC ROM related to "memory".

E?: End Finder
EP: Erase Program Memory
F?: Free Register Finder
IP: Initialize Page
LF: Locate Free Register Block
ML: Memory Loss Resize to 017
MS: Memory to Stack
OM: Open Memory
PR: Pack Register
PS: Page Switch
RX: Recall From Absolute Address in X
S?: Size Finder
SM: Stack to Memory
UR: Unpack Register
VS: Verify Size
≤?: ≤REG Finder

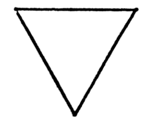
MMEMORY LOST 41C's Continuous Memory has been cleared and the calculator's status has been restored to default conditions.

MEMORY VOID 176 registers between the 16 status registers and the first key assignment are

MEMORY VOID (Con't)
not addressed by the 41C operating system. In absolute registers, 00 - 15 represent the status registers and 16 - 191 are the void. Registers 192 - 511 are main memory.
See Appendix - The Status Registers.

MERGE HP67/97 function to merge data or programs, seen in listings as MRG, f MERGE or g MERGE. This function cannot be translated by the Card Reader. When data is merged, the start address is found in R25 (HP67/97 = "I" register). See MRG.

MERGE A flowchart symbol indicating the merging or chaining of programs, for example, by using the Card Reader MRG function or XFUNCTION GETP.



MESSAGE ALARM An alarms created by XYZALM in the TIME Module that flashes an alpha string when activated. See XYZALM.

MICROCODE The sequence of assembly language operations performed by the 41C's microprocessor is often called microcode, a term which more precisely refers to bit level machine code (binary) operations. See ASSEMBLY LANGUAGE.

MIRROR PLOT A plotting mode available in the MP program file of the PPC ROM that causes function points to be reflected back from the edge they exceed rather than "flatten out" as in the normal PRPLOT operation. See MP and HP.

MK MAKE MULTIPLE KEY ASSIGNMENTS, PPC ROM 10,01, SIZE 012, Subr. levels: 3. Program prompts PRE/POST/KEY at xeq MK. This is a reference to the Hex Table; for example, to assign a specific TONE to the keyboard, look-up the TONE function (position 159) and key 159 ENTER tone number ENTER keycode (as seen during a normal ASN operation) and press R/S. Continue processing as many times as desired. No termination procedure is necessary.
See KEY ASSIGNMENTS - PPC, Appendix The Hex Table.

ML MEMORY LOSS RESIZE TO 017, PPC ROM 10,12, SIZE n/a, Subr. levels: 0. Execute only after a MEMORY LOST to quickly regain program space that defaulted to data register space.

MOD MODULO (REMAINDER). Performs Y mod X which divides Y by X and leaves the remainder. For example: 1844 MOD 19: 1844 ENTER 19 MOD. Result = 1.00. See QR.

MP MULTIPLE VARIABLE PLOT (1 - 9), PPC ROM 20,28, SIZE 035, Subr. levels: 3. Plots 1 - 9 user-defined functions simultaneously with 1 plot point per printed line. Store YMIN in R00, YMAX in R01, plot width (1 - 168 columns) in R02, XMIN in R08, XMAX in R09 and X increment in R10. Global function names are stored in R15 - 23. Input number of functions in X and xeq MP. Numerous options are available via flags and associated routines.
See HP.

MRG Card Reader xrom 30,01. A programmable function to control the Card Reader; prompts "CARD" for a manual magnetic card insertion and reads the program into memory either replacing all of the program lines after the MRG instruction or placing it after the last END in memory. However, in the latter case, MRG ERR is displayed. This function cannot be used to translate an HP67 MERGE instruction correctly. See MERGE. Also see RSUB.

MRG ERR Card Reader error message seen if an attempt is made to merge a card program while the program pointer is in a ROM program; also seen if an attempt is made to merge a card program to a program other than the last program.

MS MEMORY TO STACK, PPC ROM 10,48, SIZE 005, Subr. levels: 5. This routine recalls 5 data registers in sequence to load the stack and LASTX. R06 is assumed to contain the lowest register address of the 5-register block. See the inverse routine, SM.

MT MANTISSA OF X, PPC ROM 10,28, SIZE 000, Subr. levels: 6. Replaces X by its Mantissa.

N REGISTER The second register of the Alpha register group, normally holding 6 alpha characters. The N register can be used to save program pointers, normal data and temporary uses. Register 006 absolute of 41C memory. See M REGISTER, Appendix The Status Registers.

n Number of periods or payments in a general financial program, usually stored in R01 and computed or entered by key A. Program available in the FINANCE, REAL ESTATE, HOME MGMT. and PPC ROMs.

N! HP67/97 mnemonic for factorial (FACT).

NAME ERR HP-IL or XFUNCTION error message. An empty Alpha register or misspelled name causes this message. See the specific command for correct alpha syntax.

NATURAL NOTATION The representation of Hex characters 3A - 3F as they display, normally faster to use when decoding programs. See HEX TABLE, HN, NH.

NC NTH CHARACTER, PPC ROM 10,38, SIZE 000, Subr. levels: 6. Extracts the nth character from the right end of the Alpha register and places it in X and Alpha. X is saved in LASTX. See POSA. 10

NEW TAPE ERROR HP-IL status message sent by 82161A Digital Cassette Drive if a tape has been inserted but not positioned. 0001 0111. See INSTAT.

NEWM HP-IL Mass Storage, xrom 28,03. NEW MEDIUM initializes the mass storage medium and prompts for the number of directory entries 447. Most users will find directory sizes of 200 - 250 sufficient as a considerable amount of available storage space is occupied by the directory. Not programmable. As NEWM effectively erases a mini data cassette, it should never be accessed synthetically by eGOBEEP. See DIR, DIRECTORY.

NH NNN TO HEX, PPC ROM 10,40, SIZE 000, Subr. levels: 6. Decodes a non-normalized number in X to 14 Hex characters in alpha, for example, decoding the program pointer or the contents of other status registers. For faster conversion, SF 10. This results in a display with "natural notation". See the inverse routine, HN. Also see CODE, DECODE.

NIBBLE (sometimes spelled NYBBLE). Four bits (1's or 0's) or one half of a 41C byte. See BINARY CODED DECIMAL, BYTE.

NNN NON-NORMALIZED NUMBER. A term describing an undefined number in a 41C register, such as the contents of a status register, program pointer, etc. If a nibble other than a 0 or a 9 appears in either of the sign digits, the number is an NNN and arithmetic operations on the number will produce errors. (If the first nibble is 1, the string is an alpha string.) Each 41C register will hold 14 nibbles; for example, each digit is represented in Binary Coded Decimal by 4 bits; in program mode, each digit occupies 1 byte as it represents a position in the Hex table (a "function"). See NON-NORMALIZED NUMBERS - PPC.

NO DRIVE Error message. XFUNCTION: an attempt was made to read or store an ASCII file (GETAS or SAVEAS) when there was no mass storage device in the loop or no HP-IL module in the system. HP-IL: message appears in AUTOIO mode when there is no mass storage device in the loop.

NO KEYS HP-IL mass storage error message caused by WRTK (WRITE KEYS) if an attempt is made to create a key file when there are no assigned keys. Note that key files do not save user program reassignments.

NO MEDM HP-IL mass storage error message. Improperly installed tape.

NO PRINTER HP-IL error message, seen in AUTOIO mode when there is no Printer or Video interface device in the loop.

NO ROOM Main memory or Extended Memory is too small to accept the file, data registers, key assignments or other information. In the case of Extended Memory a file must be purged (PURFL) or an additional module inserted.
TIME Module: error message produced when there is insufficient room in the I/O buffer for an XYZALM. To remedy: use a shorter alpha message if a message alarm or reSIZE the calculator.

NO TAPE ERROR The 82161A has no tape installed and will send status byte 0001 0100. INSTAT.

NON-NORMALIZED NUMBERS - PPC Routines in the PPC ROM that manipulate non-normalized numbers.

CD: Character to Decimal
DC: Decimal to Character
HN: HEX to NNN
NH: NNN to HEX
NR: NNN Recall
NS: NNN Store
XD: Hex to Decimal
2D: Decode 2 Bytes to Decimal

See the individual program definitions.

NONEXISTENT Error message. 41C: An attempt was made to STO or RCL a nonexistent data register or execute a function in a module not plugged into an I/O port or to execute a program that was not in main memory or whose name was misspelled.
XFUNCTION: Use of the STOFLAG function with a bb.ee control word where ee is >43. Use of the GETRX, REGMOVE, REGSWAP or SAVERX functions with nonexistent main memory register numbers.
HP-IL: HP-IL Print switch set to Disable. Also caused by specifying a program or function to be plotted that is not in main memory or misspelled. In the case of PRREGX, check SIZE and bbb.eee control word in X. In the case of READRX or WRTRX, the bbb.eee control word specifies a non-existent data register.
TIME Module: Either a Control Alarm (XYZALM) or the ALMNOW function attempts to activate a program that does not exist in CATALOG 1 or a function that does not exist in CATALOG 2 (or is not programmable such as BST). Also seen in SW mode - and terminates that mode - when an attempt is made to store a split in a nonexistent register.

NOP NO OPERATION. A space filler used with instructions such as DSE or ISG to prevent them from causing a skip when the incremented digits exceed the value of eee (ISG). Any operation that does nothing is acceptable, though labels 00 - 14 are the fastest and unambiguous in program listings. A common NOP is TEXT 0, created synthetically, though it appears as a space (alpha character) to users unfamiliar with the technique.

NOP A correction or bug-fix to a published program.

NORMAL Printer mode, applicable to all peripheral Printers and Video Interface. Printers other than the 82143A and 82162A Printer are set to NORMAL mode when Flag 15 is clear and Flag 16 is set. In this mode, all input and output is printed. Program listings are printed right justified with a space before each label. Should not be used when accumulating characters in the print buffer. See MANUAL, TRACE. Also see FLAG 15, 16.

NORMALIZATION The process performed by the 41C's operating system when non-alpha data is recalled from a non-status register. The system changes the number or attempts to make it behave normally, that is, like a BCD number and not a hex number. See NNN, NR, NS.

NOT A Boolean logic operator that always gives the logical opposite of an expression. If the expression is true (=1) the result is false (0).

NOT READY FOR DATA HP-IL message. When received by the 82161A Digital Cassette Drive or the 82162A Printer, the previous byte becomes the last byte sent and transmission is ended.

NOT REMOTE ENABLE HP-IL message. The controller places all loop devices under local control where they will not respond to programmed commands but only to their front panel switches. The 82161A Digital Cassette Drive and 82162A Printer ignore this command.

NP NEXT PRIME, PPC ROM 20,14, SIZE 000, Subr. levels: 5. to use: |||Y: integer||| |||X: starting trial divisor||| The divisor must be 2 or an odd number greater than 2. Execute NP: n is returned in Y and the next divisor is returned in X. R/S for the next factor. *Note: the trial divisor must not be greater than any prime factor of Y.*

NR NNN RECALL, PPC ROM 20,50, SIZE 002, Subr. levels: 6. Recalls an NNN (stored in 2 registers to circumvent normalization). See NNN, NORMALIZATION, NS.

NS NNN STORE, PPC ROM 20,49, SIZE 002, Subr. levels: 6. Stores Y in R_X+1 in a format that allows recall by NR without normalization. See NNN, NORMALIZATION, NR.

NULL An instruction used by the 41C operating system as fillers for deleted instructions (until PACKed) or a separator for sequential numbers in program memory that are not otherwise separated.
See NOP, PACK.

NULL CHARACTER Character Code 0 places an overbar (¯) in Alpha and prints as ◆ . Nulls can only be seen in the Alpha register. See CHARACTER CODES, Appendix A, Hex Table.

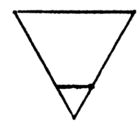
O

O REGISTER The third register of the Alpha register group, normally holding 6 alpha characters. The O register can be used to save program pointers, normal data and temporary uses. Register 007 absolute of 41C memory. See Appendix The Status Registers.

OCT DECIMAL TO OCTAL CONVERSION. Input in X must be an integer value =1,073,741,823. See the inverse function DEC. Also see TB, BD.

OFF Programmable instruction useful when the calculator is unattended or as an exit from a time consuming loop that is running down the batteries (FS? 49 OFF). Note that all flags from 11 - 26 are reset to default status at turn-on.

OFFLINE STORAGE A flowchart symbol representing storage physically outside of the machine, for example, a Printer tape or a magnetic card (or barcode).

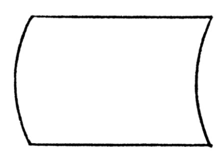


OM OPEN MEMORY, PPC ROM 10,58, SIZE 000, Subr. levels: 5. Places the curtain at absolute decimal address 16 and used by various routines in the PPC ROM to gain access to the I/O buffer and program memory. See MEMORY - PPC.

ON CONTINUOUS ON. Sets Flag 44 to defeat the automatic "off" in there is no activity for 10 minutes. See DEEP SLEEP, LIGHT SLEEP.

[ ] ON Displays the digital clock (TIME Module) and resets Flags 11 - 26 to their default status. Not programmable. Substitute CLOCK. See TIME.

ONLINE STORAGE A flowchart symbol symbolizing storage of data or programs within the system, such as Extended Memory or on a mini data cassette.



OR Boolean logic operator. Two expressions or bits are compared; if one or both are true (non 0) the result is true (1). If neither is true, the result is false.

OUT OF RANGE TIME Module error message caused by DATE+ if the calculated date is earlier than Oct. 15, 1582 or later than Sept. 10, 4320. May also be caused by T+X if a date earlier than Jan. 1, 1900 or later than Dec. 31, 2199 would result.

OUTA OUTPUT ALPHA, HP-IL Control function, xrom 28,25. Sends data and alpha to the primary (SELECTed) loop device. For certain devices such as the 3468A Digital Multimeter, OUTA is used to set operating modes and ranges. Printers will interpret OUTA as PRA.
|||ALPHA: alpha string or CLA ARCL (data) ||| See INA.

P

P REGISTER The fourth register of the Alpha register group, containing characters 22 - 24. The remaining 4 bytes are used for system scratch with functions such as CATALOG. See Appendix The Status Registers.

PA PROGRAM POINTER ADVANCE, PPC ROM 10,59, SIZE 000, Subr. levels: 0. Moves the program pointer a selected number of bytes forward or backward in memory.

PACKED END An END instruction that has a specific bit set to "flag" it as the END of a PACKed program file. If any editing takes place the bit is cleared. When GTO . . or any other operation causes a PACK, that file will be ignored to save time.

PAGE SWITCHING A memory expansion concept proposed by Richard Nelson as a means of switching QUAD memory modules on and off the 41C bus. The QUAD modules are switched physically after they have been initialized to allow the operating system to integrate them with the rest of its memory. See IP, PS, PORT EXTENDER.

PARALLEL POLL HP-IL message. A class of messages sent by the controller to cause various device responses to parallel polls - polls are sent to determine if devices need service.

PARSE MODE In Escape mode the 82162A HP-IL Printer can be set to break lines only at blank spaces (characters). This is useful in double wide mode but especially useful when printing ASCII records in Extended Memory text files that are longer than 24 characters. To set PARSE mode the sequence of characters is: Escape (27), & (38), k, 1, h OUTA. The string may be created with the XFUNCTION module or the PPC ROM. Print "parsed" lines with the OUTA instruction rather than PRA as any "normal" 41C Printer function will terminate Escape Mode. See ESCAPE MODE, EIGHT-BIT MODE, OUTA and Appendix Printer Escape Codes.

PASN PROGRAMMABLE ASSIGN, XFUNCTION 25,26. This function may be used for global labels or calculator functions. |||X: keycode - must be a valid assignable key, i.e., not 31||| |||ALPHA: name of program or function to be assigned - the program must be present in main memory or in an Application ROM that is connected at the time. If Alpha is clear (CLA) the key represented by the keycode in X will be unassigned||| See KEY ASSIGNMENTS - PPC.

PAST-DUE ALARM TIME Module. Any clock alarm earlier than the current clock time and not physically or programatically (Control Alarms) acknowledged. Interrupting Control Alarms seldom become past-due except as a result of a programming oversight. Alarms acknowledged with the STO key remain in the I/O buffer as "acknowledged past-due alarms". See XYZALM; also see CONTROL ALARM.

PCLPS PROGRAMMABLE CLEAR PROGRAMS, XFUNCTION xrom 25,27. Clears the program named in Alpha and all following it from main memory. Considerably faster than the CLP instruction which is followed by PACKING and programmable. |||ALPHA: program name||| See EP, PURGE, PURFL.

PD PROGRAM POINTER TO DECIMAL, PPC ROM 10,52, SIZE 000, Subr. levels: 5. Converts a program pointer from the last 2 bytes of register b in RAM format to a decimal byte address. See PROGRAM POINTER - PPC.

% CH PERCENT OF CHANGE calculated as [(X-Y)100] / Y. Calculates the percent increase or decrease from the number in Y to the number in X.

PK PACK KEY ASSIGNMENT REGISTERS, PPC ROM 10,09, SIZE 000, Subr. levels: 4. When key assignments are deleted the register space formerly occupied does not become available for program use. Only when pairs of assignments that were in the same register are deleted can the space be made available by PACKing. PK packs all assignments to recover the memory space. Caution: do not execute PK if there any TIME Module alarms in the I/O buffer as they will be deleted by this operation. See KEY ASSIGNMENTS - PPC.

PM PERMUTATIONS, PPC ROM 20,19, SIZE 000, Subr. levels: 5. Computes number of permutations of n objects taken k at a time = P(n,k). Input number of objects, n ENTER, input k, xeq PM. See CM.

PMT Payment in a general financial program, input or displayed in accordance with the financial sign convention. Usually stored in R04 and computed or entered by key D. Similar Programs are available in the FINANCE, REAL ESTATE, HOME MANAGEMENT and PPC ROMs.

PO PAPER OUT, PPC ROM 20,51, SIZE 000, Subr. levels: 5. Advances the paper 5 times.

POLY MATH 1 Module, xrom 01,11. Program file in the MATH application module to find the roots of a polynomial up to degree 5. The high order coefficient must be made equal to 1 prior to inputting the polynomial. For subroutine use, see ROOTS.

PORT EXTENDER A 41C accessory that plugs into an I/O port and by means of switching allows access to several ROMS, peripherals or QUAD memory modules. See Appendix Accessories.

POSA POSITION IN ALPHA, XFUNCTION xrom 25,28. Searches the Alpha register for the characters in X and places the position of the first character in X. Position numbers are 0 - 23. Returns -1 if there is no match. |||X: alpha characters or a character code|||
See ANUM, AROT, POSFL; also see NC.

POSFL POSITION IN FILE, XFUNCTION xrom 25,29. Scans the working ASCII file in Extended Memory for a match to the string in the Alpha register. Scan begins at the current pointer position and if a match is found the pointer is moved to the beginning of the matched string. In this manner, repeated occurences of a string may all be found. Initialize the pointer if necessary to the beginning of the file by: 0 SEEKPT(A). Returns the record and character pointer value to X, rrr.ccc or -1 if no match is found. |||ALPHA: target string|||
See POSA, RCLPT(A), SEEKPT(A).

POSTFIX An HP term used to describe the second and subsequent bytes of a multibyte instruction in the 41C Hex Table. The first half of the table are Postfix direct, rows 0 - 7, and the second half represent Postfix indirect, rows 8 - F. See HEX TABLE, PREFIX,

POW Mnemonic for Power Curve, a program to determine the power curve fit to a set of X, Y data points; in RPN the final equation is: X ENTER b Y/X a * and Y ENTER a / b 1/X Y/X. Often referred to as Curve Fit equation number 4.
See BEST FIT, CURVE FITTING, CV, EXP, LIN, LOG, r.

PPC PERSONAL PROGRAMMING CENTER. An independent world-wide club of calculator enthusiasts with a common interest in the study and application of HP programmable calculators.
See Appendix References, for information.

PR PACK REGISTER, PPC ROM 20,45, SIZE a/r, Subr. levels: 4. Provides storage of data in a register in base b encoded form (see table). To store a number n in position k in register Rj, input: n ENTER k xeq PR.

DATA RANGE	BASE b	POSITION NUMBERS	DATA RANGE	BASE b	POSITION NUMBERS
0 - 1	2	1 - 30	0 - 20	21	1 - 7
0 - 2	3	1 - 19	0 - 36	37	1 - 6
0 - 3	4	1 - 15	0 - 99	100	1 - 5
0 - 4	5	1 - 13	0 - 214	215	1 - 4
0 - 6	7	1 - 11	0 - 1413	1414	1 - 3
0 - 9	10	1 - 10	0 - 99999	100000	1 - 2
0 - 13	14	1 - 8			

The inverse routine is UR; also see DATA PACKING.

P-R POLAR TO RECTANGULAR. Input angle in decimal degrees, ENTER, input magnitude of the angle, xeq P-R. X and Y coordinates returned to X and Y respectively. The inverse is R-P.

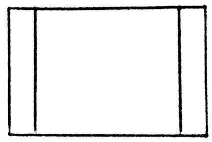
PRA PRINT ALPHA. Printer 82143A and HP-IL xrom 29,08. Prints the Alpha register, left-justified. To send command strings or Escape codes to HP-IL devices, OUTA is usually used. PRA is activated by the Printers' front panel switch if the 41C is in Alpha mode. Also inserts PRA into a program in PRGM/ALPHA mode. Converter: sends the character codes of the characters in the Alpha register to the 82166A Converter and the external device followed by End-of-Line. See PRINT STACK/ALPHA. Also see AVIEW.

PRAXIS PRINT AXIS. Printer 82143A and HP-IL xrom 29,09. Prints and labels the Y-axis of an X, Y plot via a subroutineable portion of the PRPLOT program file in the Printer ROM. Clears Flag 12 and sets FIX 4, Subr. levels: 4. R00 = Y MIN, R01 = YMAX, R02 = column width 169, R04 = Axis. See PRPLOT.

PRBUF PRINT BUFFER. Printer 82143A and HP-IL xrom 29,10. Prints the print buffer left-justified. PRX, PRA and VIEW also print the buffer. If full, the buffer prints automatically. Use of this feature, however, inhibits compatibility between the two Printers. The buffer may also be cleared without printing by turning the Printer on and off. Converter: sends an End-of-Line indicator to the Converter and the external device if the Converter is the primary device and MANIO is in effect. Accumulating character 13, Carriage Return, causes the 82162A to print its buffer. See PRINT BUFFER.

PREDEFINED PROCESS A flowchart symbol representing a prestored constant or subroutine.

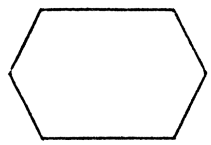
PREDEFINED PROCESS (Con't)



PREFIX   An HP term for the first byte of a multi-byte instruction. Prefix bytes come from rows 9 - F of the Hex Table. See POSTFIX, HEX TABLE.

PREFIX MASKER   One of a class of key assignments that masks bytes of instructions following it when inserted in a program. All key assignments from F3 - FF are Prefix Maskers. See BYTE GRABBER, BYTE JUMPER. Also see Appendix The Byte Grabber.

PREPARATION   A flowchart symbol representing an initialization routine or procedure, for example, Flags to be set or keystrokes required prior to running a program.



PRFLAGS   PRINT FLAGS, 82143A and HP-IL xrom 29,11. Prints the 41C status including SIZE, location of statistical register block, trig and display modes and the status of all 56 Flags. Interruptible by R/S. Also see VF.

PRINT BUFFER   A portion of memory in the 82143A (44 bytes) and 82162A HP-IL Printers (101 bytes) which holds accumulated columns of dots, characters or mode changes until an instruction is received to print the buffer (or if the buffer becomes full prematurely). Seven functions address the buffer and 5 functions print it. Print: ADV, PRA, PRBUF, PRX, VIEW. Format: FMT. Accumulate: ACA, ACCHR, ACSPEC, ACX, SKPCHR, SKPCOL; also see SYNTHETIC BLDSPEC.

PRINT DATA   CP, PRREG, PRREGX, PR≤ ; also see BV.

PRINT GRAPHICS   ACCOL, ACSPEC, BLDSPEC, SKPCHR, SKPCOL; also see BL, COLUMN PRINT NUMBER.

PRINT PLOT   PRAXIS, PRPLOT, PRPLOTP, REGPLOT, STKPLOT; also see HA, HP, HS, MP.

PRINT STACK/ALPHA   AVIEW, PRA, PRX, VIEW.

PRINT STATUS   PRFLAGS, PRKEYS; also see VF, CATALOG 1 (TRACE).

PRINTER ERROR   Error Message. Printer out of paper, jammed or malfunctioning. This message is persistent and usually requires both the 41C and the Printer to be turned off after reloading paper (if that was the cause of the problem).

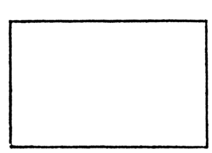
PRINTER ROUTINES - PPC   Routines for the peripheral Printer in the PPC ROM.

CP: Column Print Formatting	MP: Multiple Variable Plot
HA: High Resolution Histogram with Axis	PO: Paper Out
HP: High Resolution Plot	XE: XROM Entry
HS: High Resolution Histogram	See individual routine definitions.

PRIVATE   Error message resulting when an attempt is made to read, TRACE, print or edit a Private Program, regardless of the storage medium. Private programs also cannot be copied to mini data cassettes.

PRKEYS   PRINT KEYS, 82143A and HP-IL xrom 29,12. Prints a list of all reassigned keys and their keycodes including global labels. See VK.

PROCESS   A flowchart symbol that denotes the actual program or routine execution.



PROGRAM POINTER - PPC Routines in the PPC ROM related to the program pointer.

- Ab: Alpha Store b
- CB: Count Bytes
- DP: Decimal to Program Pointer
- PA: Pointer Advance
- PD: Program Pointer to Decimal
- Rb: Recall b
- Sb: Store b
- XE: XROM Entry

See individual routine definitions.

PROMPT Displays the Alpha register and stops program execution. Prompt is useful to display input instructions without printing the prompting string (MANUAL mode).
See AVIEW.

PROTECTING DATA, PROGRAMS
- Magnetic Cards: FLAG 14, WPRV.
- Extended Memory: Programs that are already PRIVATE may be saved in Extended Memory: SAVEP.
- Barcode: Programs can be printed in PRIVATE barcode.
- Mass Storage: SEC, UNSEC, WRTPV.

PRP PRINT PROGRAM, 82143A and HP-IL xrom 29,13. A non-programmable function to print a program listing. Prompts for the program name. Press ALPHA ALPHA (twice) without input if positioned anywhere in the program file or input the alpha name of any global label in the file and the entire program will be printed. The appearance of the listing depends upon the print mode. MANUAL mode causes continuous left-justified printing; NORMAL mode causes right-justified printing with line spaces preceding each label; TRACE causes paragraph-like printing with line numbers and line spaces only at labels.

PRPLOT PRINT PLOT, 82143A and HP-IL xrom 29,14. A self-prompting, ROM-based user language program to print X, Y plots of user defined functions.
See PRPLOTP.

PRPLOTP PRINT PLOT PROGRAMMABLE, 82143A and HP-IL xrom 29,15. Prints X, Y plots of user defined functions using pre-stored and formatted data. Part of the PRPLOT program file but executes without prompting. The function must have a global label of 6 or less characters, be located in main memory and terminate with RTN or END and place a single value in X. The following data is required prior to execution:

- R00 = Y MIN
- R01 = Y MAX
- R03 = plotting character BLDSPEC data (or 0, the default character)
- R04 = Axis
- R08 = X MIN
- R09 = X MAX
- R10 = X increment
- R11 = function name (ALPHA)

See PRAXIS, PRINTER ROUTINES - PPC.

PRREG PRINT REGISTERS, 82143A and HP-IL xrom 29,16. Prints the contents of all data registers in main memory. Not seen in the display. See BV, PRREGX.

PRREGX PRINT REGISTERS ACCORDING TO X, 82143A and HP-IL xrom 29,17. Prints the contents the desired data registers according to the control word in X |||X: bbb.eee beginning and ending registers to be printed||| The display mode must be set prior to printing.
See BV, PRREG.

PR PRINT STATISTICAL REGISTER BLOCK, 82143A and HP-IL xrom 29,18. Prints the contents of the statistical register block, pre-defined by REG — —. The display mode must be set prior to printing.

PRSTK PRINT STACK, 82143A and HP-IL xrom 29,19. Prints (according to the current display mode) and labels the contents of the automatic memory stack T, Z, Y, X. L is not printed by this function. See 7PRSTK.

PRX PRINT X, 82143A and HP-IL xrom 29,20. Prints the X register and labels the output with " *** ". Converter: sends character codes of the digits in X followed by End-of-Line if the Converter is the primary device and MANIO is in effect. See 7PTRX.

P<>S HP67/97 function that swaps the contents of R00 - R09 with R10 - R19. Registers in the HP67 are addressed by single digits only, 0 - 9, and addressing is preceded by P<>S if the alternate block of 10 registers is to be addressed. Executing P<>S again restores the initial relationship.

PSIZE PROGRAMMABLE SIZE, XFUNCTION xrom 25,30. Similar to the SIZE instruction but requires parameters in X and does not destroy the subroutine RTN stack. May be used in programs in conjunction with SIZE?, for example, if the required SIZE = nn, SIZE? input nn, X < Y? PSIZE. |||X: desired number of main memory data registers||| See SIZE, SIZE?, S?.

PSUEDO XROM An XROM number seen when a synthetic key assignment doesn't have an internal ROM function. For example, when RCL b is assigned to a key, it displays in RUN mode as XROM 01,60.

PURFL PURGE FILE, XFUNCTION xrom 25,31. Deletes (purges) the named file from Extended Memory. All of the files following the deleted file are moved forward and main memory is unaffected. |||ALPHA: file name||| See CLFL, PCLPS, PURGE.

PURGE HP-IL Mass Storage function to delete a file from the directory. HP-IL xrom 28,04. Executing PURGE renders a file inaccessible. The file space on the recording medium will be filled again when a new file can fit the space. The file must be UNSECured prior to PURGE. |||ALPHA: file name||| See PURFL, UNSEC.

PV PRESENT VALUE in a general financial program, input and displayed in accordance with the financial sign convention. Usually stored in R03 and computed or entered by key C. Program is available in the FINANCE, REAL ESTATE, HOME MANAGEMENT and PPC ROMs. Also see FINANCIAL SIGN CONVENTION.

PVT MATH 1 Module, xrom 01,05. Subroutineable portion of the MATRIX program file. To use, SF 04, CF 06 - 10, SF 21. Bypasses initial prompting. See MATRIX for register useage.

PWRDN HP-IL Control function, xrom 28,36. Sets all devices that are in Standby (front panel switch) to their lowest power condition. Any loop message and most 41C operations cancel this mode.

PWRUP HP-IL Control function, xrom 28,37. Powers up all devices from Standby condition.

Q

Q LOADER A PPC term describing a class of synthetic key assignments (or barcodes) that load the Q register (in right to left order) into program memory. A Q Loader may be assigned via the MK program with inputs of 4, 16 - 28 (any will do), keycode.

Q REGISTER The tenth register of 41C memory used for temporary alpha scratch by the operating system. See Appendix The Status Registers.

QR QUOTIENT REMAINDER, PPC ROM 10,54, SIZE 000, Subr. levels: 6. Replaces Y and X by (Y-Y mod X)/X (quotient) and Y mod X (remainder). See MOD.

r, r^2 Mnemonics for the calculated value that measures the goodness of fit of a curve fit equation to a set of data points. The closer r[ABS] is to ±1, the more accurate the fit. $r^2 = [XY - X Y/n]^2/[(X^2-(X)^2/n)(Y^2-(Y)^2/n)]$ See BEST FIT, CURVE FITTING.

R/ ROLL UP. Shifts contents of the automatic memory stack "upward" by 1 register. The contents of T Z Y X become Z Y X T (T is placed in the X register. Useful for proper positioning of data for various operations within a program. Also, slightly faster than RDN (roll down) when optimizing run time is important. When R/ is repeated 4 times consecutively, the stack is returned to its original order. Inverse of RDN.

RAD RADIANS MODE. Sets the 41C to calculate trig functions in radians. Input in decimal degrees is assumed.

RAM Error message generated by an attempt to use the COPY function to download a program already in main memory. COPY works only on ROM program files.
2. Random Access Memory. Semiconductor memory organized into discrete addressable sectors and readily recalled, written to or erased by the user. Most memory associated with the 41C is non-volatile - that is, requiring only a few microamperes to retain data. The buffers in the Digital Cassette Drive and peripheral Printers are cleared at power off.

RANDOM NUMBER One of a series of unpredictable or chance numbers, usually in fractional form. For statistical use, a number of standard stringent tests are applied to test "randomness". In reality, calculated numbers are pseudorandom as they follow one another from a set of strictly defined arithmetic operations. See GN, RN, SEED.

Rb RECALL b, PPC ROM 20,52, SIZE 000, Subr. levels: 6. A brief routine designed to be used with the XE routine to enter ROM programs at arbitrary points (local labels, line numbers, etc.). Normally if the pointer address of a ROM program is written into program memory, the ROM must always be in the same port for the relative address to be valid. See XE.

RC I HP67/97 function equivalent to RCL 25 on the 41C. "I" is the indirect control register in the HP67 and is limited to merging data (not supported by the 41C) from a magnetic card, number of display digits, increment and decrement counters, STO, RCL and execute numeric labels 0 - 9 and 20 - 24. Also seen in HP67 program listings as RCL I and h RC I.

RCL RECALL. Copy the contents of a data register to X. Depending upon SIZE, RCL can directly address registers 00 - 99 and the status registers. To recall a stack register, press (.) the decimal point before the register name, T, Z, Y, X or L. Data register numbers higher than 99 are addressed by RCL SHIFT (indirect) – –.

RCL (HP67) Certain data registers in the HP67/97 are addressed by letter rather than by numbered address and translate as follows. RCL "A" = RCL 20, B = 21, C = 22, D = 23, E = 24, I = 25. When the "I" register is listed as "(i)", it should be interpreted as INDIRECT.
See (i)

RCLAF RECALL ACCURACY FACTOR, TIME Module, xrom 26,18. Recalls the clock accuracy factor to X from the TIME Module's internal registers. The accuracy factor will be in the range of -99.9 - +99.9. For details, see ACCURACY FACTOR, CORRECT, SETAF.

RCLFLAG XFUNCTION xrom 25,32. Places an alpha string in X representing the status of Flags 00 - 43. It may be stored in any data register for later recall to restore the display and trig modes and any user flags within that grouping.
See d REGISTER, STOFLAG.

RCLPT, RCLPTA RECALL POINTER, RECALL POINTER BY ALPHA. XFUNCTION 25,33. Recalls the pointer position in the extended memory working file to X. If the file is not the working file, use RCLPTA with the name of the file in the Alpha register. This need only be performed once for each file. If used with a program file, the total byte count including the END is returned to X. If used with an ASCII file or data file, the pointer has the format rrr (data file) or rrr.ccc (ASCII file) where rrr = the register (data) or the record (ASCII) and ccc = the character number divided by 1,000.
RCLPTA|||ALPHA: file name||| See SEEKPT(A).

RCLSW RECALL STOPWATCH, TIME Module, xrom 26,19. Recalls the Stopwatch (SW) time to X whether running or not to 6 digit precision. The number of displayed digits depends upon

RCLSW (Con't)
the current display mode. This instruction is the programmable equivalent of [RCL] in the special SW mode. If the Stopwatch is running when RCLSW is executed, the time may be ± .03 seconds from the actual Stopwatch time. See ATIME24 for information on displaying Stopwatch splits in Alpha; also see STOPSW, SW, TIME FORMATTING.

RD RECALL DISPLAY MODE, PPC ROM 20,05, SIZE 001, Subr. levels: 6. Restores the status of Flags 16 - 55 previously stored in R_X by the SD routine. Used to restore the display and trig mode. Use LASTX to restore the stack after calling RD. |||X: $register_X$||| See RCLFLAG, STOFLAG, SD.

R-D RADIANS TO DEGREES conversion. |||X: decimal degrees||| Inverse of D-R.

RDN ROLL DOWN. Shifts contents of the automatic memory stack "downward" by 1 register. Useful for sequential access to different stack registers. See R/.

RDTA Card Reader instruction: READ DATA, xrom 30,02. Reads the contents of one or a set of magnetic cards into main memory registers starting at R00. See RDTAX.

RDTAX Card Reader instruction: READ DATA ACCORDING TO X, xrom 30,03. Reads the contents of one or a set of magnetic cards from R00 on the first card of the set to the register block defined by the control word in X. The format is bbb.eee where bbb specifies the first register address where data is to be copied and eee specifies the last register address /1,000. The error message CARD ERR indicates that the SIZE allocation is inadequate to store the specified data. The cards may be inserted in any order and the system will prompt for the lowest numbered track not yet read. See RDTA. Also see WDTAX.

READ ERR HP-IL mass storage error message indicating that invalid data was detected on the medium, possibly the result of a damaged tape or a hardware problem. Verify the file by inputting its name in Alpha and executing VERIFY.

READA READ ALL, HP-IL mass storage, xrom 28,05. Reads a "Write All" file (up to 2,352 bytes) into the 41C. All of main memory is replaced and all conditions at the time of recording the file are duplicated including Flag status, data, key assignments and the position of the program pointer. If the I/O buffer contained Timer alarms at the time of recording, they will be re-instated by this operation. If 2 tones are heard on completion of READA, some or all of the Alarms may be past-due. Use ALMCAT to verify the presence of obsolete Alarms. Additionally, any unusual errors such as a lost global label linkage (unusual or unexpected entries in CATALOG 1) or "garbage" left in the I/O buffer as a result of synthetic experimentation will also be restored. |||ALPHA: Write All file name||| See I/O BUFFER, WRTA.

READING XFUNCTION: ARCLREC, GETAS, GETP, GETR, GETREC, GETRX, GETSUB, GETX. MASS STORAGE: READA, READK, READP, READR, READRX, READS, READSUB. CARDS: MRG, RDTA, RDTAX, RSUB.

READK READ KEYS, HP-IL mass storage, xrom 28,06. READK replaces all keys assigned in USER mode with new assignments. Global labels are not affected. Possible error: NO ROOM. |||ALPHA: Key file name||| The file contains key assignments only and does not contain any other status information. See READS, WRTK, WRTS.

READP READ PROGRAM, HP-IL mass storage, xrom 28,07. Reads a program from mass storage such as a mini data cassette and replaces the last program in main memory unless that program contains an END (resulting from GTO . .). This feature allows extremely long programs to be chained so that execution can proceed uninterrupted. |||ALPHA: mass storage program file name||| See READSUB.

READR READ REGISTERS, HP-IL mass storage, xrom 28,08. Copies data from a mass storage data file into main memory data registers beginning at R00. |||ALPHA: data file name||| See READRX, SEEKR.

READRX READ REGISTERS ACCORDING TO X, HP-IL mass storage, xrom 28,09. Reads registers from the current register pointer position into main memory data registers defined by the control word in X. Prior to READRX the medium must be "moved" to the beginning data register in the file by the SEEKR, Seek Register, instruction. For example, if R05 of the mass storage data file is the first register of interest (file numbers begin with 00), input 5, xeq SEEKR. CLX SEEKR will point to the beginning of the file. When the medium has been positioned, input the control word in X |||X: bbb.eee beginning address.ending address|||

READS READ STATUS, HP-IL mass storage, xrom 28,11. Sets calculator status from a mass storage Status file including SIZE, location of statistical register block, trig and display modes and the status of all 56 Flags. Subroutine RTNs are overwritten by a Status file; key assignments are not affected. |||ALPHA: Status file name||| See WSTS, WRTS; also see READK.

READSUB READ SUBROUTINE, HP-IL mass storage, xrom 28,11. Reads the named subroutine from a mass storage program file into main memory following the last program in memory. The program pointer is not repositioned and execution continues at the next line.
|||ALPHA: subroutine program file name||| Possible error: insufficient space in program memory to contain the subroutine file. See GETSUB, RSUB, READP.

READY FOR COMMAND HP-IL message. Every HP-IL command is followed by this message before another is sent. The 82161A Digital Cassette Drive responds by executing the previous command and the 82162A Printer responds by preparing to power down.

READY GROUP HP-IL messages. Refers to a class of HP-IL messages such as Send Data, Send Status, End of Transmission and other specific messages usually originated by active controllers or talkers.

REC TOO LONG XFUNCTION error message generated when an attempt is made to exceed 254 characters in an ASCII file (APPCHR, Append Character).

RECALL b Recalls the contents of status register "b" to X. The rightmost 2 bytes of b represent the program pointer and may translated to a decimal number via various synthetic routines and the PPC ROM. If RCL b is assigned to a key and performed in RUN mode at two points of interest in program memory, the difference between the 2 decoded numbers is the byte count. Essential technique for optimizing short/long form label useage.
See b REGISTER, BYTE COUNT, CB, Appendix The Status Registers.

RECORD In general, a fixed number of bytes equivalent to the smallest amount of information that can be written to a storage medium; for example, a mini data cassette record is 256 bytes in length and a magnetic card record is 224 bytes. In an Extended Memory ASCII file, a Record may have a length of 1 - 254 characters (256 bytes) allowing great flexibility in the choice of Printers and other creative use.

RECORD NUMBER ERROR HP-IL Status byte. The 82161A retrieved an unexpected record number and sent status byte 0001 1001 (INSTAT).

REDEFINED KEYBOARD Plug-in ROMs have the ability to put all or part of the 41C's CPU to "sleep" and give temporary new definitions to all keys. HP's Diagnostic ROMs override all calculator functions and keys and the TIME Module has 2 modes that render the keyboard responsive only to certain keys, ALMCAT and SW. Users can mimic this capability using the GETKEY instruction in the XFUNCTION Module. Each key that is to be redefined has a local label corresponding to its keycode in program memory, for example: R/S would correspond to Label 84, ON to Label 01, ENTER to Label 41 and so on. The program code would read: GETKEY GTO (or XEQ) IND X. If the "redefined" key is pressed within approximately 10 seconds the calculator will not respond to ON/OFF or STOP but rather to the local label routine. If a VIEW or AVIEW is in progress, it is not interrupted by pressing the key.
See DIAGNOSTIC ROM, ALMCAT, SW. Also see GETKEY.

REG HP67/97 mnemonic for PRREGX where X = .009 and then repeated with X = 20.025. Seen as PRREG, f REG or h REG in HP67/97 program listings. The Card Reader's automatic translation of this function causes the affected registers to be viewed and paused in the display if no Printer is in the system.

REGMOVE XFUNCTION xrom 25,35. Copies main memory data registers to another location in main memory according to a control word in X. The control takes the form sss.dddnnn where sss = starting register of the source register block; ddd = destination register; nnn = the number of registers to be copied. |||X: sss.dddnnn|||
See BLOCK ROUTINES - PPC, REGSWAP.

REGPLOT Printer 82143A and HP-IL xrom 29,21. Plots a single function value on one printed line using prestored parameters in R00 - R03. The control word in R02 takes the form nnn.aaa where nnn represents the number of columns (169) and .aaa specifies the y-axis column in which the x-axis bar will be printed. For aaa = 0, the axis will be at the bottom

REGPLOT (Con't)
of the plot and for aaa = 0, the axis is omitted. The plotting character in R03 refers to either the default small "x" plotting character or BLDSPEC data to print a customized plot character. Input: |||X: Y value||| R00 = Y MIN, R01 = Y MAX, R02 = nnn.aaa, R03 = plot symbol or 0 (default). See PRAXIS, PRPLOT, PRPLOTP, STKPLOT, PRINTER ROUTINES - PPC.

REGSWAP XFUNCTION xrom 25,36. Exchanges the contents of main memory register blocks. The control word in X takes the form sss.dddnnn, where sss = starting register of the first block; ddd = destination register; nnn = number of registers to be exchanged.
See BLOCK OPERATIONS - PPC, REGMOVE, P<>S.

RELATIVE BRANCHING A feature of the HP67/97 calculators enabling a jump to a line number, also called Rapid Reverse Branching. The number of lines backward in program memory MOD 224 was stored as a negative number in the "I" register and the instruction was GTO (i). This feature cannot be translated to the 41C which requires a label name or number for a jump.

REMOTE HP-IL Control function, xrom 28,38. Sets the primary (SELECTed) device to remote mode enabling it to respond to programmed commands. See LOCAL.

REMOTE ENABLE HP-IL message. The controller places all loop devices in remote mode so that devices that are addressed as listeners will respond only to interface data rather than their front panel controls. The 82161A Digital Cassette Drive and 82162A Printer ignore this message.

RENAME HP-IL mass storage, xrom 28,12. Change a mass storage file name. The file must first be UNSECured. |||ALPHA: old file name, new file name||| Programmable.

REPLACE See CURSOR, REPLACE.

RF RESET FLAGS, PPC ROM 10,13, SIZE 000, Subr. levels: 6. Resets all 41C Flags to Master Clear status except for FIX 2, rather than FIX 4. The stack is unchanged. See STOFLAG.

RK REACTIVATE KEY ASSIGNMENTS, PPC ROM 20,06, SIZE 002, Subr. levels: 6. Transfers assignment bit maps stored in R_X and R_{X+1} to status registers |- and e to reactivate suspended key assignments. See the initializing routine, SK.

RN RANDOM NUMBER GENERATOR, PPC ROM 20,16, SIZE 001, Subr. levels: 5. Generates a pseudo-random number from a seed prestored in Rnn. |||X: address of seed register||| xeq RN.
See GN, RANDOM NUMBER, SE, SEED.

RND ROUND. Rounds the number in X to the number of decimal places specified by the display mode. For example, RND 5.231844 to 2 places: FIX 2 5.231844 RND. Result: the digits 1844 are lost. The original input is saved in LASTX. See INT.

ROLL DOWN HP-IL Video Interface function. The screen rolls down 1 line.
|||X: 27||| ACCHR |||X: 84||| ACCHR. See RDN.

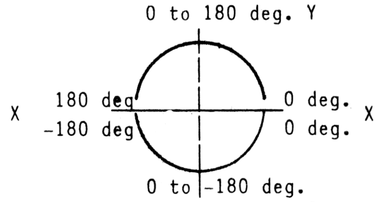
ROLL UP HP-IL Video Interface function. The screen rolls up 1 line.
|||X: 27||| ACCHR |||X: 83||| ACCHR. See R/.

ROM Error message resulting from an attempt to edit a program in an application module.
2. Read Only Memory. Semiconductor memory whose contents are burned-in by the manufacturer and cannot be altered by users. Application modules are "ROMs" as are three IC's on the 41c's logic board which contain the operating system (functions).

ROM ADDRESS A ROM address in the 41C system is not necessarily the same as its physical location. For example, regardless of what I/O ports the TIME Module and HP-IL Module are plugged into, CATALOG 2 will display the TIME Module first, followed by HP-IL and then the modules in I/O ports 1, 2, etc. There are 16 blocks of 4K bytes numbered 0 - 15 that comprise the ROM addresses. 0 - 2 are reserved for the 3 operating system ROMs, 3 is unused and 4 is reserved for the Diagnostic ROM. 5 = TIME Module; 6 = HP-IL; 7 = Printers and the balance correspond to ports 1 - 4, where 8 and 9 are the lower and upper 4K of Port 1 and 14 and 15 are the lower and upper 4K of Port 4. It is this addressing scheme that makes 16K EPROM box accessories possible as well as Port Extenders.
See PORT EXTENDER, EPROM BOX.
Also see Appendix for names and addresses of HP accessories manufacturers.

ROOTS MATH 1 Module, xrom 01,12. Part of the POLY program file in the MATH Application Pac to fund the roots of a polynomial of degree 5. Prior to use, SF 00 and SF 21. The program may be called as a subroutine without input halts and uses R00 - R22. Data must be prestored as follows: R00 = a_0; R01 = a_1; R02 = a_2; R03 = a_3; R04 = a_4; R22 = degree. The high order coefficient must be set equal to 1. See POLY.

R-P RECTANGULAR TO POLAR. To convert from rectangular to polar coordinates, input Y coordinate, ENTER, input X coordinate, xeq R-P. Angle θ is returned to Y and magnitude r is returned to X.



RSUB READ SUBROUTINE, Card Reader, xrom 30,04. Programmable function, prompting with "CARD". The program on the inserted card(s) will replace the last program in main memory unless the last program itself is executing the RSUB function. In that case, the program will be read in after the last program in memory. After the program is read into memory the program continues running at the next line of program memory - it does not execute the new program as a subroutine; it simply loads it. Execute "program name" will run the subroutine. See MRG.

RT RETURN ADDRESS TO DECIMAL, PPC ROM 10,51, SIZE 000, Subr. levels: 5. Press the key assigned to RCL b to place the program pointer/first return address in X. RT converts bytes 2 and 3 to a decimal byte address. See PROGRAM POINTER - PPC.

RTN RETURN. Required as the last step of a subroutine unless the last step is an END or .END. which perform the same function.

RUN MODE One of three operating modes of the 41C, where the calculator is "on" or "awake" but not running a program. The CPU is "running" the display and actively controlling the keyboard in this mode. Compare with DEEP SLEEP and LIGHT SLEEP.

RUNSW RUN STOPWATCH, TIME Module, xrom 26,20. Programmable operation used to control the Stopwatch when the 41C is not in the special SW mode. The Stopwatch begins running from its present position. To start at 00:00:00.00 seconds, use CLX SETSW RUNSW.

RX RECALL FROM ABSOLUTE ADDRESS IN X, PPC ROM 10,57, SIZE 000, Subr. levels: 4. Valid input addresses are 192 - 511. CF 25 prior to use. If the NONEXISTENT message appears as a consequence of using this routine, proceed immediately as follows: ENTER (PRGM) SST (PRGM) R/S to avoid MEMORY LOST. RX is useful to recall data stored in the memory space between .END. and the key assignment registers. See SX.

S

s HP67/97 mnemonic for standard deviation, SDEV in the 41C. The equivalent statistical register block in the 41C may begin at R14 or R04 if the "s" instruction was preceded in HP67 program memory by a P<>S instruction. The Card Reader correctly translates this function. If no Card Reader is available, confirm the location of the statistical registers prior to use. Also seen in HP67/97 program listings as "S" or "g s".

S1 STACK SORT, PPC ROM 20,46, SIZE 000, Subr. levels: 5. Arranges the stack in numerical order with the highest value in X; to reverse the order, SF 10 prior to use.
See S2, S3 (Array Sorts).

S2 SMALL ARRAY SORT, PPC ROM, 20,28, SIZE a/r, Subr. levels: 5. Sorts any block of main memory data registers in ascending order according to a control word in X. The control takes the form bbb.eeeii where bbb = the beginning register address, eee = the ending register address (=32 for optimum processing times) and ii = increment (sort every nth register; default is 1).
See S3 (large Array Sort).

S3 LARGE ARRAY SORT, PPC ROM 20,47, SIZE a/r, Subr. levels: 4. Sorts any block of main memory data registers in ascending order according to a control word in X. The control takes the form bbb.eee, where bbb = the beginning register address and eee = the ending register address. For arrays of 32 or less, S2 is faster. See S1 and S2.

S? SIZE FINDER, PPC ROM 10,15, SIZE 000, Subr. levels: 5. Returns the number of allocated data registers to X. See SIZE?.

SAVEAS SAVE ASCII, XFUNCTION, xrom 25,37. Records the named ASCII file in Extended Memory on to the mass storage medium such as a mini data cassette. Prior to recording, a data file of equal length to the ASCII file must be created with the HP-IL function, CREATE. |||X: size of ASCII file in registers (determined by viewing the Extended Memory Directory, EMDIR, or FLSIZE)||| |||ALPHA: file name to be used in mass storage directory||| CREATE. To transfer the file: |||ALPHA: Extended Memory file name, mass storage file name |||. See GETAS; also CREATE.

SAVEP SAVE PROGRAM, XFUNCTION, xrom 25,38. Copies a program in main memory to a file in Extended Memory. As files in Extended Memory cannot be secured, copying a program file with a name that already exists (as a program file) will overwrite the file with the revised program. The main memory - CATALOG 1 - name and the Extended Memory - EMDIR - name need not be the same. |||ALPHA: program name, file name||| See EMDIR.

SAVER SAVE REGISTERS, XFUNCTION, xrom 25,39. Copies all main memory data registers to a named Extended Memory data file. Similar to the Card Reader operation WDTA. Prior to executing SAVER, the data file space must be created with the CRFLD function. For example: 19 registers are to be saved in Extended Memory; |||X: 19||| |||ALPHA: data file name||| CRFLD. To use SAVER: |||ALPHA: data file name|||. See SAVERX; also see CLFL, CRFLD.

SAVERX SAVE REGISTERS ACCORDING TO X, XFUNCTION, xrom 25,40. Copies selected main memory data registers to a data file in Extended Memory according to a control word in X. Similar to the Card Reader operation WDTAX. Storage starts at the current pointer position. |||X: bbb.eee beginning and ending main memory registers to be copied||| |||ALPHA: data file name||| Prior to executing SAVER, the data file space must be created with the CRFLD function. See SAVER; also see CRFLD, SEEKPT(A).

SAVEX XFUNCTION, xrom 25,41. Copies the X register to the working data file at the current pointer position. The pointer is automatically incremented. To control storage to an existing data file, position the data file pointer to the desired register with SEEKPT. Use SEEKPTA with the data file name in Alpha if the file is not the current working file. If the file has been cleared (not purged) or just been created, the file pointer will automatically be at register 00. See SEEKPT, SAVER, SAVERX.

Sb STORE b, PPC ROM 20,01, SIZE 000, Subr. levels: a/r. Provides a STO b (i.e., move the program pointer) with a ROM mode interpretation to transfer execution of a running program to any arbitrary point in a ROM. The subroutine stack is overwritten. PROGRAM POINTER - PPC.

SCI SCIENTIFIC NOTATION DISPLAY. Displays each number with a single digit left of the decimal point followed by the specified (prompted SCI – –) number of decimal places and multiplied by a power of 10. A maximum of 8 mantissa digits are displayed. See MT.

SD STORE DISPLAY MODE, PPC ROM 20,03, SIZE 001, Subr. levels: 6. Saves the status of Flags 16 - 55 in the data register specified in X. See RCLFLAG, STOFLAG. Also see the inverse routine, RD.

SDEV STANDARD DEVIATION. Calculates the sample standard deviations of X and Y using data accumulated in the statistical register block. For the X values, the 1st, 2nd and 6th registers are used and for the Y values, the 3rd, 4th and 6th. These registers contain ΣX, ΣX^2, ΣY, ΣY^2, ΣXY and n. Press X<>Y after execution to see the Y value. To quickly calculate the population standard deviation from this data, xeq MEAN, Σ+, SDEV. Restore the original Σ register contents with MEAN, Σ-. See MEAN, ΣREG.

SDS SOFTWARE DEVELOPMENT SYSTEM. A system rented by HP to customers who are developing custom ROMs, consisting of a 41C, Card Reader, ROM simulator and associated software, disc drive and HP85. The system produces a ROM image that is used to make the production ROMs.

SE SELECTION WITHOUT REPLACEMENT, PPC ROM 20,56, SIZE a/r, Subr. levels: 4. Selects a

SE (Con't)
random element from a block of consecutive registers. Subsequent elements selected from the block will not be repeated. SE expects the following data: R06 = 1st register of the selection block; R07 = number of registers in the block. Input the address of the register holding the random number seed in X, xeq SE. Calls RN as a subroutine. See RN.

SEC SECURE, HP-IL mass storage, xrom 28,13. Protects a mass storage file from accidental erasure or editing similar to clipping the corner of a magnetic card. It does not make a file private. |||ALPHA: file name||| A typical program file sequence might include: Global name,mass storage name in Alpha, WRTP (record the file), mass storage name only, VERIFY (verify proper recording), SEC. Inverse of UNSEC.

SECONDARY ADDRESS HP-IL message used by the controller for devices that can respond to 2-byte addresses. The 82161A Digital Cassette Drive and 82162A Printer do not support this command nor do they respond to it.

SECTOR a.k.a. PHYSICAL RECORD. A grouping of adjacent bits on a recording medium, contain-a checksum and in some cases, a header.

SEED A number passed to a pseudo-random number generating routine from which it calculates each successive random number. Depending upon the generator in use, a good seed is one that would guarantee the longest cycle of random numbers without repetition, usually a fraction ending in 1, 3, 7 or 9. Ideally, the seed itself should be random and unpredictable, such as a number extracted from a running timer to several digits of precision. See RANDOM NUMBER, RN.

SEEKPT, SEEKPTA SEEK POINTER, SEEK POINTER BY ALPHA, XFUNCTION, xroms 25,42 - 25,43. Positions the pointers in a file to the locations indicated by the control word in X. SEEKPTA is used when the ASCII or data file is not the current working file. SEEKPT may be used in other cases. |||ALPHA: ASCII or data file name (SEEKPTA only)||| |||X: rrr if a data file or rrr.ccc if an ASCII file, where rrr represents the record number and ccc the character within the record / 1,000||| For example, place the pointer at the 44th character of record 18: 18.044 SEEKPT. When the ASCII file pointer contains an integer only, the first character, 0, is assumed. SEEKPT(A) is used to initiate data storage, text storage and editing functions. See RCLPT(A).

SEEKR SEEK REGISTER. HP-IL mass storage, xrom 28,14. Positions the mass storage medium to a selected register within a data file. It must be used prior to read and write operations if a prior operation has not already done so. Using this feature, a data file may be of virtually unlimited length and addressed at any point. For example, the 19th register of a data file 1844 registers deep may be addressed by 18 SEEKR. Using the READRX instruction, any block of data registers may be read into any valid location in the 41C's main memory. For example, to read the block of registers in the "1844" file into calculator data registers 19 - 95, after SEEKing the beginning register, 19.095, xeq READRX. |||X: data file register address, =0||| |||ALPHA: data file name|||

SELECT HP-IL control function, xrom 28,39. Selects a device to be the primary device in the HP-IL loop, the device SELECTed to perform the programmed commands. For example, to read the directory (DIR) on only 1 of several mass storage devices in the loop, input its sequence number in the loop (address) and xeq SELECT. |||X: address|||. AUTOIO, MANIO, REMOTE.

SELECTED DEVICE CLEAR HP-IL message. The controller clears all devices that are addressed as listeners. The 82161A Digital Cassette Drive rewinds to the start of the first record and ceases to send data. The 82162A Printer defaults to a cleared print buffer, Escape mode, single-wide printing, left-justified non-parse modes.

SEND ACCESSORY ID HP-IL message. The 82161A digital Cassette Drive responds to this command with 16 and the 82162A Printer responds with 32. See FINDID, SEND DEVICE ID.

SEND DATA HP-IL message. The HP-IL controller commands the active talker on the loop to send its data string if possible. The 82162A Printer does not respond.

SEND DEVICE ID HP-IL message. Upon receiving this command, HP-IL devices send an ASCII string corresponding to their identity, usually 2 letters for manufacturer ID, such as HP, 5 digits and a revision letter code such as A. Example: HP-IL Converter = HP82166A. The 82161A Digital Cassette Drive and the 82162A Printer do not respond. See SEND ACCESSORY ID, FINDID.

SEND STATUS HP-IL message. When this message is received, the loop's addressed talker will send its status bytes to the controller (INSTAT). The 82161A Digital Cassette Drive sends 1 byte and the 82162A Printer sends 2 bytes. See INSTAT, X<>F.

SETAF SET ACCURACY FACTOR, TIME Module, xrom 26,21. Implements a correction factor that will be maintained in the TIME Module's own registers and used to adjust the time base. One pulse (of 10,240/second) will be added or subtracted every nn.n seconds to slow down or speed up the time-keeping. The input range is ±99.9 seconds. Input "factor" in X, check the sign of the number and xeq SETAF. See CORRECT, RCLAF; see ACCURACY FACTOR for definition.

SETDATE TIME Module, xrom 26,22. Sets the date. The input date must follow the selected date format, either the default MDY format - Month.DayYear, MM.DDYYYY, or the alternate format, DMY - Day.MonthYear, DD.MMYYYY. Input limits are between Jan. 1, 1900 and Dec. 31, 2199. See DMY and MDY; DATE FORMATTING.

SETIME TIME Module, xrom 26,23. Sets the clock time. Input may be in either 12 or 24 hour format. In 12 hour format, input a PM time as a negative number. Due to the imprecision possible when attempting to set time according to a time signal, SETIME should be temporarily assigned to an unshifted User mode key. Slight adjustments may be made with the T+X function. For example, the clock time may be set to a clock signal within .25 seconds and adjusted gradually by inputting 1 E -5 and pressing T+X repeatedly until the clock is synchronized. See CORRECT, an alternate method of setting time; also see T+X.

SETSW SET STOPWATCH, TIME Module, xrom 26,24. Sets the stopwatch to an input positive or negative time ±99:59:59.99 hours. This cannot be performed in the special SW mode. Input must be a time formatted number, HH.MMSShh. A negative input sets a Timer Alarm and sounds 16 pairs of tones when it passes through 0. In SW mode it sounds 2 tones. The stopwatch may also be set while it is running either from the keyboard or by a program; for example, the code TIME SETSW executed while the stopwatch is running effectively synchronizes the stopwatch to the clock and enables storing splits in Clock time rather than relative or elapsed time. See SW, RCLSW, STOPSW, RUNSW.

SF SET FLAG may be used to set Flags 00 - 29 only. See IF, TOGGLE FLAG.

Σ+, Σ- Accumulates summations of X, Y input data (or deletes data in the case of an error). If only X data is accumulated, it is good practice to clear Y prior to summation, 0 ENTER X Σ+. This avoids accumulating "garbage" in the statistical register block that may produce OUT OF RANGE or other errors. The 6 register statistical block sums the following: 1st Reg = Sum of X inputs; 2nd Reg = Sum of X ; 3rd Reg = Sum of Y inputs; 4th Reg = Sum of Y ; 5th Reg = Sum of X(Y); 6th Reg = n(umber) of inputs.

ΣC REG CURTAIN EXCHANGE, PPC ROM 10,21, SIZE a/r, Subr. levels: 6. Interchanges pointers in status register c to the statistical register block and R00. See CURTAIN - PPC.

Σ? REG FINDER, PPC ROM 10,14, SIZE 000, Subr. levels: 5. Returns the number of the first register of the 6 register statistical block.

ΣREG SPECIFY STATISTICAL REGISTER LOCATION. Input any starting address that is convenient = highest numbered data register-6.

SIGN UNARY OF X. Returns -1 if X is negative, 1 if X=0, 1 if X is positive and 0 if X contains alpha data. Provides a convenient means of testing for alpha data. The original contents of X are preserved in LASTX.

SIMEQ SIMULTANEOUS EQUATIONS, MATH 1 Module, xrom 01,02. Subroutineable portion of the MATRIX program file in the MATH ROM. To use, SF 04, SF 05, CF 06 - 10, SF 21. The routine skips initial prompting and prompts for the column vector. See MATRIX for register useage.

SIN SINE OF X. |||X: angle in decimal degrees||| Check DEG, RAD or GRAD mode.

SINGLE WIDE MODE The normal width character print mode (5 columns wide) in effect at turn-on and when Flag 12 is clear or an Escape sequence to set this mode has been sent to the 82162A Printer. Also in effect after receiving a Selected Device Clear message.
See DOUBLE WIDE MODE.

SIZE DATA REGISTER ALLOCATION. Prompts – – –. If the PACKING ...TRY AGAIN message is seen, sufficient space is not available in main memory; either some key assignments, Alarms, or short programs must be deleted to allocate the desired number of data registers.
See PSIZE; also see ALMCAT, CLP, PCLPS.

SIZE ERR HP-IL mass storage error message occurring in response to READS (READ STATUS) when there is insufficient space in main memory for a status change.

SIZE ERROR HP-IL mass storage status byte. This error is generated by the 82161A Digital Cassette Drive when a specified track number is greater than 1 and corresponds to status byte 0001 1100. Not seen in the 41C display. See INSTAT.

SIZE? XFUNCTION, xrom 25,44. Places the number of data registers currently allocated in main memory in X. Programmable. See S?, PSIZE, SIZE.

SK SUSPEND KEY ASSIGNMENTS, PPC ROM 20,04, SIZE 002, Subr. levels: 5. Stores the key assignment bit maps from status registers ⊢ and e into R_X and R_{X+1}, respectively and stores 0 in both status registers. Use of this routine does not yield any additional memory space, but it does temporarily inactivate key assignments that may be inconvenient momentarily.
See the inverse routine, RK.

SKPCHR SKIP CHARACTERS. Printer 82143A and HP-IL xrom 29,22. Skip character accumulates 7 column spaces into the print buffer. |||X: number of character positions to skip|||
See PRINT BUFFER, PRBUF.

SKPCOL SKIP COLUMNS. Printer 82143A and HP-IL xrom 29,23. Skip columns accumulates a number of skipped columns - 1 dot wide - into the print buffer.
|||X: number of columns to skip 168||| See PRINT BUFFER, PRBUF, SKPCHR.

SM STACK TO MEMORY, PPC ROM 20,55, SIZE 005, Subr. levels: 5. Stores the stack registers including LASTX into a continuous block of 5 data registers. The address of the lowest register is stored in R06. May be useful when there is a possibility that an Interrupting Control Alarm will disturb the stack in the middle of a routine. The inverse routine is MS.

SOL MATH 1 Module, xrom 01,10. Subroutineable portion of the SOLVE program file in the MATH ROM to calculate f(X)=0 on an interval. Flag 01 is used and Flag 21 must be set prior to calling SOL. The function must be keyed into program memory followed by either a RTN or an END and place a value in X. R00 - R06 are used by the routine. R01 = Guess 1, R02 = Guess 2, R06 = function name. See SOLVE, SV.

SOLUTION BOOK A series of books published by the 41C Users' Library on various applications. "Time Solutions I", for example, supports the TIME Module with advanced programs for general timing, automobile trips, sports training, appointment management.

SOLVE MATH 1 Module, xrom 01,09. Program file in the MATH ROM to calculate the solution to f(X)=0 on an interval. See SOL, SV.

SORTING ROUTINES - PPC. Routines in the PPC ROM for sorting.

S1: Stack Sort	S3: Large Array Sort
S2: Small Array Sort	AL: Alphabetize X and Y

See the individual routine definitions.

SOURCE 1. The start register of a block of registers. Up to 3 integer digits are used to specify the source block in main memory for the functions REGMOVE and REGSWAP.
2. v. The origination of commands - data frames - in the HP-IL loop, usually by the controller (41C or HP80 series computer) or the active talker.

SR SHORTEN RETURN STACK, PPC ROM 20,00, SIZE 002, Subr. levels: (unlimited). Recalls 5 return pointers stored in R_X and R_{X+1} by LR, combining them in status registers a and b. Every call on SR must be preceded in time by a call on LR. Used this way, they allow unlimited subroutine depth. See LR, Appendix The Status Registers.

ST I HP67/97 function equivalent to STO 25 on the 41C.
See RC I.

STALL ERROR HP-IL message. When the 82161A Digital Cassette Drive senses a stall, the device sends 0001 0010 as the status byte. Not seen in the 41C's display. See INSTAT.

STAR BURST See BOXED STAR.

STATUS BYTE HP-IL message. Refers to one or two 8 bit bytes sent by HP-IL devices to indicate their condition and operating modes, different for each device. See INSTAT.

STATUS REGISTERS Sixteen registers at the beginning of 41C memory that are used by the operating system as scratch. The registers L, T, Z, Y and X are available for general use as are the 24 bytes used for alpha strings. The remaining registers hold status information such as SIZE, statistical register allocation, location of the .END., the program pointer, subroutine returns, Flag status and key assignment bit maps. See Appendix The Status Registers.

STK HP67/97 function to flash or print the stack in T, Z, Y, X order. If the Printer is in the system, it must be turned on to avoid an error. The equivalent 41C function is PRSTK. Also seen in HP67/97 listings as PRST, f STACK, g STK. Automatically translated by the Card Reader from an HP67/97 program card as 7PRSTK.

STKPLOT STACK PLOT, 82143A or HP-IL Printer, xrom 29,24. Plots a single function value and takes its parameters from the stack. |||T: Y value||| |||Z: Y minimum||| |||Y: Y maximum||| |||nnn.aaa where nnn = the number of columns (169) and .aaa = the Y axis column in which the X axis bar will be printed. For aaa = 0, the axis will be at the bottom of the plot and for aaa = 0, the axis will be omitted.|||
See PRPLOT, PRPLOTP, REGPLOT; also see PRINTER ROUTINES - PPC.

STO For syntax and limits, see RCL.

STO (HP67) See RCL (HP67).

STOFLAG STORE FLAG STATUS, XFUNCTION, xrom 25,45. Sets the status of Flags 00 - 43 or any selected adjacent Flags within that group using data obtained by RCLFLAG and normally recalled from a data register. |||X: RCLFLAG (appears as an alpha string) data|||
To restore selected Flags: |||Y: RCLFLAG data||| |||X: control word in the form bb.ee beginning and ending flags to be restored||| xeq STOFLAG
See the inverse function RCLFLAG. Also see RD, SD; d REGISTER.

STOPIO HP-IL control function, xrom 28,40. Stop input/output, clear the loop and reset all devices.

STOPSW STOP STOPWATCH, TIME Module, xrom 26,25. Stops the running Stopwatch under program control. Note: 41C's that are hardware modified to run at 2x normal speed may respond differently to this instruction and not stop the Stopwatch. If this response is noted, key STOPSW into program memory twice in succession to remedy. See RUNSW, SETSW, SW.

STORE b A synthetic instruction that stores the number in X into the status register b and by so doing, instantly places the calculator at a different location in memory. Using this command with a meaningless number in X has unpredictable consequences. STO b has the same effect as a compiled numeric GTO and takes the same amount of time to execute but it can transfer execution to any file in memory, main, Extended, ROM or even stack and data registers. See b REGISTER, PROGRAM POINTER - PPC, Appendix The Status Registers.

STORE c A synthetic instruction that stores the number in X into status register c. An incorrectly formatted number causes MEMORY LOST immediately. See COLD START, Appendix A, Status Reg's.

STORE d A synthetic instruction that stores the number in X into the Flag status register. Properly formatted, 56 flags may be set at once, using only 12 bytes of memory.
See d REGISTER, STOFLAG, Appendix The Status Registers.

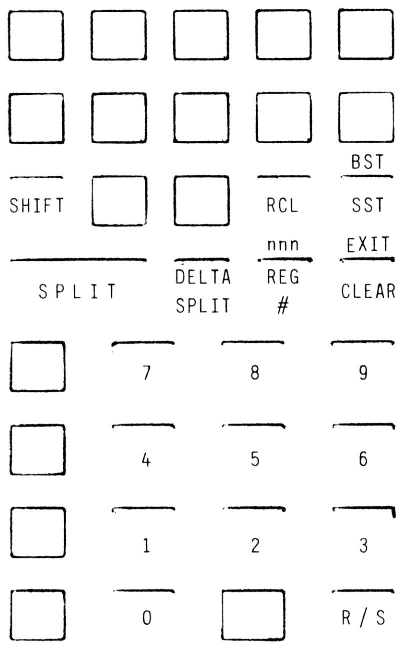
SU SUBSTITUTE CHARACTER, PPC ROM 10,39, SIZE 000, Subr. levels: 6. Required inputs are a single alpha character in Y and a number in the range of 1 - 10 in X. The routine will work properly on a string in alpha of less than 14 characters to replace the xth character in alpha (counting from the right) by the character in Y. The XFUNCTION equivalent of this sequence is performed by rotating (AROT) the desired character to the leftmost position in alpha, executing XTOA, inputting the character code of the character to be inserted, ATOX,

SU (Con't)
and rotating the string back to its original position (ATOX). See AROT, ATOX, CHARACTER CODE, XTOA.

SV SOLVE, PPC ROM 20,10, SIZE 010, Subr. levels: 4. Approximates a solution to an equation of the form f(X)=0 using the Secant Method. Key function into program memory with a global label of 6 or less characters and followed by either RTN or END. SV uses R06 - R09. Store function name in R06. Select display setting. To view iterations, SF 10. Input step size ENTER input guess, xeq SV.

R06: function label R08: $f(X_i)$
R07: X_i R09: dx_i See SOL, SOLVE.

SW STOPWATCH MODE, TIME Module, xrom 26,26. Redefines the calculator keyboard to digital Stopwatch functions. Only the marked keys are active:



RCL: Switches the display between viewing the Stopwatch and recalling stored splits. An " = " sign is always seen preceding the register pointer when in RCL mode.
BST: Backsteps the register pointer to display a split in a lower numbered register.
SST: Advances the register pointer.
ENTER: stores a split in the register indicated by the pointer. Holding ENTER down momentarily displays the split to 2 digit precision. Holding any inactive key displays the split to 1 digit precision without storing it.
CHS: Switches to Delta Split mode where the displayed splits represent the difference between the displayed split and the previous split.
EEX: Removes the counter from the display.
[ ] EEX: Allows entry of a 3 digit register address.
CLX: Clears the stopwatch if not running.
[ ] CLX: Exits SW mode.
0 - 9: Change the pointer address

The programmable equivalents of these functions are: RCLSW, RUNSW, SETSW, STOPSW. Also see Appendix A, Bugs 1 - 9 (Bug 2).

SWITCHED QUAD Refers to the technique of installing an SPST switch within the case of an 82170A QUAD Memory Module to allow switching it on and off the bus of the 41C. See PAGE SWITCHING, IP, PS.

SX STORE Y IN ABSOLUTE ADDRESS X, PPC ROM 10,56, SIZE 000, Subr. levels: 4. Store data or program lines in any register in user memory. It may be used for direct modification of programs and assignments or storing data in the space between .END. and the assignment registers. If program execution results in the NONEXISTENT message, proceed as follows: (PRGM) SST (PRGM) R/S. This avoids MEMORY LOST. Valid inputs are 192 - 511. See MEMORY - PPC.

SYNTHETIC BLDSPEC A time- and byte-saving technique of creating BLDSPEC characters in 12 bytes as opposed to the "normal" method in the Printer manual which uses 32 - 40 bytes per character. A knowledge of synthetic programming technique is required to enter the required code or access to the PPC ROM. The XFUNCTION Module may also be used to create the required character string. A detailed explanation of this technique may be found in each of the first three references.

SYNTHETIC INSTRUCTION Any 41C instruction that cannot be entered into program memory using normal keystrokes. Hundreds of functions have been discovered which greatly expand the power of the 41C system and which are not supported by HP documentation. Programs using these instructions however are acceptable in the 41C Users' Library if documented clearly as such. Synthetic instructions are used to address the program pointer, execute portions of Application Module programs as subroutines without going to labels, control of system flags, saving memory, program self-modification, enhanced graphics, 6 additional TONE frequencies (128 TONES including 8 durations x 16 frequencies), memory partitioning, operating system exploration, multi-byte key assignments, processing speed increase and addressing more than 319 registers of memory. See the first four references for more information.

SYNTHETIC KEY ASSIGNMENT Creation of non-standard key assignments by using special programs to store unusual bytes into the key assignment registers, for example FIX 2 (rather than FIX), TONE D, GTO IND X, RCL b (program pointer), or eGOBEEP.
See eGOBEEP; Appendix References.

SYNTHETIC LABEL Creation of a label containing punctuation characters, "globalizing" a local alpha label for the purpose of indirect addressing or a global label containing more than 7 characters.

SYNTHETIC PROGRAMMING The use of programming techniques that are undocumented by the manufacturer. The general class of techniques first discovered by W. C. Wickes and supported by the PPC users' group in their publications. See References.

SYNTHETIC TONE Tone instructions that are created synthetically. Synthetic programming techniques create a total of 108 new tone instructions for a total of 16 frequencies with durations between .023 and 5 seconds. The technique is used for control applications, music, games and prompting. The TIME Module and Wand use "synthetic tones" for signalling purposes.
See Appendix TONES.

SYSTEM CONTROLLER Only one device can be a system controller on the HP-IL loop. For example, when the 41C and a Series 80 computer with an 82938A interface card are in the same loop, the Series 80 Computer is the system controller. The system controller has the capability of taking control from another controller such as the 41C at any time.

T

T1 BEEP ALTERNATIVE, PPC ROM 10,47, SIZE 000, Subr. levels: 5. A short tone burst useful as an unobtrusive audio prompt. Originally written as part of a "Phasers" routine.

T+X TIME, HMS+. TIME Module, xrom 26,27. Adjusts clock time by the amount specified in X, positive or negative. May be used to adjust for time zone changes or to implement minute corrections to the clock (increments as small as 1 E-6, 1/100th second, are possible).
See OUT OF RANGE for limits of input.

T REGISTER Register 000 absolute of 41C memory, the "Top" register of the automatic memory stack. See Appendix The Status Registers.

TAKE CONTROL HP-IL message. The active controller uses this command to transfer control of the loop to another controller such as the 41C passing control to an HP-85.

TALK ADDRESS HP-IL message. The HP-IL controller sends an address from 0 - 30 to cause a loop device to become the active talker. The 82161A Digital Cassette Drive and 82162A Printer respond if their addresses match.

TALKER Refers to the device in the HP-IL loop that is sending data to listener devices. At any given time there is only one talker on the loop. A Mass Storage device is a talker when it is transmitting program bytes to the controller's memory. A Printer is a listener when it is told to print. It is a talker while it is actually printing.

TAN TANGENT. |||X: angle in decimal degrees||| Check DEG, RAD or GRAD mode.

TB BASE TEN TO BASE B, PPC ROM 20,18, SIZE 007, Subr. levels: 4. Store base b in R06 (2 =b =19). Input base 10 number in X, xeq TB. Base b result is limited to 13 digits in the Alpha register and will be displayed if Flag 10 is set. The inverse routine is BD.

TIME TIME Module, xrom 26,28. Places the current clock time in X to 6 digit precision. Seen in the display register if executed from the keyboard according to the current 12 or 24 hour format in use. See CLOCK, [ ] ON.

TIME DISPLAY FORMATTING The input/display format used to represent time by the TIME Module. HH.MMSShh = HOURS . MINUTES SECONDS hundredths. |H|H|.|M|M|S|S|h|h|. All TIME functions use this syntax for I/O. See SETIME, CORRECT.

TIME OUT ERROR HP-IL message. The 82161A Digital Cassette Drive sends data byte 0001 1000 when no data is detected on the tape. See INSTAT.

TIMER ALARM A count-down alarm activated by the Stopwatch as it passes through 0. This alarm will activate regardless of the operating mode of the 41C. The message "TIMER ALARM" is displayed and 16 pairs of tones are sounded. The alarm is not stored in the I/O buffer and consequently does not become past-due if not acknowledged. To set a Timer Alarm: input the amount of time the Stopwatch must run before activating the alarm as a negative number, HH.MMSShh; SETSW, RUNSW. The time must be set in Run mode or by a program.

TIPS AND ROUTINES Refers to "Calculator Tips and Routines" by John Dearing. A collection of explanations, short highly useful programs and subroutines and items on the care and feed- of 41C calculators. Many practical applications of synthetic techniques are included as well as tips for novice users. See References.

TN TONE N (0 - 127), PPC ROM 10,32, SIZE 000, Subr. levels: 3. A tone demonstration and checking routine. Input tone number in X, xeq TN. All synthetic tones are demonstrated by this program. See SYNTHETIC TONE, TN.

TOGGLE FLAG A section of code that changes the state of a user Flag every time it is encountered in a running program. For example, FC?C 19 SF 19 will alternately set or clear Flag 19. May be used with any Flag 30. For use with System Flags, see IF.

TONE Activates a single audible tone of approximately 1/4 second duration and frequencies between 175 and 1050 Hz. Input 0 - 9 in response to TONE — — prompt.
See BEEP, BENDER, BEEP. Also see Appendix TONES.

TONE ALARM A simple clock alarm without an accompanying alpha message.
See XYZALM.

TRACE One of three Printer modes, set by front panel switches in the case of the 82143A and 82162A Printers and the status of Flags 15 and 16 for other HP-IL Printers and the Video Interface. In TRACE mode all keystrokes are printed and all output. During a running program every line of code will be printed as well as intermediate results whenever the X register is altered. See MANUAL, NORMAL; also Flags 15 - 16.

TRACE w/STACK OPTION Each line of instructions executed by a running program as well as the contents of the stack whenever it is changed are printed in this mode. Applies to HP-IL Printers only (but not the 82162A Printer). To enter this mode, SF 15, SF 16.

TRACK The area of a recording medium that a detector (such as a tape head) can read without moving.

TRANSMIT ERROR HP-IL error message. Possible causes: one of the devices in the loop is turned off or improperly connected; Flag 33 is set; the SELECTed device in MANIO mode may not be able to execute the command; a crash or malfunction.

TRIGGER HP-IL control function, xrom 28,41. Activates the primary loop device if the device can respond. Each device will have its own parameters and response.

U

UD UNCOVER DATA REGISTERS, PPC ROM 20,44, SIZE a/r, Subr. levels: 6. UD uses the contents of R00 established by the last call on HD to restore the curtain to its previous position. Each use of UD must be preceded in time by a call on HD or a MEMORY LOST results. The stack is unchanged after executing this routine. See HD; also see CURTAIN - PPC.

UNLISTEN HP-IL message. The HP-IL controller resets all addressed listeners in the loop to idle, usually to reset them in an orderly manner before addressing new listeners.

UNSEC UNSECURE, HP-IL mass storage, xrom 28,15. Cancels the protection given to a mass storage file. If the file has been secured, it cannot be changed or purged until UNSEC has been performed. |||ALPHA: file name||| See SEC.

UNTALK HP-IL message. The controller sends a command to cause the addressed talker in the loop to become idle.

UPPERCASE MODE Normal operating mode of 41C peripheral printers, controlled by the status of Flag 13. Flag 13 set = lowercase A - Z characters (other characters are unaffected). This mode change is saved in the print buffer as a data byte. Creating a text string with lowercase characters eliminates the requirement of setting Flag 13. Although the program line appears unintelligible in program mode, it prints normally.

UR UNPACK REGISTER, PPC ROM 20,44, SIZE a/r, Subr. levels: 5. Decodes data stored in a register in base b encoded form by PR. To recall encoded data in position k in register j, input k, xeq UR. See DATA PACKING, PR.

V

VALID DATES See OUT OF RANGE for valid date inputs to TIME Module functions.

VCOL VIEW COLUMN, MATH 1 Module, xrom 01,03. Part of the MATRIX program file. To use at any time after inputting matrix elements, xeq VCOL. The output format is: "B1= ......", "B2=......", "Bn=......" See MATRIX, VMAT.

VER VERIFY, Card Reader, xrom 30,05. Used to confirm proper recording or identify a card. Execute VER prompts "CARD". The following messages may be seen: CARD ERR = a card with no data or program recorded on it or an improper type; CHECKSUM ERR = a soiled or damaged card; MALFUNCTION = a damaged card; TYPE t TR nn, where t represents (P) program card, (D) data card, (S) status card, (A) Write-All card, (7P) HP67 data card, (7D) Hp67 program card. VER is programmable if an extra step is taken to insert it in a program.
1. Assign VER temporarily to any key. 2. Turn off the 41C and remove the Card Reader.
3. In PRGM mode, press the key assigned to VER. 4. Re-insert the Card Reader. CHECKSUM.

VERIFY HP-IL mass storage, xrom 28,16. Verifies that a mass storage file has been correctly recorded. |||ALPHA: file name|||. Possible syntax error: improper format in Alpha. For example, if the recorded program and the mass storage file have different names and the Alpha register contains "program name,file name", the file will not be found. Programmable. If the file is verified, the display is unchanged. If an error was detected the messages MEDM ERR or DRIVE ERR may be seen. See CHECKSUM.

VF VIEW FLAGS, PPC ROM 20,58, SIZE 000, Subr. levels: 4. Displays the numbers of those Flags which are set in groups of 4. Defaults to PRFLAGS if a Printer is in the system and enabled. See PRFLAGS.

VIDEO INTERFACE FUNCTIONS See CURSOR..., ACCHR, BACKSPACE, CARRIAGE RETURN, CLEAR DEVICE, FLAGS 15, 16, INVERSE VIDEO, ROLL DOWN, ROLL UP, TRACE w/STACK OPTION.

VIEW Displays the contents of any register without altering the stack. Automatically prints is a Printer is in the system and enabled. If Flag 21 is set and there is no Printer, VIEW will halt program execution. Additionally, VIEW causes the Printer to print its buffer. AVIEW.

VK VIEW KEY ASSIGNMENTS, PPC ROM 10,36, SIZE 000, Subr. levels: 2. Displays the keycodes of reassigned keys from top to bottom and left to right. VK leaves the stack cleared.

VK (Con't)
Defaults to PRKEYS if a Printer is in the system and enabled. See PRKEYS.

VM VIEW MANTISSA, PPC ROM 10,26, SIZE 000, Subr. levels: 5. Views the full mantissa of the number in X without altering the stack. Alpha is cleared. See EX.

VMAT VIEW MATRIX, MATH 1 Module, xrom 01,04. Part of the MATRIX program file in the MATH Module. To use at any time after inputting matrix elements, xeq VMAT. No input is required. Output format is: "A1, 1=......", An, n=......". See MATRIX, VCOL.
See MATRIX, VCOL.

VOID See MEMORY VOID, Appendix A, The Status Registers.

VS VERIFY SIZE, PPC ROM 10,30, SIZE 000, Subr. levels: 6. Insert the sequence: nn VS FC?C 25 PROMPT to verify that the size is at least nn.
See SIZE? and PSIZE for XFUNCTION alternative.

W

WALL WRITE ALL, Card Reader, xrom 30,06. Writes the entire contents of the 41C's main memory to magnetic cards, 336 registers (= 21 Tracks in the case of a 41CV), including data, program, I/O buffer and status registers. WALL cards must be maintained as a set because MEMORY LOST results if an incomplete set is read into the calculator. When the WALL set has been loaded the program pointer will be reset to its position at the time of recording. Timer alarms, if any, will be reinstated in the I/O buffer resulting in possible past-due alarms. Their presence is signalled by two short tones. Verifies as "TYPE A TR nn".
See WRTA, READA.

W/DATA HP67/97 mnemonic for WRITE DATA and equivalent to recording the contents of R00 - 25 of a 41C. Track 1 contains R00 - R09 and R20 - 25 and track 2 contains R1- - 19. Also seen in HP67/97 listings as WDTA, f W/DATA.

WDTA WRITE DATA, Card Reader, xrom 30,07. Writes the contents of all main memory data registers to magnetic cards, 32 registers per card. Does not require input. See WDTAX.

WDTAX WRITE DATA ACCORDING TO X, Card Reader, xrom 30,08. Writes the contents of main memory data registers to magnetic cards as directed by a control word of the form bbb.eee. |||X: bbb.eee beginning register to be recorded. ending register||| The data is returned to the calculator by RDTAX. The sequence CLX WDTAX provides a convenient means of neutralizing unmarked or obsolete magnetic cards that would disrupt the calculator if they were read such as cards of an obsolete WALL set (accidental reading could cause MEMORY LOST). Such a card would not alter memory if it were read. See WDTA.

WNDDTA WAND DATA, xrom 27,01. When encountered by a running program, execution stops and the prompt "W: SCAN DATA" is given. When a single line of data bar code is scanned, the program resumes.

WNDDTAX WAND DATA ACCORDING TO X, xrom 27,02. Suspends a running program until a set of data is scanned by the wand and loaded into data registers specified by the control word in X. The word is of the form bbb.eee, beginning and ending registers to be loaded with the scanned data. The system prompts "W: SC TO nn" where nn represents the numbered row of barcode. The operation may be terminated prematurely or ignored by pressing backarrow.

WNDLNK WAND LINK SUBROUTINE, xrom 27,03. Prompts: "W: SCN SUBLNK" and continues after the first line of barcode is scanned with "W: RDY nn". The 41C automatically executes the subroutine and resumes execution of the main program at the next line. The program is read into main memory after the last program in memory if the instruction WNDLNK is in the current last program; if not, the last program is replaced by the Wand subroutine.

WNDSCN WAND SCAN, xrom 27,05. Translates user-designed barcode into the decimal equivalent of the binary value of each byte and stores value in a data register. Storage of each byte (eight bars) begins sequentially in R01. The number of bytes stored - registers used - is

WNDSCN (Con't)
returned to X. The stored values can be interpreted by a user program.

WNDTST WAND TEST, xrom 27,06. Tests a row of barcode and displays (or prints, if possible) the value of each bit in the Alpha register. The binary sums of each byte are stored in data registers whose addresses correspond to the byte numbers. R00 is used for a counter. SF 29 to separate the bit display with radix marks. Example:

L |1 1 0 0 1 0 1 1|0 1 1 1 0 1 0 1|0 1 0 0 0 0 1 0|0 1 0 0 0 0 0 1|0 1 0 0 1 0 0 0|0 1 0 0 0 0 0 1|0 1 0 0 1 0 0 1| R

B1.=1.1.0.0.1.0.1.1.
B2.=0.1.1.1.0.1.0.1.
B3.=0.1.0.0.0.0.1.0.
B4.=0.1.0.0.0.0.0.1.
B5.=0.1.0.0.1.0.0.0.
B6.=0.1.0.0.0.0.0.1.
B7.=0.1.0.0.1.0.0.1.

At completion R00 = 8.007 (loop counter), R01 = 203, R02 = 117, etc.

WORKING FILE XFUNCTION term referring to the file to which information is being written to or read from. The file name in Alpha makes an Extended Memory file a working file for certain operations. May be compared to GTO. See RCLPT(A), SEEKPT(A).

WPRV WRITE PRIVATE, Card Reader xrom 30,09. Recording a program in this mode prevents the program from being viewed, copied or edited when read back into any 41C. Also useful to prevent accidental tampering. See PRIVATE, WRTPV.

WRITING INSTRUCTIONS
Magnetic Cards: WALL, WDTA, WDTAX, WPRV, WSTS.
Extended Memory: APPCHR, APPREC, CRFLAS, CRFLD, INSCHR, INSREC, SAVEP, SAVER, SAVERX, SAVEX; SAVEAS.
Digital Cassette: CREATE, NEWM, WRTA, WRTK, WRTP, WRTPV, WRTR, WRTRX, WRTS. SAVEAS.

WRTA WRITE ALL, HP-IL mass storage, xrom 28,17. Copies the entire contents of the 41C to a file in mass storage, in the case of a 41CV, 336 registers, 10 records, including program pointer location, key assignments, timer alarms, I/O buffer, status and all data and program material. Programmable. |||ALPHA: write-all file name||| If a file name is input that is already used for a Write All file, that file will be replaced by the new file. See READA.

WRTK WRITE KEYS, HP-IL mass storage, xrom 28,18. Writes key assignments to a mass storage file of all keys reassigned to CAT 2 and CAT 3 functions. If an unsecured file exists of the same name and type, it will be replaced by the new file. |||ALPHA: file name||| See WSTS.

WRTP WRITE PROGRAM, HP-IL mass storage, xrom 28,19. Copies a program from main memory to a mass storage file. If an unsecured program file exists with the same name, it will be replaced. If the new file requires a larger number of records than the old file it is moved to a position after the last recorded file on the medium. The program and the tape file need not have the same names. |||ALPHA: program name, mass storage file name|||
or if the program pointer is already positioned to the program |||ALPHA: ,file name|||
or if the program and the mass storage file have the same name |||ALPHA: program name|||
Programs may be recorded with Flag 11 set to execute immediately when read.
See SEC, UNSEC, VERIFY.

WRTPV WRITE PROGRAM, PRIVATE, HP-IL mass storage, xrom 28,20. Programs that are already private cannot be copied to mass storage. See PRIVATE.

WRTR WRITE REGISTERS, HP-IL mass storage, xrom 28,21. Copies all main memory data registers to an existing data file on the mass storage medium. Prior to recording, the file must be created (CREATE). Data is stored in the file starting at file register 0.
|||ALPHA: data file name||| Possible error: END OF FL, if the data file is not large enough to contain all allocated data registers. See READR, SEEKR, WRTRX. Also see CREATE.

WRTRX WRITE REGISTERS ACCORDING TO X, HP-IL mass storage, xrom 28,22. Prior to execution, the medium must be positioned by a SEEKR, a previous WRTR, READRX or READR.
|||X: bbb.eee beginning main memory data register. ending register|||
|||ALPHA: data file name||| See CREATE, READR, READRX, WRTR.

WRTS WRITE STATUS, HP-IL mass storage, xrom 28,23. Copies 41C status to a file in mass

WRTS (Con't)
storage. Unlike the similar Card Reader instruction, key assignments are not copied. Statistical block location, data SIZE, the status of Flags 00 - 43 and trig and display modes are saved as well as the contents of the stack and alpha register. Data may be keyed into Alpha or the stack prior to recording to identify or classify the status file. Note that the first 7 characters in Alpha are reserved for the file name.
|||ALPHA: status file name||| See WSTS, Appendix A, The Status Registers

WSTS WRITE STATUS, Card Reader, xrom 30,10. Writes the current calculator status to a magnetic card including key assignments. Track 1 records the 16 status registers and the subsequent tracks record the portion of the I/O buffer that contains user key assignments. If there are less than 32 key assignments, only 1 card is required. See WRTS for a description of 41C status. Also see Appendix The Status Registers.

X

\- x - HP97 function to print the X register, HP67 pauses X for 5 seconds. When translated by the 41C, the function causes an attempt to print if a Printer is in the system, else, it pauses for 5 seconds. Also seen in HP67/97 listings as PRTX, PRINT X, f -x-.

$\bar{x}$ HP67/97 mnemonic for MEAN. The equivalent statistical register blocks in the 41C begin at R04 or R14. Normally the Card Reader will translate $\bar{x}$ as MEAN preceded in memory at some point by ≤REG 14.

X REGISTER The fourth register of 41C memory, the normally displayed register at the bottom of the automatic memory stack. See Appendix The Status Registers.

X>=0? One of two missing relational tests in the 41C. May be synthesized by X≠0? X>0?.

X-AXIS The horizontal axis in a rectangular coordinate system. The Printer ROM program PRPLOT(P) prompts for values of the X-Axis to scale the plot, XMAX? XMIN? See PRAXIS.

XD HEX TO DECIMAL, PPC ROM, 10,25, SIZE 000, Subr. levels: 5. A subroutineable portion of the LB program file to convert 2 hex digits from the alpha register to their decimal equivalent, 0 - 255. See LB.

XE XROM ENTRY, PPC ROM 10,19, SIZE 000, Subr. levels: 5. This routine allows entry to a ROM program at any selected point, rather than only at Global labels. The subroutine pointer must be set up by the following procedure, prior to program execution. GTO the desired starting ROM program line and in RUN mode, manually perform the sequence, CLA RCL b STO M ASTO n, where n is any desired data register. In the RAM program which is to enter the specfied ROM line place the sequence CLA ARCL n xeq XE. The stack will be preserved and Alpha will be cleared. RCL b must be assigned to the keyboard: see MK or Appendix H, "KA".

XEQ EXECUTE. Used to access most 41C functions unless they are assigned to the keyboard or to instruct the running program to perform a subroutine. The instruction XEQ followed by a local alpha or numeric label uses three bytes, part of which is used to store the relative jump distance (compile) to be used on subsequent runs. XEQ followed by a global label uses 1 byte plus 1 byte for each alpha character. These are not compiled. Execute (ROM PROGRAM) uses 2 bytes and stores the ROM number and function sequence number. See Execution Timing.

X<>F X EXCHANGE FLAG, XFUNCTION, xrom 25,46. Exchanges the number in the X register with the status of the first eight user flags expressed as a binary sum (0 - 255). Each Flag is represented by a power of 2 and added to the total. For example to determine the value of Flag 05: 2 ENTER 5 Y/X. Result = 32. Flag 03 = 8. Therefore, to set Flags 05 and 03 simultaneously, use 40 X<>F. This may be considered as Extended Flag 40. 256 Extended Flags are possible. See EXTENDED FLAGS, INSTAT.

X<>I HP67/97 mnemonic for X 25. Also seen in HP67/97 programs as f X-I and h X-I.

XL XROM INPUTS FOR LB, PPC ROM 20,57, SIZE 000, Subr. levels: 4. This routine provides the LB (load Bytes) or MK (Make Key Assignments) bytes for use in creating or key assigning synthetic instructions. An XROM number of the form AA,BB is input in the form AA ENTER BB, xeq XL. Y will contain the B byte and X the A byte. Peripheral functions can be keyed into

XOR Boolean logic operator, Exclusive Or, to compare 2 expressions. If only one expression is true (non-zero), the result is true. Any other case is false.
See AND, NOT, OR.

XROM External ROM used in 41C I/O ports. An XROM identification system used by the 41C operating system takes the form of a 2 byte word, AA,BB where A = 0 - 31 for 31 unique ROMs and B = the function number in the ROM. For example, CREATE is the first function in the HP-IL mass storage ROM 28, hence 28,01. When the ROM or peripheral device is not in the system the programmed function displays as an XROM number rather than an instruction name. ROM programs display as XROM (GLOBAL) though they only occupy 2 bytes regardless of the length of the label. See PSEUDO XROM; also see Appendix, XROM Identification.

XTOA XFUNCTION, xrom 25,47. X TO ALPHA appends a character to alpha corresponding to the code number in X, 0 - 255. |||X: character code or Hex table decimal number|||
See ATOX, CHARACTER CODE, DC, HEX TABLE.

X=Y? X≠Y? The only 2 relational tests (of 10) that can be used to compare alpha strings.
SIGN may be used to test if a string is an ALPHA STRING.

X>=Y? One of 2 missing relational tests. May be synthesized by X≠Y? X>Y?

X<> X EXCHANGE REGISTER – –. Swaps the contents of any register with X. Depending upon SIZE, X<> can directly address registers 00 - 99 and the status registers. To X<> a stack register, press (.) before the register name, T, Z, Y, X (nop), or L. Data register addresses higher than 99 are indirect: X<> SHIFT – –.

XYZALM X,Y,Z ALARM, TIME Module, xrom 26,29. Sets various types of TIME Module alarms.
See Appendix, Alarm Parameters.

Y

Y-AXIS The vertical axis in a rectangular coordinate system.

Y REGISTER The third register of 41C memory - the third from the top of the RPN stack.
See Appendix The Status Registers.

Y/X RAISE Y TO Xth POWER. Y must be a positive real number; X may be any real number. Number ENTER power Y/X. This function may also be used to calculate roots. To calculate the n-th root of X: ($n\sqrt{X}$) X ENTER n 1/X Y/X.

Z

Z REGISTER The second register of 41C memory - the second from the top of the RPN stack.
See Appendix A, The Status Registers.

ZERO HP-IL mass storage, xrom 28,24. Places 0 in all registers of an existing unsecured data file, effectively "CLRG". |||ALPHA: file name||| See CLFL.

+K ADDITIONAL KEY ASSIGNMENTS, PPC ROM 10,03, SIZE 012, Subr. levels: 3. May be used under program control to create multibyte and synthetic key assignments. It should be used after MK or 1K so that the appropriate flags will have been set. Does not prompt. The sequence prefix ENTER postfix ENTER keycode xeq +K makes the corresponding key assignment. Data registers 09 - 11 are used by the routine.

-B STORE PART OF LB, PPC ROM 10,24, SIZE 012, Subr. levels: 4. Used in conjunction with L- to permit programs to write other programs.

1K FIRST KEY ASSIGNMENT, PPC ROM 10,02, SIZE 012, Subr. levels: 3. A non-prompting subroutine that will make a key assignment of any type under program control. For additional key assignments, see +K.

2D DECODE 2 BYTES TO DECIMAL, PPC ROM 10,55, SIZE 000, Subr. levels: 6. Evaluates the decimal equivalents for the last 2 bytes in X. Returns decimal equivalents of the next-to-last byte in X and the last byte in M. Use X<>M to view.

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EXECUTION TIMING

Execution times of the various functions in this table were computed by using the TIME module and running each function numerous times, after packing, to fall within the limited resolution of the Stopwatch. They should be taken as relative times only, as an aid to optimizing programs by using faster operations and combinations of operations. For example, the use of Global subroutines within a program file significantly slows program operation. The use of AVIEW to print output in a program that mandates a Printer will also slow the program considerably. It will be noticed that entry of digits in scientific notation is much faster than long strings of zeroes, even to the point of constructing a number in program memory; for example, the digit string 5.0000009 takes 20% longer to execute than it does when it is constructed by the code: 5, ENTER, 9 E-7, +. Additionally, it consumes 2 more bytes when entered as a digit string. The effects of lengthy Global labels, stack arithmetic, different display modes, conditionals (up to 50% faster if true) and other operations can be compared.

As the timing of individual instructions varies ±10% from machine to machine and can be affected by environmental and other factors, these times have been "pseudo-standardized" by use of the following routine: LBL 01 + GTO 01. The suggestion is taken from P. 189 of the "PPC ROM USERS MANUAL":

> "This routine was run beginning with 1 in the Y, Z and T registers and with X clear. R/S was pressed, and then pressed again after 100 seconds to establish a speed count. Results ranged from the low 1600's to middle 1700's for various 41C's, so 1700 was established as a reference count. Execution times presented for each [operation] have been normalized to the 1700 speed count..."

Actually, the routine was run several times for 1,000 seconds to minimize variability and the execution times were converted by the factor obtained.

```
LBL "17?"   "↑/Z"   CLST    TIME     .164009    HMS+   XYZALM   1      ENTER   ENTER
ENTER   CLX    LBL 01    +    GTO 01    LBL "Z"    BEEP    17 E3    /    STOP*    END
```

*The STOP must be included to prevent a return to LBL 01. Press GTO . . to eliminate the pending RTN.

Instructions are grouped under the following headings:
- Alpha operations
- Conditionals
- Data input/output
- Labels and branching
- Misc. single and dyadic functions
- Printing
- Statistical
- Time
- Trig operations

Operations that showed extreme variability were excluded as were functions such as PROMPT, STOP and END. Time is shown in milliseconds.

ALPHA OPERATIONS

Instruction	Time	Comments
Alpha strings		10(number of alpha characters) + 13
example:	23	1 alpha character
	53	4 " "
	93	8 " "
ARCL X	80	
ARCL nn	120.5	
ASTO X	26 - 28.5	CLA (26) - 24 characters (28.5)
ASTO nn	31.5 - 33.5	12 - 24 characters
AVIEW	319	12 characters, No Printer, Flag 21 Clear
	882	13 "
	1446	14 "
	2010	15 "
	3703	18 "
	4828	20 "
	7082	24 "
CLA	10	

Each additional alpha character (greater than 12) adds 512 milliseconds

Execution Timing, con't.

CONDITIONALS

Instruction	Time	Comments
SF	30.5	
CF	31	
FS?	22	T
	31	F
FS?C	31	T
	44	F
FC?	21	T
	31	F
FC?C	32	T
	44	F
X=Y?	10	T
	20.5	F
X≠Y?	10	T
	20.5	F
X>Y?	27.5	T
	38	F
X<Y?	27.5	T
	38	F
X<=Y?	28	T, 27(X=Y)
		23(X=0)
	38	F
X=0?	12	T
	22	F
X≠0?	12	T
	23	F
X>0?	12	T
	23	F
X<0?	13	T
	22	F
X<=0?	11	T, X=0
	12	X 0
	22	F
ISG Rnn	71 - 75	
ISG X	66 - 70	ii=default*
	65 - 69	ii=counter*
ISG IND nn	83 - 88	
DSE Rnn	67 - 70	
DSE X	62 - 65	
DSE IND nn	80 - 82	
DSE IND	101	DSE number= 9999999999

DATA INPUT/OUTPUT

Instruction	Time	Comments
CHS	11.5	
CLD	20	
CLRG	74.5 - 344	(SIZE * 2.75)+11
CLST	10.5	
CLX	10	

DIGIT ENTRY See top of column 2

Instruction	Time	Comments
Digit Entry	57.5	single digit
	91	2 digits
	156	4 "
	217.5	6 "
	278.5	8 "
	334.5	10 "
Digit Entry time = (n digits * 30.5) + 31		
n Digits + 1 Digit Exponent		
	112.5	1 digits
	146	2 "
	210	4 "
	273.5	6 "
	333.5	8 "
Time = (n digits * 31) + 82		
n Digits + 2 Digit Exponent		
	139	1 digits
	172.5	2 "
	238	4 "
Time = (n digits * 33) + 106		
ENTER	11	
LASTX	13	
PSE	1300	
R/	12	
RCL nn(00 - 15)	23.5	
RCL nn(16 - 99)	25.5	
RCL Y	20	
RDN	17	
STO nn(00 - 15)	20.5	
STO nn(16 - 99)	22	
STO Y	16.5	
ST+ nn	36	
ST- nn	37	
ST* nn	42	
ST/ nn	41	
ST+ stack	31	
ST- stack	32	
ST* stack	42	
ST/ stack	41	
VIEW nn	127	numeric data
	155	alpha data
VIEW X	122	Flag 29 Set Display=0.00
	131	Dsp=88,888.
	144	Dsp=8,888,888,888.
	150	Dsp=6 alpha char.
VIEW X	118	Flag 29 Clear Display=9
	120	Display=99
	130	Dsp=8888888888
X<> nn	24	
X<> stack	19	
X<>Y	10	

* ISG default refers to the cc portion of the control word, iiiii.fffcc. When cc is not specified the operating system assumes a default of 1. It is marginally faster when specified but consumes more bytes.

Execution Timing, con't.

LABELS AND BRANCHING

Instruction	Time	Comments

XEQ a Global subroutine. Memory was set up with a series of Global labels, each consisting of LBL "N" END. The comments column indicates the number of characters in each Global name and the number of labels in memory from the subroutine call to the .END.

Instruction	Time		Comments
XEQ GLOBAL	135		1 label/END, 1 char.
	145		2 " " " "
	155		3 " " " "
	165		4 " " " "
	185		6 " " " "
XEQ GLOBAL	185		1 label/END, 7 chars.
	205		2 " " " "
	225		3 " " " "
	245		4 " " " "
	265		5 " " " "

The distance in bytes is irrelevant as the Global labels and ENDs are linked - they are not compiled. Search always starts at the last END in main memory and steps to each GLOBAL and END until a match is found.

Instruction	Time		Comments
GTO GLOBAL	105		1 Global label w/a 1 char. name
	185		1 Global label w/a 7 char. name
XEQ LOCAL ALPHA LABEL	855	n.c.	The byte distance was 224. 855 represents the time taken the first time the code was executed. 65 represents the time taken the second time (compiled).
	65	c.	
XEQ nn (00 - 14)	845		110 byte distance, not compiled
	65		" " " , compiled
XEQ nn (15 - 99)	855		224 byte distance, not compiled
	65		" " " , compiled
GTO nn (00 - 14)	865		distance = 224 bytes, not compiled
	455		distance = 110 bytes " "
	25		" " " , compiled
GTO nn (15 - 99)	905		distance = 224 bytes, not compiled
	515		distance = 110 bytes, not compiled
	35		" = 110 or 224 bytes, compiled

Timing the Global label instruction itself:

1 character	44
2	49
3	52
5	59
7	67

Timing local label instructions:

LBL 11 - 14	10.5
LBL 15 - 99	13
LBL a - J	13

MISCELLANEOUS FUNCTIONS, ONE AND TWO ARGUMENT

ABS	14	
BEEP	1018	
DEC	59 - 66	depends on argument
ENG n	16	
E/X	107	
E/X-1	99.5	
FACT (1 - 69)	23.5 - 339	(n * 4.65)
FIX	16	
FRC	19.5	

HMS	30
HMS+	67 - 97
HMS-	59 - 90
HR	40
INT	21
LOG	222
LN	199
LN1+X	149
MOD	17 - 20
OCT	109 - 130

Con't. on following page.

Execution Timing, con't.

Instruction	Time	Comments
%	35	
%CH	64 - 100	
PI	17.5	
RND	18.5	FIX 0
	20	FIX 2
	21.5	FIX 4
	23	FIX 6
	24.5	FIX 8
SCI	16	
SIGN	13.5	
SQRT	40	
TONE 0 - 9	270	
TONE IND nn	284.5	nn = 3
	279.5	nn = 9
X/2	34.5	
Y/X	106.5 - 547	
1/X	35	
10/X	101.5	

PRINTER 82143A

Instruction	Time	Comments
ACA	84	Buffer was emptied
ACCHR	59	prior to each
ACCOL	58	operation
ACSPEC	82.5	
ACX	69 - 106	
BLDSPEC	52	1st character
PRA	349	6 characters
	562	12 "
	715	24 "
AVIEW	628	12 "
PR	5577	
PRX	286 - 615	depends upon num. of digits
	154 - 188	X contains alpha

PRINTER 82162A, HP-IL

Instruction	Time	Comments
ACA	129	Buffer emptied
ACCHR	102	prior to each
ACCOL	98.5	operation. No
ACSPEC	128.5	other device in
ACX	111 - 152	I/O loop.
BLDSPEC	32	
PRA	174	6 characters
	219	12 "
	535	24 "
AVIEW	516	12 "
PR	5382	
PRX	193 - 418	numeric data
	154 - 188	alpha data

A slight (approx. 5% speed increase was observed when the Printers were connected to AC chargers.

Buffer operations are faster on the 82143A which has a smaller buffer. All other instructions executed faster on the 82162A. The number and type of devices (and I/O mode) in the loop will affect timing significantly.

STATISTICAL FUNCTIONS

Instruction	Time	Comments
CL	23.5	
MEAN	102	Minimum time
SDEV	444	" "
Σ+	221	
Σ-	221	
ΣREG IND nn	43	
ΣREG	30	

TIME MODULE, selected functions

Instruction	Time	Comments
DATE	150	
DATE+	276	
DDAYS	311	
DOW	183	
RCLSW	58	
RUNSW	25	
SETSW	43	
STOPSW	25	
ADATE	72 93 107	FIX 2, 4, 6
ATIME	89 109 128	" " " "
ATIME24	73 92 112	" " " "
TIME	75	Varies acc. to time of day and clock mode

TRIG FUNCTIONS

Instruction	DEG	RAD	GRAD	Comments
ACOS	528	461	504	Argument in
ASIN	450	383	426	DEG, GRADS
ATAN	292	224	268	mode = 30;
COS	501	400	500	in RAD =.52
SIN	483	393	500	Inverses of
TAN	338	240	342	these values used for the inverse functions.
DEG	19.5			
D-R	86.5 - 98			
GRAD	20.5			
RAD	19.5			
R-D	71 - 88			

THE "HEX" TABLE

DESIGNED BY KEITH JARETT

HP-41C COMBINED HEX/DECIMAL BYTE TABLE

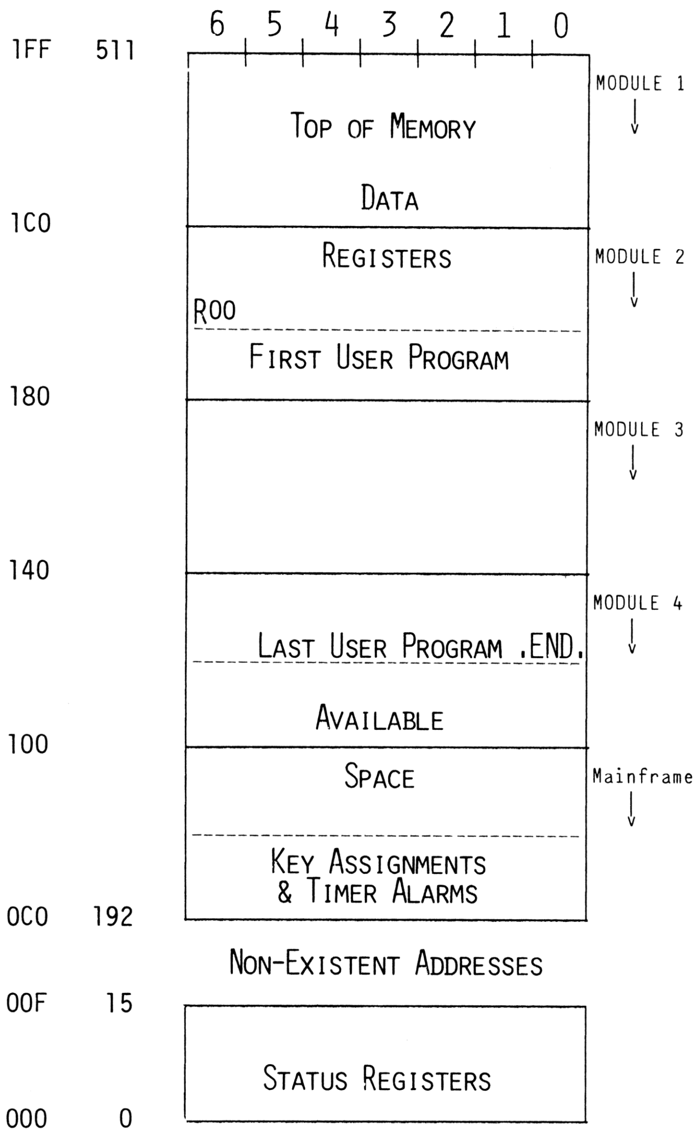
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
0	NULL 00 ‾ 0 ◆	LBL 00 01 ⊼ 1 ×	LBL 01 02 ▒ 2 x̄	LBL 02 03 ▒ 3 ←	LBL 03 04 ⊼ 4 α	LBL 04 05 ⊼ 5 β	LBL 05 06 Γ 6 Γ	LBL 06 07 ▒ 7 ↓	LBL 07 08 ▒ 8 Δ	LBL 08 09 ▒ 9 σ	LBL 09 10 ▒ 10 ◆	LBL 10 11 ▒ 11 λ	LBL 11 12 μ 12 μ	LBL 12 13 ∡ 13 ∡	LBL 13 14 ▒ 14 τ	LBL 14 15 ▒ 15 Φ	0
1	0 16 ▒ 16 θ	1 17 ▒ 17 Ω	2 18 ▒ 18 δ	3 19 ▒ 19 Ä	4 20 ▒ 20 ä	5 21 ▒ 21 Ä	6 22 ▒ 22 ä	7 23 ▒ 23 Ö	8 24 ▒ 24 ö	9 25 ▒ 25 Ü	. 26 ▒ 26 ü	EEX 27 ▒ 27 Æ	NEG 28 ▒ 28 œ	GTO ᵀ 29 ≠ 29 ≠	XEQ ᵀ 30 ▒ 30 £	W ᵀ 31 ▒ 31 ▒	1
2	RCL 00 32 32	RCL 01 33 ! 33 !	RCL 02 34 " 34 "	RCL 03 35 # 35 #	RCL 04 36 $ 36 $	RCL 05 37 % 37 %	RCL 06 38 & 38 &	RCL 07 39 ' 39 '	RCL 08 40 (40 (	RCL 09 41) 41)	RCL 10 42 * 42 *	RCL 11 43 + 43 +	RCL 12 44 , 44 ,	RCL 13 45 - 45 —	RCL 14 46 . 46 .	RCL 15 47 / 47 /	2
3	STO 00 48 0 48 0	STO 01 49 1 49 1	STO 02 50 2 50 2	STO 03 51 3 51 3	STO 04 52 4 52 4	STO 05 53 5 53 5	STO 06 54 6 54 6	STO 07 55 7 55 7	STO 08 56 8 56 8	STO 09 57 9 57 9	STO 10 58 : 58 :	STO 11 59 ; 59 ;	STO 12 60 < 60 <	STO 13 61 = 61 =	STO 14 62 > 62 >	STO15 63 ? 63 ?	3
4	+ 64 @ 64 @	— 65 A 65 A	* 66 B 66 B	/ 67 C 67 C	X<Y? 68 D 68 D	X>Y? 69 E 69 E	X≤Y? 70 F 70 F	Σ+ 71 G 71 G	Σ− 72 H 72 H	HMS+ 73 I 73 I	HMS− 74 J 74 J	MOD 75 K 75 K	% 76 L 76 L	%CH 77 M 77 M	P→R 78 N 78 N	R→P 79 O 79 O	4
5	LN 80 P 80 P	X↑2 81 Q 81 Q	SQRT 82 R 82 R	Y↑X 83 S 83 S	CHS 84 T 84 T	E↑X 85 U 85 U	LOG 86 V 86 V	10↑X 87 W 87 W	E↑X-1 88 X 88 X	SIN 89 Y 89 Y	COS 90 Z 90 Z	TAN 91 [91 [	ASIN 92 \ 92 \	ACOS 93] 93]	ATAN 94 ↑ 94 ↑	→DEC 95 _ 95 _	5
6	1/X 96 ᵀ 96 ᵀ	ABS 97 a 97 a	FACT 98 b 98 b	X≠0? 99 c 99 c	X>0? 100 d 100 d	LN1+X 101 e 101 e	X<0? A ▒ 102 f	X=0? B ▒ 103 g	INT C ▒ 104 h	FRC D ▒ 105 i	D→R E ▒ 106 j	R→D F ▒ 107 k	→HMS G ▒ 108 l	→HR H ▒ 109 m	RND I ▒ 110 n	→OCT J ▒ 111 o	6
7	CLΣ T ▒ 112 p	X<>Y Z ▒ 113 q	PI Y ▒ 114 r	CLST X ▒ 115 s	R↑ L ▒ 116 t	RDN M [▒ 117 u	LASTX N / ▒ 118 v	CLX O] ▒ 119 w	X=Y? P ↑ ▒ 120 x	X≠Y? Q _ ▒ 121 y	SIGN ⊢ᵀ ▒ 122 z	X≤0? a ▒ 123 π	MEAN b ▒ 124 |	SDEV c ▒ 125 →	AVIEW d Σ 126 Σ	CLD e ⊢ 127 ⊢	7
	0 0000	1 0001	2 0010	3 0011	4 0100	5 0101	6 0110	7 0111	8 1000	9 1001	A 1010	B 1011	C 1100	D 1101	E 1110	F 1111	

HP-41C COMBINED HEX/DECIMAL BYTE TABLE

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
8	DEG IND 00 128 ◆	RAD IND 01 129 ×	GRAD IND 02 130 x̄	ENTER↑ IND 03 131 ←	STOP IND 04 132 α	RTN IND 05 133 β	BEEP IND 06 134 Γ	CLA IND 07 135 ↓	ASHF IND 08 136 Δ	PSE IND 09 137 σ	CLRG IND 10 138 ◆	AOFF IND 11 139 λ	AON IND 12 140 μ	OFF IND 13 141 ∡	PROMPT IND 14 142 τ	ADV IND 15 143 Φ	8
9	RCL IND 16 144 θ	STO IND 17 145 Ω	ST+ IND 18 146 δ	ST− IND 19 147 Ä	ST* IND 20 148 ä	ST/ IND 21 149 Ä	ISG IND 22 150 ä	DSE IND 23 151 Ö	VIEW IND 24 152 ö	ΣREG IND 25 153 Ü	ASTO IND 26 154 ü	ARCL IND 27 155 Æ	FIX IND 28 156 œ	SCI IND 29 157 ≠	ENG IND 30 158 £	TONE IND 31 159 ▒	9
A	XR 0-3 IND 32 160	XR 4-7 IND 33 161 !	XR8-11 IND 34 162 "	X12-15 IND 35 163 #	X16-19 IND 36 164 $	X20-23 IND 37 165 %	X24-27 IND 38 166 &	X28-31 IND 39 167 '	SF IND 40 168 (	CF IND 41 169)	FS?C IND 42 170 *	FC?C IND 43 171 +	FS? IND 44 172 ,	FC? IND 45 173 —	GTO XEQ IND IND 46 174 .	SPARE IND 47 175 /	A
B	SPARE IND 48 176 0	GTO 00 IND 49 177 1	GTO 01 IND 50 178 2	GTO 02 IND 51 179 3	GTO 03 IND 52 180 4	GTO 04 IND 53 181 5	GTO 05 IND 54 182 6	GTO 06 IND 55 183 7	GTO 07 IND 56 184 8	GTO 08 IND 57 185 9	GTO 09 IND 58 186 :	GTO 10 IND 59 187 ;	GTO 11 IND 60 188 <	GTO 12 IND 61 189 =	GTO 13 IND 62 190 >	GTO 14 IND 63 191 ?	B
C	GLOBAL IND 64 192 @	GLOBAL IND 65 193 A	GLOBAL IND 66 194 B	GLOBAL IND 67 195 C	GLOBAL IND 68 196 D	GLOBAL IND 69 197 E	GLOBAL IND 70 198 F	GLOBAL IND 71 199 G	GLOBAL IND 72 200 H	GLOBAL IND 73 201 I	GLOBAL IND 74 202 J	GLOBAL IND 75 203 K	GLOBAL IND 76 204 L	GLOBAL IND 77 205 M	X<>-- IND 78 206 N	LBL -- IND 79 207 O	C
D	GTO -- IND 80 208 P	GTO -- IND 81 209 Q	GTO -- IND 82 210 R	GTO -- IND 83 211 S	GTO -- IND 84 212 T	GTO -- IND 85 213 U	GTO -- IND 86 214 V	GTO -- IND 87 215 W	GTO -- IND 88 216 X	GTO -- IND 89 217 Y	GTO -- IND 90 218 Z	GTO -- IND 91 219 [	GTO -- IND 92 220 \	GTO -- IND 93 221]	GTO -- IND 94 222 ↑	GTO -- IND 95 223 _	D
E	XEQ -- IND 96 224 ᵀ	XEQ -- IND 97 225 a	XEQ -- IND 98 226 b	XEQ -- IND 99 227 c	XEQ -- IND100 228 d	XEQ -- IND101 229 e	XEQ -- IND102 230 f	XEQ -- IND103 231 g	XEQ -- IND104 232 h	XEQ -- IND105 233 i	XEQ -- IND106 234 j	XEQ -- IND107 235 k	XEQ -- IND108 236 l	XEQ -- IND109 237 m	XEQ -- IND110 238 n	XEQ -- IND111 239 o	E
F	TEXT 0 IND T 240 p	TEXT 1 IND Z 241 q	TEXT 2 IND Y 242 r	TEXT 3 IND X 243 s	TEXT 4 IND L 244 t	TEXT 5 INDM[245 u	TEXT 6 IND N/ 246 v	TEXT 7 INDO] 247 w	TEXT 8 IND P↑ 248 x	TEXT 9 INDQ_ 249 y	TEXT10 IND⊢ᵀ 250 z	TEXT11 IND a 251 π	TEXT12 IND b 252 |	TEXT13 IND c 253 →	TEXT14 IND d 254 Σ	TEXT15 IND e 255 ⊢	F
	0 0000	1 0001	2 0010	3 0011	4 0100	5 0101	6 0110	7 0111	8 1000	9 1001	A 1010	B 1011	C 1100	D 1101	E 1110	F 1111	

HP 41C STATUS REGISTERS

	6	5	4	3	2	1	0 ← Byte Number		
e	SHIFTED KEY ASSIGNMENTS				SCRATCH		LINE NO.	015	00F
d	USER FLAGS (00 - 29)				SYSTEM FLAGS			014	00E
c	≤ REG		COLD START		REG 00	END		013	00D
b	3RD RTN	2ND RETURN		1ST RETURN		ADDRESS POINTER		012	00C
a	6TH RETURN		5TH RETURN		4TH RETURN		3RD RTN	011	00B
⊢	UNSHIFTED KEY ASSIGNMENTS				SCRATCH			010	00A
Q	TEMPORARY ALPHA SCRATCH							009	
P	SCRATCH/ALPHA 25 - 28				ALPHA REGISTER 22-24			008	
O	ALPHA REGISTER 15 - 21 CHAR.							007	
N	ALPHA REGISTER 8 - 14 CHAR.							006	
M	ALPHA REGISTER 1 - 7 CHAR.							005	
L	STACK REGISTER L							004	
X	STACK REGISTER X							003	
Y	STACK REGISTER Y							002	
Z	STACK REGISTER Z							001	
T	STACK REGISTER T							000	
	SIGN	MANTISSA				SIGN	EXP		



41C MEMORY MAP

Key Assignment Flag Bits

Hexadecimal

09 01	19 11	29 21	39 31	49 41
0A 02	1A 12	2A 22	3A 32	4A 42
0B 03	1B 13	2B 23	3B 33	4B 43
0C 04		2C 24	3C 34	4C 44
0D 05	1D 15	2D 25	3D 35	
0E 06	1E 16	2E 26	3E 36	
0F 07	1F 17	2F 27	3F 37	
10 08	20 18	30 28	40 38	

Decimal

9 1	25 17	41 33	57 49	73 65
10 2	26 18	42 34	58 50	74 66
11 3	27 19	43 35	59 51	75 67
12 4		44 36	60 52	76 68
13 5	29 21	45 37	61 53	
14 6	30 22	46 38	62 54	
15 7	31 23	47 39	63 55	
16 8	32 24	48 40	64 56	

KEY ASSIGNMENT BYTES FOR USE WITH "LB"

SHIFTED KEY / UNSHIFTED

SUBROUTINE DECISION TABLE
Bytes Saved

Bytes in repeated sequence	Number of times called (XEQ) 2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	- 6	- 7	- 8	- 9	-10	-11	-12	-13	-14	-15	-16	-17	-18	-19
3	- 5	- 5	- 5	- 5	- 5	- 5	- 5	- 5	- 5	- 5	- 5	- 5	- 5	- 5
4	- 4	- 3	- 2	- 1	0	1	2	3	4	5	6	7	8	9
5	- 3	- 1	1	3	5	7	9	11	13	15	17	19	21	23
6	- 2	1	4	7	10	13	16	19	22	25	28	31	34	37
7	- 1	3	7	11	15	19	23	27	31	35	39	43	47	51
8	0	5	10	15	20	25	30	35	40	45	50	55	60	65
9	1	7	13	19	25	31	37	43	49	55	61	67	73	79
10	2	9	16	23	30	37	44	51	58	65	72	79	86	93
11	3	11	19	27	35	43	51	59	67	75	83	91	99	107
12	4	13	21	31	40	49	58	67	76	85	94	103	112	121
13	5	15	25	35	45	55	65	75	85	95	105	110	115	120
14	6	17	28	39	50	61	72	83	94	105	116	127	138	149
15	7	19	31	43	55	67	79	91	103	115	127	139	151	163

PPC Calculator Journal, V6 N6 P32, gives the following formulas for calculating the bytes saved by using subroutines.

For subroutines executed directly:

Bytes Saved = R C - [(R + 2) + 3C]   where R = number of bytes in sequence
C = number of times sequence is used

For subroutines executed indirectly:

Bytes Saved = R C - [(R + 2) + 2C + 7]

Barcode Types

1	Program, unprivate
2	Program, private
4	Direct Execution
5	Paper Keyboard
6	Numeric Data
7	ALPHA replace data
8	ALPHA append data
9	Numeric sequenced data
10	ALPHA replace sequenced data
11	ALPHA append sequenced data
0, 3	unused

41C, Bugs 1 - 9

Bug 1. Early machines did not save LASTX when executing + and -. To remedy this, insert STO L prior to ≤ instructions.

2. Early machines had an indirect addressing bug that permitted addressing registers in program memory. This Bug can be used to address data registers in Extended Memory or to store Stopwatch splits in Extended Memory. Arguments from 999 to 704 correspond to main memory registers 25 to 319.

3. Early machines were capable of indirectly addressing all 56 Flags. The classic test for this bug is: 49 SF IND X. If the BAT annunciator lights, the machine has Bug 3.

4. Many machines cannot correctly compute the SIN of very small angles. (5.729577951 E-99)

5. Incomplete CLP if an 82143A Printer is plugged in and turned on. Use DEL(ete).

Mode	Maximum no. lines cleared
NORM or TRACE	233
MAN	1089
No Printer	1089

6. Improper digit termination when translating HP67/97 programs. For example: EEX, CHS, 7, CHS, 5, CHS translates as E-7-5- on one line.

7. Fragmented 7 character Alpha strings can be stored in X with this Bug. Errors in comparing Alpha strings result.

8. Programs do not compile if turned off in PRGM mode. Editing a program and turning the 41C off in PRGM mode leaves the XEQ and GTO instructions compiled as they were prior to editing.

9. A highly useful Bug found on all 41Cs. Deleting lines when CATALOG 1 is stopped in PRGM mode allows jumping directly into the I/O buffer. See References PPC CJ, V7 N9 P25.

Keying 41C Synthetic Instructions

Reprinted from P P C Calculator Journal, V8 N6 p79.**

Instructions not normally keyable are called synthetic instructions (discovered and documented by PPC Members and "supported" by PPC**). The creation and use of synthetic instructions is called synthetic programming, SP, and is not supported by Hewlett-Packard. Do not call or write HP for information on SP. SP will not harm your HP-41C or HP-41CV in any way -- Except for an occasional MEMORY LOST that is experienced by every SP beginner. Examples of synthetic instructions are shown below.

	DISPLAY	PRINTER	REMARKS
01	DSE M	01 DSE [	These six of the 16 status
02	ISG N	02 ISG \	registers from row 7 of the
03	VIEW O	03 VIEW]	HEX table print differently
04	X<>P	04 X<> ↑	than they display. See
05	RCL Q	05 RCL _	Reference 2.
06	STO |-	06 STO ┬	
07	TONE Z	07 TONE Z	One of 128 synthetic tones.
08	RCL F	08 RCL F	Direct RCL of register 107.
09	LBL ^A	09♦LBL "A"	A Global label.
10	^"PPC"	10 ""PPC""	Quotes in text lines are easy.
11	^[illegible]	11 "ΓαΒ×"	Any 'special' character is possible.

12 E3	12 E3	Short form saves a byte.
13 ˆ	13 ""	PPC NOP, TEXT Ø.

Many methods have been developed to create the instructions illustrated above. The PPC ROM, Byte Jumping, Key Assignment Cards, and HP67/97 Cards have been used by SP'ers. The method described below uses a synthetic key assignment which may be "created" on any HP-41C or HP-41CV using PPC classified BUG 9 as follows. Do exactly as described.

1. Master Clear to obtain MEMORY LOST.
2. ASN "+" to the LN Key.
3. ASN "DEL" to the LOG Key.
4. Switch to USER mode.
5. Switch to PRGM and do the following.

LBL ˆT	
CAT 1	R/S immediately with LBL ˆT in display.
DEL 001	Press LOG, +.
BST	Be patient.
GTO .005	Use LN for 005, see LBL 03.
DEL 003	Press LOG SQRT, see STO 01.
"?AAAAAA"	In ALPHA, see ?A¯¯¯¯¯.

6. Switch out of PRGM mode. GTO . .

If you followed the above procedure correctly you have assigned the Byte Grabber, BG, to the LN key. Press and hold until NULL and confirm the XROM 28,63. Record on a status card if you wish.

Pressing the BG Key causes the HP-41 to open a register of seven bytes in program memory and insert a test 7 character string. The 7 character text line of a NULL, question mark, and five more NULL's (displayed as overscore), however needs 8 bytes because of the leading TEXT 7 byte. The result is the grabbing of the next byte in program memory. This process brings the grabbed byte into the text line and leaves the following bytes to fend for themselves. We will use this process to "create" new instructions. Whenever BG appears in the instructions press the LN key. This will always add a seven byte text line in memory which is usually deleted when you are finished.

The table on the back*of this brief description is the HP-41 HEX table. The decimal byte number is in the lower left corner. Each row and column has a Hexadecimal notation of 0 thru F. The first line of each box is the basic or prefix instruction. The second line shows the ASCII (ALPHA display) representation on the right and the argument or postfix on the left. The lower right character is the printer representation of the byte. The table is in two parts. The printer does not print characters in the lower half of the table. The display is defined for only 83 characters, all others are boxed stars.

Let's make the instructions shown above. For convenience ASN PACK to the LOG key, and BST to the TAN key. Do not BG at the step immediately preceding an END. We will use RCL as the byte to grab. Precede all instructions with an ENTER and BST to the ENTER before you BG. Delete unneeded text line.

As a preliminary exercise to better understand Synthetic instruction generation by Byte Grabbing, key the following: 01 ENTER, 02 * . BST to line 01 and press the LN key (in USER Mode) to BG. Line 02 is now composed of the text Byte (247) followed by 7 ASCII characters, a NULL, Question Mark, four NULLS and a letter B. Observe that the * is gone! Look at HEX 42, decimal 66 in the table on the back of this sheet.* The BG absorbed the * and displayed this byte as its ASCII character. BST to ENTER and BG the newly created line. The ? becomes STO 15, the NULLs invisible, and the "B" is now * again. The new text line has a boxed star as the last character. This is the Text 7 byte created by the first BG. Delete these lines, PACK, and try the following.

*See HEX TABLE on page .

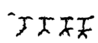
**Personal Programming Center. For free Special Issue of PPC's Calculator Journal, send 9" x 12" self-addressed envelope with 2 oz. first class postage attached to: 2545 W. Camden Place, Santa Ana, CA 92704.

```
DSE M      Bytes 151 and 117
           ENTER
           RCL IND 23
           RDN        BG at ENTER

ISG N      Bytes 150 and 118
           ENTER
           RCL IND 22
           LASTX      BG at ENTER

VIEW O     Bytes 152 and 119
           ENTER
           RCL IND 24
           CLX        BG at ENTER

X<>P       Bytes 206 and 120
           ENTER
           RCL IND 78
           X=Y?       BG at ENTER

RCL Q      Bytes 144 and 121
           ENTER
           RCL IND 16
           X≠Y?       BG at ENTER

STO |-     Bytes 145 and 122
           ENTER
           RCL IND 17
           SIGN       BG at ENTER

TONE Z     Bytes 159 and 113
           ENTER
           RCL IND 31
           X   Y      BG at ENTER

RCL F      Bytes 144 and 107
           ENTER
           RCL IND 16
           R-D        BG at ENTER

LBL ^A     Bytes 192, 0, 242, 0, 65
           ENTER
           RCL IND 66
           ENTER
           "ZA"       BG at ENTER
```

Note: The "A" may also be period, comma, semicolon, etc.

```
^"PPC"     Bytes 245, 34, 80, 80, 67, 34
           01  ENTER
           02  ^XPPCX  (X's used for ")
```

BG at ENTER, ASCII characters now individual instructions. Line 03 and 07 are E/X-1. Delete and replace with RCL 02. BST to ENTER, BG. Delete text line and STO 15. See modified text line using "special" character quotes.



```
           Bytes 244, 6, 4, 5, 1
           01  ENTER
           02  ^ABCD   (any four alpha characters)
```

BG at ENTER. Delete four following instructions. Insert LBL 05, LBL 03, LBL 04, LBL 00. BG at ENTER. Delete text line and STO 15. LINE 02 is four "Hangman characters".

```
E3         Bytes 27, 19
           ENTER
           1 EEX 3     PACK, BG at ENTER.
```

Note: A NULL precedes numeric entries. PACK will remove the NULL provided the previous instruction is not a numeric entry. The BG will only grab the null if you do not PACK.

```
^          Byte 240
           ENTER
           RCL IND T   BG at ENTER
```

This brief note described simple procedures for recognizing typical synthetic instructions in program listings and how they may be synthesized in memory using the synthetic key assignment called the F7 Byte Jumper, Prefix Masker, or Byte Grabber. No attempt was made to explain the functions themselves. See references below for additional information. Synthetic Programming is here to stay, and effective 1 January 1982 HP's User Library will accept programs containing synthetic instructions.

-- Richard Nelson

R E F E R E N C E S

1. PPC is a non-profit California Corporation dedicated to 'Personal' Computing. Personal means the computer is with the user, the user does not go to the computer. See footnote **.

2. SYNTHETIC PROGRAMMING ON THE HP-41C, soft bound, 92 pages. $11 Postpaid. Larken Publications, 4517 N.W. Queens Ave., Corvallis, OR 97330.

3. CALCULATOR TIPS AND ROUTINES ESPECIALLY FOR THE HP41C/41CV, soft bound, 130 pages. $15 Postpaid. Corvallis Software, Inc. P.O. Box 1412, Corvallis, OR 97339.

4. ALL Calculator Books (some software) -- EduCALC Mail Store. Send for free catalog, a must have "reference". 27963 Cabot Road, South Laguna, CA 92677.

SYNTHETIC KEY ASSIGNMENTS

The Synthetic Key Assignment program on page 72 provides an easy way to place non-standard codes and functions in program memory. Unlike the PASN function in the XFUNCTION Module, "KA" is not limited to single byte functions. Such functions as STO IND 31 or TONE 8, FIX 2, RCL IND X and RCL b may be assigned to a single key. The first person to write a key assignment program was John McGechie of the PPC Melbourne, Australia Chapter. Programs with various options and conveniences such as PACKing the key assignment registers appear in the PPC ROM and in William Wickes "Synthetic Programming on the HP-41C". This version, the shortest known, was revised by Paul Lind of Seattle, Washington and is based on a program called "Economy Key Assignments Program" by Geoff Smith, a member of the Melbourne Chapter.

Instructions: xeq "KA" "ASN 2 KEYS"

Assign any functions to the key locations where the synthetic or multi-byte instructions will eventually reside, for example LN. When these keys are assigned, R/S.

"KEY"

Here a reference to the "HEX Table" on page 64 is necessary. Look up the prefix - first part of the function in the table, for example, TONE. TONE appears on line 9, column F and has the decimal number 159 at the bottom of its box. 159 is the Prefix. The second byte, or argument such as 9 - as in TONE 9 - is the Postfix. Finally, the keycode must be input. If the "substitute" function was assigned to the shifted [G] key (%), the keycode will be - 22 . This represents the second key on the second row, shifted. Therefore, to assign TONE 9 to the prepared key, input: 159 ENTER 9 ENTER -22 R/S.

In a similar fashion, RCL has a Prefix of 144; SF has a Prefix of 168 and so on. The multi-byte instructions will generally be found in the lower half of the table.

To assign a synthetic instruction such as RCL b, input 144 as the Prefix and find the Postfix for "b" on the 7th row (MEAN, b, 124 appears in the box). Input: 144 ENTER 124 ENTER keycode R/S.

This program requires keys to be assigned in pairs. If only one key is needed, simply assign it twice and delete the unneeded assignment when the process is complete.

Try: 159 ENTER 26 - TONE 26 and execute it in RUN mode to hear a 5-second tone.

Assign the eGØBEEP function (see page 75) with the inputs: 4 ENTER 167 ENTER keycode.

Here are some common Prefixes:

RCL	144
STO	145
ISG	150
DSE	151
VIEW	153
FIX	156
SF	168
TONE	159
X<>	206

```
LBL"KA
END
167 BYTES
```

NO FRILLS SYNTHETIC KEY ASSIGNMENT PROGRAM

BY PAUL LIND

```
01♦LBL "KA"
02♦LBL 01
03 "ASN 2 K
      EYS"
04 PROMPT
 05 ""                 240
06 XEQ 02
07 XEQ 02
08 X<> [   (M)     206, 117
09 RCL c           144, 125
10 X<>Y
11 "×iμ♦ "         244, 1, 105, 12, 0
12 ASTO c          145, 125
13 STO 00
14 RDN
15 STO c           145, 125
16 CLST
17 GTO 01

18♦LBL 02
19 ASTO L
20 "KEY"
21 PROMPT
22 CLA
23 ARCL L
24 X<> Z
25 XEQ 04
26 XEQ 04
27  E1     (10)    27, 17
28 ST/ Y
29 X<>Y
30 STO ]   (0)     145, 119
31 ABS
32 INT
33 LASTX
34 FRC
35 .1
36 -
37 ST* Z
38 X=0?
39 GTO 03
40 RDN
41 4
42 X=Y?
43 ISG Z

44♦LBL 03
45 RDN
46 X<>Y
47 16
48 *
49 +
50 0
51 X<> ]   (0)     206, 119
52 SIGN
53 8
54 *
55 X>0?
56 CLX
57 -

58♦LBL 04
59 INT
60 X=0?
61 "⊢♦♦♦♦"              245, 127, 0,
62 OCT                      0, 0, 0
63  E3       (1 E3)    27, 19
64 /
65 10
66 +
67 X<> d               206, 126
68 FS?C 19
69 SF 20
70 FS?C 18
71 SF 19
72 FS?C 17
73 SF 18
74 FS?C 15
75 SF 17
76 FS?C 14
77 SF 16
78 CF 07
79 SF 03
80 X<> d               206, 126
81 ARCL X
82 "⊢***"
83 0
84 X<> \         (N)  206, 118
85 STO [         (M)  145, 117
86 RDN
87 RDN
88 END
```

ROW 1 (01 : 03)

ROW 2 (01 : 03) con't

ROW 3 (04 : 07)

ROW 4 (08 : 11)

ROW 5 (12 : 16)

ROW 6 (17 : 20)

ROW 7 (21 : 25)

ROW 8 (26 : 30)

ROW 9 (31 : 37)

ROW 10 (38 : 43)

ROW 11 (44 : 51)

ROW 12 (52 : 59)

ROW 13 (60 : 63)

ROW 14 (64 : 68)

ROW 15 (69 : 73)

ROW 16 (74 : 77)

ROW 17 (78 : 82)

ROW 18 (83 : 85)

ROW 19 (86 : 88)

THE eGØBEEP KEY ASSIGNMENT

Using the Synthetic Key Assignment program (pages 71 - 74) the "eGØBEEP" function may be assigned to the keyboard. The inputs to "KA" or any similar key assignment program such as "MK" (in the PPC ROM) are: 4 ENTER 167 ENTER (keycode). Although the function name appears odd, it serves a highly useful function. All Printer functions for both the 82143A and HP-IL Printers may be entered into program memory whether or not a printer is attached. PRP does not work properly and LIST automatically lists 71 lines but all other functions operate normally. Assignment of this key eliminates the need for assigning Printer functions to the keyboard.

A further bonus is that all HP-IL functions may be entered or executed from the keyboard by "eGØBEEP". The numbers to fill the prompt: eGØBEEP _ _ are given at the left. They correspond to the XROM numbers for Mass Storage and Control functions and to XROM numbers + 64 for Printer functions. The numbers most frequently used are quickly memorized or looked up on a chart. For convenience, the reproduction below may be used for a Xerox master to make a quick reference card.

-PRINTER-		READR	08
ACA	65	READRX	09
ACCHR	66	READS	10
ACCOL	67	READSUB	11
ACSPEC	68	RENAME	12
ACX	69	SEC	13
BLDSPEC	70	SEEKR	14
LIST	71	UNSEC	15
PRA	72	VERIFY	16
'PRAXIS	73	WRTA	17
PRBUF	74	WRTK	18
PRFLAGS	75	WRTP	19
PRKEYS	76	WRTPV	20
PRP	77	WRTR	21
'PRPLOT	78	WRTRX	22
'PRPLOTP	79	WRTS	23
PRREG	80	ZERO	24
PRREGX	81		
PRΣ	82		
PRSTK	83	-CTL FNS-	
PRX	84	AUTOIO	27
REGPLOT	85	FINDID	28
SKPCHR	86	INA	29
SKPCOL	87	IND	30
STKPLOT	88	INSTAT	31
FMT	89	LISTEN	32
		LOCAL	33
-MASS ST-		MANIO	34
CREATE	01	OUTA	35
DIR	02	PWRDN	36
NEWM		PWRUP	37
PURGE	04	REMOTE	38
READA	05	SELECT	39
READK	06	STOPIO	40
READP	07	TRIGGER	41

eGØBEEP quick
reference card
Xerox master ---->

-PRINTER-		READR	08
ACA	65	READRX	09
ACCHR	66	READS	10
ACCOL	67	READSUB	11
ACSPEC	68	RENAME	12
ACX	69	SEC	13
BLDSPEC	70	SEEKR	14
LIST	71	UNSEC	15
PRA	72	VERIFY	16
'PRAXIS	73	WRTA	17
PRBUF	74	WRTK	18
PRFLAGS	75	WRTP	19
PRKEYS	76	WRTPV	20
PRP	77	WRTR	21
'PRPLOT	78	WRTRX	22
'PRPLOTP	79	WRTS	23
PRREG	80	ZERO	24
PRREGX	81		
PRΣ	82		
PRSTK	83	-CTL FNS-	
PRX	84	AUTOIO	27
REGPLOT	85	FINDID	28
SKPCHR	86	INA	29
SKPCOL	87	IND	30
STKPLOT	88	INSTAT	31
FMT	89	LISTEN	32
		LOCAL	33
-MASS ST-		MANIO	34
CREATE	01	OUTA	35
DIR	02	PWRDN	36
NEWM		PWRUP	37
PURGE	04	REMOTE	38
READA	05	SELECT	39
READK	06	STOPIO	40
READP	07	TRIGGER	41

SYNTHETIC TONES

One of the remarkable features of 41C calculators that is not documented by HP is their ability to generate a wide variety of tones with durations as short as .02 seconds and as long as 5 seconds. Here is a program by Robert Swanson, a Physiologist at the Oregon Health Sciences University, that enables you to sample these tones in various combinations and to time them. The program uses a subroutine from the PPC ROM* called DC** by Roger Hill of Southern Illinois University, shown here as a Global subroutine and reproduced with his permission.

"TNe" TONES 0 - 127. TNe is a subroutine which will write a "miniprogram" consisting of: TONE n, TONE m, STO b. The miniprogram is stored in the T register and the absolute address of byte 6 of the T register is left in Alpha at the return to the main program. TNe expects: 1) decimal tone numbers in X and Y, 2) Flag 14 to be set if 2 tones are wanted, clear if only 1 tone is wanted, 3) Alpha register cleared. Line 70 appends a TONE instruction followed by line 71 which calls DC (Decimal to Character) which appends the character which corresponds to the first tone and leaves the original Y in X at its return. Line 72 checks to see if a second tone is wanted and then appends the instruction STO b prior to ASTO'ing in the T register. Finally, the absolute address of byte 6 of T is left in Alpha for later execution by the main program by an instruction such as X<>b.

APPLICATION PROGRAM 1, "T2". Measure the duration of a tone (decimal 0 - 127).

Instructions: In USER mode, press key [B]. At the prompt "A ↑ CYCLES", input the tone number, ENTER, input the number of cycles you wish to time (2 identical tones per cycle). R/S. Let the program run to the next STOP, line 28, with the decimal tone number in X. Simultaneously start the stopwatch and press R/S. At the next tone, TONE 8, stop the stopwatch. Record the elapsed time and the number of tones -- 2 times the number of cycles. Repeat as often as desired by pressing R/S. To measure the tare, key in any tone number and at least 50 cycles. At the first STOP, CF 26, start the stopwatch when R/S is pressed and stop the timing when the tone number reappears in the display. The tone duration is calculated as $t - t_0$, t is the gross execution time per tone when Flag 26 is set, and t_0 is the tare per tone with Flag 26 clear, approximately 0.098/tone. If you wish to compare your measured values with those in the literature, add 0.015 seconds, i.e., the execution time of a single tone when Flag 26 is clear.

APPLICATION PROGRAM 2, "T4". Listen to a sequence of 4 tones.

This program is designed to find out how a sequence of 4 tones will sound. Once you have found the combination you want for a particular program, they may be created as program lines using synthetic programming techniques***.

Instructions: In USER mode, press key [D]. At the first prompt, "a ↑ b", input the decimal number of your first tone (a), ENTER, then input the decimal number of your second tone (b). If both tones are identical, R/S immediately after the ENTER. Do not omit the ENTER when a = b. At the second prompt, "c ↑ d", input the third (c) and fourth (d) tones, R/S. The program will stop with the digit 5 in the display. If you press R/S without an entry, a sequence of 4 tones will be executed 5 times. If you want to hear it fewer or more times, input that value, but only when the "5" appears the first time. Press R/S to repeat the same sequence.

Example: You want to have a "cuckoo" and a "chirp, chirp" effect in your program. By trial and error (and the help of the graph of tone execution times), you test the sequence: a = 24, b = 39, c = 89, d = 57. Note some other interesting combinations: 100, 87, 80, 70; 32, 37, 38, 89.

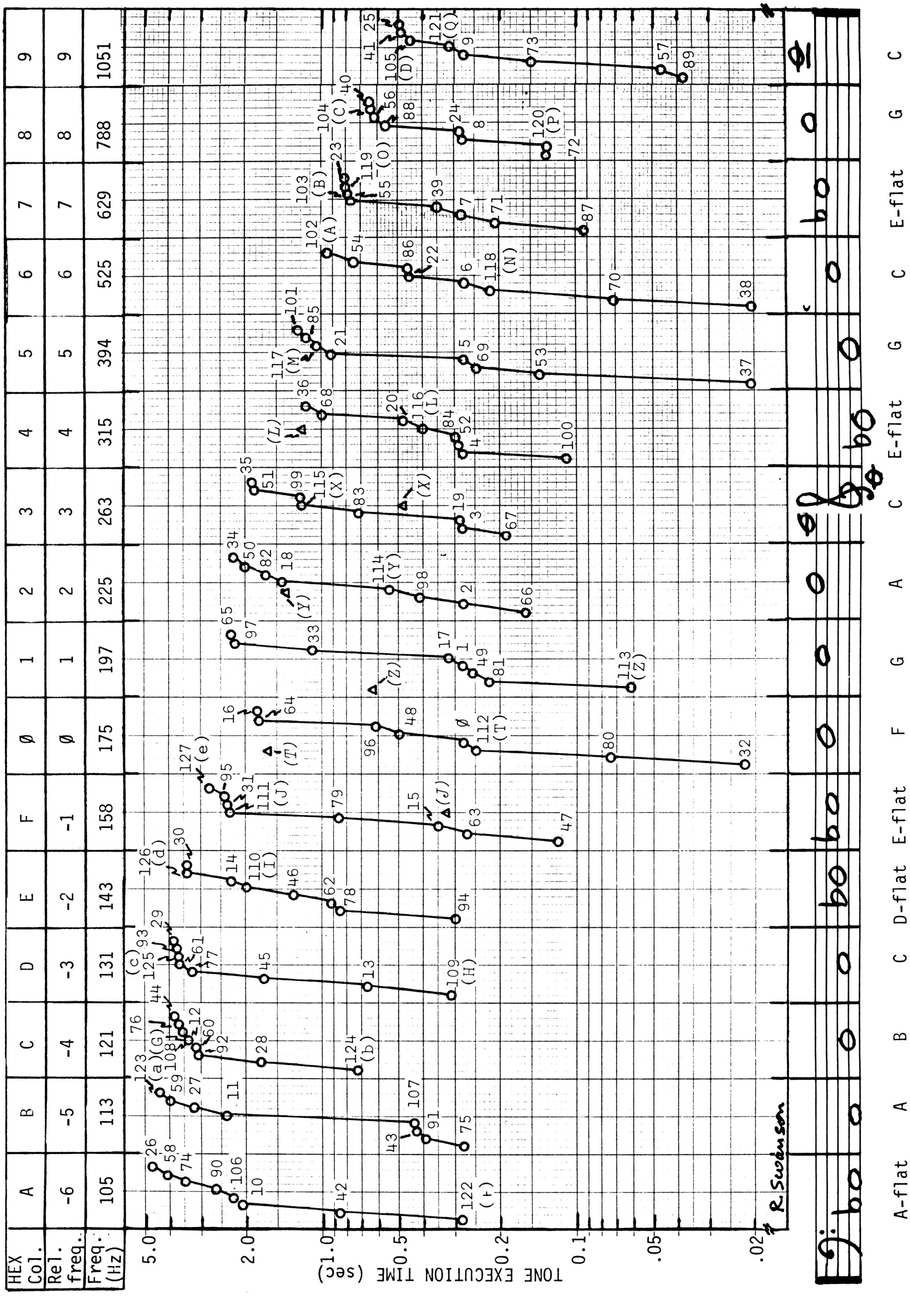
-- Robert Swanson

NOTE: The program listing on page 78 is annotated with the decimal byte numbers of the synthetic lines. They may be entered in a program with the aid of the "Byte Grabber", described on pages 67 - 69, by key assignments using the "KA" program on page 71 or by the "LB" program in the PPC ROM. Of course, there is also barcode, see pages 79 - 81.

* The PPC ROM was programmed as a special project by PPC, Personal Programming Ctr.. Its members worldwide financed its development, design and documentation. The ROM is now available to the public and is accompanied by a 500 pp. manual. For information about this exceptional Application Module, write PPC, 2545 W. Camden Place, Santa Ana, CA 92704, U.S.A. PPC is a non-profit Corporation.

** See page 14 for definition. See Reference #1 for the background of this programming technique.

*** Synthetic programming techniques are described throughout this book. An understanding of these techniques is not necessary for those who wish to begin using them. Synthetic tone routines have been used for control applications, Morse Code and music including Star Wars, Mozart, Bach Toccata and Fugue and Close Encounters!



HEX Col.
A B C D E F Ø 1 2 3 4 5 6 7 8 9
Rel. freq.
-6 -5 -4 -3 -2 -1 Ø 1 2 3 4 5 6 7 8 9
Freq. (Hz)
105 113 121 131 143 158 175 197 225 263 315 394 525 629 788 1051
TONE EXECUTION TIME (sec)
5.0 2.0 1.0 0.5 0.2 0.1 .05 .02
A-flat A B C D-flat E-flat F G A C E-flat G C E-flat G C
R Swanson

HP-41C/CV TONE TABLE: Execution Times and XROM Numbers*

	Ø	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Ø	Ø 0.28 60,00	1 0.28 60,01	2 0.28 60,02	3 0.28 60,03	4 0.28 60,04	5 0.28 60,05	6 0.28 60,06	7 0.28 60,07	8 0.27 60,08	9 0.27 60,09	10 2.08 60,10	11 2.42 60,11	12 3.37 60,12	13 0.67 0.80 60,13	14 2.30 60,14	15 0.35 60,15
1	16 1.82 60,16	17 0.32 60,17	18 1.43 60,18	19 0.29 60,19	20 0.48 60,20	21 0.94 60,21	22 0.45 60,22	23 0.82 60,23	24 0.29 60,24	25 0.49 60,25	26 4.70 60,26	27 3.23 60,27	28 1.75 60,28	29 3.85 60,29	30 3.46 60,30	31 2.37 60,31
2	32 .022 60,32	33 1.10 60,33	34 2.25 60,34	35 1.90 60,35	36 1.17 60,36	37 .020 60,37	38 .020 60,38	39 0.35 60,39	40 0.65 60,40	41 0.49 60,41	42 0.83 60,42	43 0.43 60,43	44 3.80 60,44	45 1.71 60,45	46 1.29 60,46	47 0.12 60,47
3	48 0.50 60,48	49 0.26 60,49	50 2.04 60,50	51 1.85 60,51	52 0.29 60,52	53 0.14 60,53	54 0.75 60,54	55 0.77 60,55	56 0.62 60,56	57 .046 60,57	58 4.07 60,58	59 3.99 0.41 60,59	60 3.19 60,60	61 3.77 0.39 60,61	62 0.93 60,62	63 0.27 60,63
4	64 1.79 61,00	65 2.29 61,01	66 0.16 0.40 61,02	67 0.19 61,03	68 1.01 61,04	69 0.25 61,05	70 .072 .032 61,06	71 0.21 61,07	72 0.13 61,08	73 0.15 61,09	74 3.58 61,10	75 0.28 61,11	76 3.60 61,12	77 3.30 61,13	78 0.85 61,14	79 0.87 61,15
5	80 .075 61,16	81 0.22 61,17	82 1.68 61,18	83 0.72 61,19	84 0.30 61,20	85 1.16 61,21	86 0.46 61,22	87 .093 61,23	88 0.56 61,24	89 .038 61,25	90 2.61 61,26	91 0.39 61,27	92 3.12 61,28	93 3.78 61,29	94 0.30 61,30	95 2.45 61,31
6	96 0.62 61,32	97 2.21 61,33	98 0.41 61,34	99 1.21 61,35	100 0.11 61,36	101 1.27 61,37	102 A 0.96 61,38	103 B 0.80 61,39	104 C 0.64 61,40	105 D 0.45 61,41	106 E 2.26 0.23 61,42	107 F 0.43 61,43	108 G 3.54 61,44	109 H 0.31 61,45	110 I 2.00 61,46	111 J 2.33 *0.33* 61,47
7	112 T 0.25 *1.66* 61,48	113 Z .061 *0.64* 61,49	114 Y 0.55 *1.40* 61,50	115 X 1.19 *0.48* 61,51	116 L 0.40 *1.20* 61,52	117 M 1.07 [61,53	118 N 0.22 \\ 61,54	119 O 0.78] 61,55	120 P 0.13 ↑ 61,56	121 Q 0.32 _ 61,57	122 ⊦ 0.29 ⊤ 61,58	123 a 4.38 61,59	124 b 0.73 61,60	125 c 3.77 61,61	126 d 3.45 61,62	127 e 2.84 61,63

*KEY. Within each box: Row 1, LEFT: Decimal tone number; RIGHT: Tone shown in display if other than the least significant digit (Tones 102 - 127). Row 2, LEFT: Execution time (sec), HP-41 ROM revision 0:D 1:F 2:F (actual tone duration is about 15 msec less); RIGHT: Printed tone when different from that of the display. Row 3, Tones 111 - 116 (italics): Times for a previous ROM revision; Tones 13, 59, 61, 66, 70, 106 (small type): Times from PPC ROM User's Manual, page 437, which differed by more than 20% of the above values. Row 4: XROM numbers.

Programs to encode, test and time synthetic tones:

```
LBL T2
LBL T4
LBL TNe
END
161 BYTES

01♦LBL "T2"
02♦LBL B
03 "a ↑ CYC
        LES"
04 PROMPT
05 SF 14
06 X<>Y
07 ENTER↑
08 CLA
09 XEQ 14
10 STO Z
11 RDN
12 CLX
13 LASTX
14 256
15 -
16 SIGN
17 R↑

18♦LBL 01
19 ASTO X
20 X<> b     206, 124
21 DSE Y
22 GTO 01
23 TONE 8
24 RDN
25 X<>Y
26 STO Y
27 LASTX
28 STOP
29 GTO 01
30♦LBL "T4"
31♦LBL D
32 "a ↑ b"
33 XEQ 04
34 R↑
35 "c ↑ d"
36 XEQ 04
37 R↑
38 5
39 CF 22
40 STOP
41 FC?C 22
42 ENTER↑
43 X≠Y?
44 STO Y
45 SIGN

46♦LBL 02
47 SF 14

48♦LBL 03
49 ASTO X
50 X<> b     206, 124
51 X<>Y
52 R↑
53 STO Z
54 FS?C 14
55 GTO 03
56 DSE L
57 GTO 02
58 X<>Y
59 STO Y
60 STOP
61 SIGN
62 GTO 02

63♦LBL 04
64 PROMPT
65 X<>Y
66 SF 14
67 CLA

68♦LBL "TNe
           "
69♦LBL 14
 70 "⊢"      242, 127, 159
71 XEQ "DC"
72 FS?C 14
73 GTO 14
 74 "⊢∡"     243, 127, 145, 124
75 ASTO T
76 "ᵀ♦"      242, 96, 0
77 END
```

Robert Swanson

```
LBL DC
END
68 BYTES

01♦LBL "DC"
02 INT
03 256
04 MOD
05 LASTX
06 +
07 OCT
08 X<> d     206,126
09 FS?C 11
10 SF 12
11 FS?C 10
12 SF 11
13 FS?C 09
14 SF 10
15 FS? 07
16 SF 09
17 FS? 06
18 SF 08
19 X<> d     206, 126
20 X<> [     206, 117
21 RCL \     144, 118
22 "⊢*"
23 X<> ]     206, 119
24 X<>Y
25 STO \     145, 118
26 X<> ↑     206, 120
27 "⊢*"
28 STO ↑     145, 120
29 RDN
30 X<> ]     206, 119
31 X<> \     206, 118
32 STO [     145, 117
33 RDN
34 END
```

Roger Hill

"T2", "T4", "TNe" BY ROBERT SWANSON

ROW 1 (01 : 03)

ROW 2 (01 : 03) con't.

ROW 3 (04 : 09)

ROW 4 (10 : 14)

ROW 5 (15 : 21)

ROW 6 (22 : 26)

ROW 7 (27 : 30)

ROW 8 (31 : 32)

ROW 9 (33 : 35)

ROW 10 (36 : 40)

ROW 11 (41 : 47)

ROW 12 (48 : 53)

ROW 13 (54 : 57)

ROW 14 (58 : 64)

ROW 15 (65 : 68)

ROW 16 (69 : 71)

ROW 17 (72 : 74)

ROW 18 (75 : 77)

"DC" DECIMAL TO CHARACTER BY ROGER HILL

ROW 1 (01 : 03)

ROW 2 (04 : 09)

ROW 3 (10 : 14)

ROW 4 (15 : 18)

ROW 5 (19 : 22)

ROW 6 (23 : 27)

ROW 7 (28 : 32)

ROW 8 (33 : 34)

XROM LIST, 1 - 10

XROM 01, MATH 1B

MATRIX	01
SIMEQ	02
VCOL	03
VMAT	04
PVT	05
DET	06
INV	07
EDIT	08
SOLVE	09
SOL	10
POLY	11
ROOTS	12
INTG	13
DIFEQ	14
FOUR	15
C+	16
C-	17
C*	18
C/	19
MAGZ	20
CINV	21
Z↑N	22
Z↑1/N	23
e↑Z	24
LNZ	25
a↑Z	26
LOGZ	27
Z↑W	28
Z↑1/W	29
SINZ	30
COSZ	31
TANZ	32
SINH	33
COSH	34
TANH	35
ASINH	36
ACOSH	37
ATANH	38
SSS	39
ASA	40
SAA	41
SAS	42
SSA	43
TRANS	44
*FN	45

XROM 02, STAT 1B

ΣBSTAT	01
ΣBSTG	02
*BE	03
ΣMMTUG	04
ΣMMTGD	05
*MT	06
*MD	07
ΣAOVONE	08
ΣAOVTWO	09
ΣANOCOV	10
ΣLIN	11
ΣEXP	12
ΣLOG	13
ΣPOW	14
ΣPOLYP	15
ΣPOLYC	16
ΣMLRXY	17
ΣMLRXYZ	18
ΣPTST	19
ΣTSTAT	20
ΣXSQEV	21
ΣEEFXSQ	22
ΣCTKK	23
ΣCTKKK	24
ΣSPEAR	25
ΣNORMD	26
ΣCHISQD	27
*a	28
*b	29

XROM 03, SURVEY 1B

TRAV	01
COMP	02
TRANSIT	03
ADJUST	04
INTER	05
CURVE	06
HORIZ	07
VERT	08
RESECT	09
PREAREA	10
ENDVOL	11
PIT	12
COORD	13
ACRES	14
AZ	15
BRG	16
CIR	17
INVERSE	18
NE	19
TS	20
*AO	21
*∡	22
*BR	23
*DL	24
*DS	25
*EL	26
*H	27
*S	28
*A1	29
*B1	30
*IN	31
*YN	32

XROM 04, FINANCE 1C

MONEY	01
IRR	02
MIRR	03
NPV	04
AMORT	05
SL	06
DB	07
SOYD	08
BOND	09
DAYS	10
*N	11
*I	12
*PV	13
*PMT	14
*FV	15
*IRR	16
*MIRR	17
*NPV	18
*AMORT	19
*SL	20
*DB	21
*SOYD	22
*PRC	23
*YLD	24
*DAYS	25
*BGN	26
*SIZE	27
*DATA	28
*DATA1	29
*OUT	30
*TGL	31
*TGL1	32
*Y/N	33
$ENG	34

XROM 06, CIR ANL 1A

GNAP	01
*J	02
PHASE	03
H<F>dB	04
H<F>	05
GM=	06
R=	07
L=	08
C=	09
LNAP	10
RS	11
RP	12
CS	13
CP	14
LS	15
LP	16
TF	17
GY	18
LCS	19
LCP	20
LINE	21
STUBO	22
STUBS	23
ICIS	24
VCIS	25
RS=	26
LS=	27
CS=	28
LCS=	29
LINE=	30
ICIS=	31
VCIS=	32
TF=	33
GY=	34
RP=	35
LP=	36
CP=	37
LCP=	38
STUBO=	39
STUBS=	40
PV	41
P∡V	42
PVdB	43
∡V2/V1	44
V2/1dB	45
V2/V1	46
PI	47
P∡I	48
PIdB	49
∡I2/I1	50
I2/1dB	51
I2/I1	52
PZIN	53
P∡ZIN	54
ZIN	55
∡ZIN	56
PP2/P1	57
P2/P1	58
ALL	59
*AN	60
MAT	61
C	62
*C+	63

XROM 07, STRCTA 1B

SECTION	01
SIMPLE	02
CANT	03
FIXED	04
PROPPED	05
SPAN	06
NSPAN	07
FIXL	08
FIXR	09
MOMENTS	10
SETTLE	11
CFRAME	12
VECTOR	13
SIZE?	14
SZ?	15
ATANY/X	16
BEAM	17
*B	18
*AI	19
*L1	20
*P1	21
*M1	22
*W1	23
*P	24
*M	25
*L	26
*W	27

XROM 19, STRCTB 1A

COLE	01
COLSI	02
TBEAM	03
RBEAM	04
CONCOL	05
ITCON	06
IRCON	07

XROM 08, STRESS 1B

SIMPLE	01
CANT	02
FIXED	03
PROPPED	04
SPAN	05
NSPAN	06
FIXL	07
FIXR	08
MOMENTS	09
COLUMN	10
SECTION	11
MOHR	12
DELTA	13
REC	14
SODER	15
VECTOR	16
SIZE?	17
ATANY/X	18
BEAM	19
*B	20
*AI	21
*L1	22
*L	23
*P1	24
*P	25
*M1	26
*M	27
*W1	28
*W	29
*ROS	30
*MO	31
*COL	32

XROM 09, HOME MN 1A

BUDGET	01
TRAVEL	02
STOCKS	03
FINANCE	04
BAL	05
IRA	06
INS	07
CHECK	08
HOME	09
BUY?	10
STORE	11
RELOAD	12
CL	13
*	14
*0	15
*e	16
N	17
*I	18
PV	19
PMT	20
FV	21
*J	22
*H	23

XROM 10, GAMES 1A

BAGELS	01
BIOR	02
BIOF	03
CRAPS	04
HANG	05
PINBALL	06
SWAR	07
SUBHUNT	08
BOOM	09
INI	10
P	11
SIZE?	12
RNDM	13
RNDMW	14

XROM LIST, 10 - 16

XROM 10,

C PPC 1981

▾MK	01
▾1K	02
▾+K	03
▾F?	04
▾LF	05
▾CK	06
▾VA	07
▾UD	08
▾PK	09
▾A?	10
▾DC	11
▾ML	12
▾RF	13
▾Σ?	14
▾S?	15
▾C?	16
▾DT	17
▾AD	18
▾XE	19
▾HD	20
▾ΣC	21
▾LB	22
▾L-	23
▾-B	24
▾XD	25
▾VM	26
▾EX	27
▾MT	28
▾DS	29
▾VS	30
▾EP	31
▾TN	32
▾CX	33
▾CU	34
▾CD	35
▾VK	36
▾AL	37
▾NC	38
▾SU	39
▾NH	40
▾HN	41
▾BL	42
▾FL	43
▾BI	44
▾IP	45
▾PS	46
▾T1	47
▾MS	48
▾IF	49
▾CB	50
▾RT	51
▾PD	52
▾DP	53
▾QR	54
▾2D	55
▾SX	56
▾RX	57
▾OM	58
▾PA	59
▾GE	60
▾Ab	61
▾E?	62
▾FI	63

XROM 11,

REAL EST 1B

▾$	01
▾N	02
▾*I	03
▾PV	04
▾PMT	05
▾FV	06
▾12*	07
▾12/	08
▾BEG/END	09
▾LIST	10
▾CLFIN	11
▾AMORT	12
▾NPV	13
▾IRR	14
▾MIRR	15
▾DEPR	16
▾IPA	17
▾GPMT	18
▾WRAP	19
▾SUMMARY	20
▾EQ	21
▾RENT	22
▾*N	23
▾I*	24
▾*PV	25
▾*PMT	26
▾*FV	27
▾*AMORT	28
▾*AMT	29
▾*SL	30
▾*SOYD	31
▾*DB	32
▾*NPV	33
▾*IRR	34
▾*MIRR	35
▾CALC	36
▾SALE	37
▾Y	38
▾R	39
▾CH	40
▾*EQ	41
▾*RT	42
▾OUT	43
▾SIZE?	44
START	45
CLK	46

XROM 12,

MACHINE 1A

▾CAM	01
▾HAR	02
▾CYC	03
▾PAR	04
▾DWELL	05
▾GEN4BAR	06
▾4BAR	07
▾CRANK	08
▾GEAR	09
▾SPUR	10
▾INV	11
▾SPRING	12
▾MOTION	13
▾COORD	14
▾POINTS	15
▾3POINTS	16
FCON	17
BCON	18
▾INI	19
▾*?	20
▾*IN	21
▾+360	22
▾*OUT	23
▾KEY	24

XROM 13,

THRML 1A

▾KWONG	01
▾IDEAL	02
▾POLYTRP	03
▾ISNFLOW	04
▾FLOW	05
▾FLOW2	06
▾H2O	07
▾Re	08
▾ENERGY	09
▾HEATEX	10
▾A0	11
▾E0	12
▾ACNT	13
▾ECNT	14
▾APAR	15
▾EPAR	16
▾APRC	17
▾EPRC	18
▾ACRS	19
▾ECRS	20
▾BLKBODY	21
▾EbL	22
▾UNIT?	23
▾SZ?	24
▾INPUT	25
▾OUTPUT	26
▾KEY	27
-SI	28
SI-	29

XROM 14,

NAVIG 1A

▾NA	01
▾*NA	02
▾STAR	03
▾*STAR	04
▾SUN	05
▾*SUN	06
▾*SUNL	07
▾*SUNU	08
▾MOON	09
▾*MOON	10
▾*MOONU	11
▾*MOONL	12
▾VENUS	13
▾*VENUS	14
▾P	15
▾MARS	16
▾*MARS	17
▾JUPITER	18
▾*JUPIT	19
▾SATURN	20
▾*SATUR	21
▾SRT	22
▾*SRT	23
▾JD	24
▾D+T	25
▾LBRYZX	26
▾ZYXdHA	27
▾DSPHAd	28
▾*IN	29
▾*IN1	30
▾*DMT	31
▾*DMS	32
▾*HR	33
▾*T	34
▾FA	35
▾GST	36
▾BODY	37
▾*BODY	38
▾SIGHT	39

XROM 14,
NAVIG Con't

▾RM	40
▾DR	41
▾*DR	42
▾GCPOS	43
▾*GCPOS	44
▾GC	45
▾*GC	46
▾GCPLAN	47
▾*GCPLAN	48
▾GCPLOT	49
▾*GCPLOT	50
▾DSPP2	51
▾LOTOL	52
▾*LOTOL	53
▾DSPL	54
▾DSPLO	55
▾RLPOS	56
▾*RLPOS	57
▾RL	58
▾*RL	59
▾*M/a	60

XROM 15,

PETROL 1B

▾Z	01
▾CG	02
▾CCG	03
▾BG	04
▾CBG	05
▾UG	06
▾CUG	07
▾TcPc	08
▾CTcPc	09
▾CCWA	10
▾PROP	11
▾W0	12
▾COMP	13
▾SOUR	14
▾IN	15
▾CGASG	16
▾CTPC	17
▾W1	18
▾CHV	19
▾CCK	20
▾W2	21
▾W3	22
▾CO	23
▾CCOb	24
▾CCO	25
▾CGS	26
▾W4	27
▾W5	28
▾BO	29
▾CBOb	30
▾CBO	31
▾CBT	32
▾UO	33
▾CUOd	34
▾CUOb	35
▾CUO	36
▾CW	37
▾CCW	38
▾BW	39
▾CBW	40
▾UW	41
▾CUW	42
▾CPSAT	43
▾CFR	44
▾CCFR	45
▾RS	46

XROM 16,

PETROL 1B

▾CRSb	01
▾PBP	02
▾CPBP	03
▾BT	04
▾CBTb	05
▾RSW	06
▾CRSW	07
▾CT	08
▾CCT	09
▾CCTb	10
▾TITLE	11
▾W6	12
▾Y/N?	13
▾ITcPc	14
▾STDTP	15
▾SEPTP	16
▾T	17
▾P	18
▾GASG	19
▾OILG	20
▾IRS	21
▾RSI	22
▾%NACL	23
▾%POR	24
▾W7	25
▾W8	26
▾W9	27
▾X0	28
▾X1	29
▾X2	30
▾X3	31
▾X4	32
▾X5	33
▾X6	34
▾X7	35
▾X8	36
▾OUTK	37
▾OUTU	38
▾OUT	39
▾INK	40
▾INU	41
CZ	42
CCR	43
CON	44
INCON	45

XROM LIST, 19 - 30

XROM 19, SECUR 1A

⊤BONDS	01
⊤STOCK	02
⊤CALL	03
⊤OPTION	04
⊤HEDGING	05
⊤BFLY	06
⊤BULL	07
⊤CSEC	08
⊤CBOND	09
⊤SPEC	10
⊤PRC	11
⊤YLD	12
⊤ATY	13
⊤ATP	14
JDAY	15
⊤BEP	16
⊤*BFLY	17
⊤DBEP	18
⊤UBEP	19
⊤CONV	20

Also see XROM 07
STRCTB 01 - 07

XROM 19, CLINLAB 1A

⊤BEERS	01
⊤BSA	02
⊤CREAT	03
⊤BLOOD	04
⊤O2SAT	05
⊤RCI	06
⊤TBV	07
⊤THY	08
⊤RADCORR	09
⊤RIA	10
⊤BSTAT	11
⊤CHI	12
⊤TSTAT	13
⊤TDIST	14
⊤*	15
⊤*0	16
⊤*1	17
⊤*2	18
⊤*3	19
⊤*4	20
⊤*5	21
⊤*6	22
⊤*7	23
⊤*8	24
⊤*9	25
⊤*A	26
⊤*C	27
⊤*CO	28
⊤*CR	29
⊤*CS	30
⊤*F	31
⊤*H	32
⊤*HG	33
⊤*IN	34
⊤*I125	35
⊤*I131	36
⊤*P	37
⊤*P≠	38
⊤*PR	39
⊤*R	40
⊤*SE	41
⊤*SR	42
⊤*TC	43
⊤*X	44
⊤*XE	45
⊤*YN	46

XROM 20, C PPC 1981

⊤SR	01
⊤Sb	02
⊤LR	03
⊤SD	04
⊤SK	05
⊤RD	06
⊤RK	07
⊤BV	08
⊤CV	09
⊤IG	10
⊤SV	11
⊤FD	12
⊤FR	13
⊤DF	14
⊤NP	15
⊤GN	16
⊤RN	17
⊤BD	18
⊤TB	19
⊤PM	20
⊤CM	21
⊤CJ	22
⊤JC	23
⊤CA	24
⊤LG	25
⊤HA	26
⊤HS	27
⊤CP	28
⊤MP	29
⊤HP	30
⊤BA	31
⊤M2	32
⊤M3	33
⊤M1	34
⊤BE	35
⊤M4	36
⊤M5	37
⊤IR	38
⊤DR	39
⊤BM	40
⊤BR	41
⊤BX	42
⊤BΣ	43
⊤BC	44
⊤UR	45
⊤PR	46
⊤S1	47
⊤S3	48
⊤S2	49
⊤NS	50
⊤NR	51
⊤PO	52
⊤Rb	53
⊤AM	54
⊤MA	55
⊤SM	56
⊤SE	57
⊤XL	58
⊤VF	59

XROM 25, -EXT FCN 1B

ALENG	01
ANUM	02
APPCHR	03
APPREC	04
ARCLREC	05
AROT	06
ATOX	07
CLFL	08
CLKEYS	09
CRFLAS	10
CRFLD	11
DELCHR	12
DELREC	13
EMDIR	14
FLSIZE	15
GETAS	16
GETKEY	17
GETP	18
GETR	19
GETREC	20
GETRX	21
GETSUB	22
GETX	23
INSCHR	24
INSREC	25
PASN	26
PCLPS	27
POSA	28
POSFL	29
PSIZE	30
PURFL	31
RCLFLAG	32
RCLPT	33
RCLPTA	34
REGMOVE	35
REGSWAP	36
SAVEAS	37
SAVEP	38
SAVER	39
SAVERX	40
SAVEX	41
SEEKPT	42
SEEKPTA	43
SIZE?	44
STOFLAG	45
X<>F	46
XTOA	47

XROM 26, -TIME- B

ADATE	01
ALMCAT	02
ALMNOW	03
ATIME	04
ATIME24	05
CLK12	06
CLK24	07
CLKT	08
CLKTD	09
CLOCK	10
CORRECT	11
DATE	12
DATE+	13
DDAYS	14
DMY	15
DOW	16
MDY	17
RCLAF	18
RCLSW	19
RUNSW	20
SETAF	21
SETDATE	22
SETIME	23
SETSW	24
STOPSW	25
SW	26
T+X	27
TIME	28
XYZALM	29

XROM 27, - WAND 1F -

WNDDTA	01
WNDDTX	02
WNDLNK	03
WNDSUB	04
WNDSCN	05
⊤WNDTST	06

XROM 28, -MASS ST 1H

CREATE	01
DIR	02
NEWM	03
PURGE	04
READA	05
READK	06
READP	07
READR	08
READRX	09
READS	10
READSUB	11
RENAME	12
SEC	13
SEEKR	14
UNSEC	15
VERIFY	16
WRTA	17
WRTK	18
WRTP	19
WRTPV	20
WRTR	21
WRTRX	22
WRTS	23
ZERO	24

XROM 28, -CTL FNS

AUTOIO	27
FINDID	28
INA	29
IND	30
INSTAT	31
LISTEN	32
LOCAL	33
MANIO	34
OUTA	35
PWRDN	36
PWRUP	37
REMOTE	38
SELECT	39
STOPIO	40
TRIGGER	41

XROM 29, -PRINTER 2D

ACA	01
ACCHR	02
ACCOL	03
ACSPEC	04
ACX	05
BLDSPEC	06
LIST	07
PRA	08
⊤PRAXIS	09
PRBUF	10
PRFLAGS	11
PRKEYS	12
PRP	13
⊤PRPLOT	14
⊤PRPLOTP	15
PRREG	16
PRREGX	17
PRΣ	18
PRSTK	19
PRX	20
REGPLOT	21
SKPCHR	22
SKPCOL	23
STKPLOT	24
FMT	25

XROM 30, CARD READER

MRG	01
RDTA	02
RDTAX	03
RSUB	04
VER	05
WALL	06
WDTA	07
WDTAX	08
WPRV	09
WSTS	10
7CLREG	11
7DSP0	12
7DSP1	13
7DSP2	14
7DSP3	15
7DSP4	16
7DSP5	17
7DSP6	18
7DSP7	19
7DSP8	20
7DSP9	21
7DSPI	22
7DSZ	23
7DSZI	24
7ENG	25
7FIX	26
7GSBI	27
7GTOI	28
7ISZ	29
7ISZI	30
7P<>S	31
7PRREG	32
7PRSTK	33
7PRTX	34
7RCLΣ	35
7SCI	36

82162A CHARACTER SET

ASCII (l.) ALTERNATE (r.)

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

TIMER ALARMS

Purpose of Alarm	Alpha Register	Activation	Acknowledgment
Simple alert	(clear)	During a running program. 41C on or off.	Any key.
Reminder or message	Message, up to 24 characters.	During a running program. 41C on or off.	Any key. Press STO to save message in Alarm Stack (I/O buffer).
Execute a program or peripheral function regardless of 41C mode.	↑↑ followed by a Global program label or a peripheral function	During a running program. 41C on or off. XEQs program designated by Alarm as a subroutine and returns.	Not required.
Start running a program at the current line number and at a specified time.	↑↑ Position 41C to desired program line before turning off - similar to Flag 11 in effect.	41C on or off. Begins running a program at the current line no. If ↑↑ not left in Alpha, it becomes a message alarm and must be acknowledged.	Usually not required.
Execute a program or peripheral function but not interrupt a running program.	↑ followed by a Global program label or a peripheral function.	41C on or off. If during a running program, it becomes a past due message alarm (2 tones are heard but the program is otherwise not interrupted.) The named program is run only if the 41C is off or displaying the clock.	Usually not required. If past due, Use ALMCAT to clear.
Countdown Timer	Not used. Input timing period in X as a negative number, HH.MMSShh. Xeq SETSW, xeq RUNSW.	41C on or off. Displays "TIMER ALARM" and interrupts a program.	Required only if immediate silencing is needed. Does not become past due and not saved in I/O buffer.

Syntax for all alarms except Countdown Timer

RESET ENTER DATE ENTER TIME : Z, Y, X (ALPHA AS REQ. FOR ALARM TYPE)

Reset	|Z|	HHHH.MMSSt	.001 - 10,000 input range (10 sec. minimum) if no reset: CLX
Date	|Y|	MM.DDYYYY or DD.MMYYYY	Jan. 1, 1900 - Dec. 31, 2199 if "today's" date: CLX
Time	|X|	HH.MMSSt	valid clock time in 12 or 24 hour format. To specify PM times in 12 hour format, input time, CHS. 24 hour format may be input regardless of the clock mode.

When Alarms are set by programs, CLST is usually a safe initialization procedure. Confirm that contents of Alpha register are correct as Alpha determines the alarm type. XEQ XYZALM

41C ACCESSORIES

HP-41C Quick Reference Card For Synthetic Programming. This is a $2\frac{1}{2}$" by 6" plastic card which contains a $2\frac{1}{2}$" by 4" copy of the COMBINED HEX/DECIMAL BYTE TABLE plus a complete listing of the 56 Flags and their functions. It also contains a summary of multi-byte instruction structure for use with LB. Color tinting is used to identify 4 classes of instructions (1-byte, 2-byte, 3-byte, variable length). Check dealers or PPC Chapters for availability -- the suggested retail price is $3.00. The Quick Reference Card is also by mail at $3.00 each plus $1.50 per order handling charge. If you enclose a self-addressed stamped envelope (1 ounce per 3 cards) you may ignore the handling charge. Mail to: Synthetix, 1540 Mathews Ave., Manhattan Beach, CA 90266 USA.

Eprom Box. 4/8/16K Switched Capacities, Auto On/Off with calculator, SDS compatible.

Custom Keyboard Overlays. 1 - 7 colors, reversible overlays of lexan plastic (up to 4 fit on keyboard at one time) quantities from 500 - 5000.

Write to: Dallas Development Systems, 7410 Still water Drive, Garland, Texas 75042 or call: (214) 238-1776.

Eprom Box. The HHP-16K EPROM memory offers HP-41C/CV calculator users a cost effective alternative for application program storage. Its compact size (5.8" x 3.6" x 1.1"), low power requirement and 4k/8k/16k storage capacities provide a flexible extension to the HP-41C/CV and is ideal for low to medium volume applications. Programs stored on magnetic cards or SDS disk are converted to EPROM storage through a support service program offered by Hand Held Products and its dealers. Designed by Jim De Arras. Write: F. M. Weaver Associates, Inc., 6201 Fair Valley Drive, Charlotte, N.C. 28211 or call: (704) 377-3841.

HP41 Internal Modification Services. Comp/Stop Solderless Interface used for non-soldered internal connection of ROMs and RAMs to system. Available separately to those who have the ability and equipment to perform internal modifications. Available Services: installation of single or QUAD modules inside the calculator; installation of Owner or Comp/Stop supplied Application Modules inside the calculator with defeat switch option for Catalog function efficiency; Two Times Clock Speed Modification with optional defeat switch.

6 Position Port Reliever for 41C/CV; 12 Position Port Reliever for 41C/CV (allows up to 3072 additional registers), Lithium battery memory maintenance, addressable to any port. Console to hold 41C/CV and port extenders as well as tone detection circuit, telephone dialer and HP-IL Converter. Write: Comp/Stop, Drawer 36600, Tucson, Arizona 85740 or call: (602) 888-1504.

Port Extender. Provides 7 more ports for Printer, Wand, RAM or Application ROMs (up to 6 QUAD memories for 41C, Lithium battery power for memory maintenance when disconnected from calculator, attaches to base of calculator. Write AME, Box 373, 13450 Maxella, Marina Del Rey, CA 90291 or call: (213) 306-1249.

Rechargeable Battery Pack. 3x capacity of HP NiCad battery pack, uses HP adapter and charges in or out of machine, LED charging indicator. Write: Nova Systems, Inc., 4925 Mussetter Rd., Ijamsville, MD 21754.

Magnetic Card Organizers. $8\frac{1}{2}$ x 11 clear vinyl pages punched for loose leaf book, 66 pockets per page (2 sides) plus inner pocket to hold notes, etc. Write: IMTEC, P.O. Box 1402, Bowie, MD 20716, USA.

Calculator Books by Mail. Over 40 titles available. Send for EduCalc Mail Store Book Catalogue. Write to: Edu CALC Mail Store, 27963 Cabot Road, So. Laguna, CA 92677.

Bar Code Sheets. (Synthetic Codes). Three $8\frac{1}{2}$ x 11" sheets of offset printed codes, 264 different bar codes to load all synthetic states for registers M - e. Write: Jacob G. Schwartz, 7700 Fairfield St., Philadelphia, PA 19152, USA or call: (215) 331-5324.

Carrying Cases, Printer Modifications, etc. Write: Phillip Karras, 11821 Idlewood Road, Wheaton, MD 20906 USA.

Commercial Software. Program/document custom ROMs, EPROM libraries, various applications including HP-IL, graphic arts and media, business, statistics, consultation services; write: Cary E. Reinstein, 1135 S. Washington St., Albany, OR 97321 or call: (503) 928-0053.

SYNTHETIC PROGRAMMING ON THE HP-41C by William C. Wickes. Larken Publications, 4517 NW Queens Ave., Corvallis, Oregon 97330. 92 pages.

> "... even when an HP-41C user has learned everything the Owner's Handbook can teach him, he is in for another treat: the list of HP-41C functions and programming capability is not limited to the properties catalogued in that Handbook. There exists, in fact, a whole class of functions and programming applications that can be used to greatly enhance the power of the calculator, even though the new functions cannot, at first, be executed or programmed with normal, simple keystrokes. The new functions, which are 'synthesized' by creating new combinations of normal program bytes, which are called 'synthetic functions'; their application in programs gives rise to the expression 'synthetic programming' ..."

This book humorously and thoroughly explains the inner workings of the 41C and contains a huge number of practical applications presented in step-by-step cookbook style for calculator users from beginners to "pros". Contains 28 programs and routines in addition to barcode and reference tables. Available for $11.00 (U.S.) postpaid, by surface mail, anywhere. For airmail, add: U.S., Mexico and Canada $1.00; for Europe and South America $2.00; for elsewhere $3.00

CALCULATOR TIPS & ROUTINES, Especially for the HP-41C/CV Edited by John Dearing. Corvallis Software, Inc., P.O. Box 1412, Corvallis, Oregon 97339. 136 pages.

A collection of how-to tips and short useful routines that may be inserted in the reader's own programs written by 41C users from San Francisco to Madrid to Melbourne and edited in a highly useful and readable form. "It has been written as a service to all calculator users, to bring together in one volume as many tips and routines as possible, and thus to bridge the gap between operating manuals and books of programs." Here is the Table of Contents:

> Basic Functions and Operations; Programming Tips; Initialization and Prompting; Display; Alpha Manipulations; Flags and Tones; Stack Operations; Memory and Curtain; Data Registers; Block Operations; Matrices and Data Processing; Sorting; Random Numbers; Fractions and Rounding; Arithmetic and Algebra; Geometry, Trigonometry and Calculus; Base Conversions; Unit Conversions and Shortcuts; Statistics and Probability; Time and Date; Card Reader and Wand; Printer; Banners; Interchangeable Solutions; Synthetic Load Bytes; Reference.

The book closes with a 5½ page index. Available for $15 postpaid to Canada, U.S.A. and Mexico; $20 airmail postpaid elsewhere. Payment must be in the form of a check or money order drawn on a U.S. bank. Also available at many college and university bookstores.

PPC ROM and PPC ROM USER'S MANUAL. PPC, 2545 W. Camden Place, Santa Ana, Calif. 92704, U.S.A.

Features 153 programs and routines and the most exhaustive documentation ever written for a software product. The following description is quoted from the Foreward to the 492 page manual:

> "We believe in true personal computing and that a so-called higher level language is not always the path to greater computing power. We want to manage our always-to-small memory in ways we think are best. We prefer a flexible operating system that allows us to control our programming environment, and we want a well thought out operating system that can be altered if we wish. The routines in the PPC ROM express these interests and concerns. Much of the work that went into the ROM is original and makes a contribution to the Art. Here are a few examples.
>
> Programmed and documented by hundreds of users - outstanding ratio of features per byte - unusually complete technical details - personal contact for additional help - a routines ROM, not an applications program ROM; this is a programmer's ROM - the full power of Synthetic Programming is made available to all HP-41 users - operating system extension and enhancement programs - fastest known numerical sort routine - block and matrix operations defined and programmed - extended capability and improved accuracy in financial calculations - commendable integration program - greatly enhanced multiplot and high resolution graphics programs - matrix format printing of flags set - skipping zero data in block view - better access to all of HP's ROMs with XE routine - expanded memory using IP and PS for QUAD page switching.

This ROM is now available to non-PPC members. For information, write PPC at the above address and mark "PPC ROM" on the outside of the envelope for faster processing.

For additional reference works on HP calculator applications, write to Edu CALC Mail Store, 27963 Cabot Road, So. Laguna, Calif. 92677 for their book catalogue.

MASS STORAGE "HELP" FILES

```
01♦LBL "REM
        FL"
02 CLX
03 "N LINES
         ?"
04 PROMPT
05 4
06 *
07 SF 25
08 "REM"
09 PURFL
10 CRFLAS

11♦LBL 00
12 CF 23
13 SF 25
14 AON
15 "TEXT?"
16 STOP
17 FC?C 23
18 GTO 01
19 APPREC
20 FS?C 25
21 GTO 00

22♦LBL 01
23 "REM"
24 FLSIZE
25 "FL NAME
         ?"
26 AON
27 STOP
28 AOFF
29 "⊢ "
30 -1
31 AROT
32 X<>Y
33 CREATE
34 ASTO X
35 ASHF
36 ASTO Y
37 "SAVE?"
38 PROMPT
39 "REM,"
40 ARCL X
41 ARCL Y
42 SAVEAS
43 CLX
44 END
```

```
01♦LBL "HEL
         P"
02 FC? 55
03 GTO 00
04 ADV
05 ADV
06 CF 23
07 "TITLE?"
08 AON
09 STOP
10 AOFF
11 SF 12
12 FS?C 23
13 PRA
14 CF 12
15 ADV

16♦LBL 00
17 "REMFL S
       IZE?"
18 PROMPT
19 "NAME?"
20 AON
21 STOP
22 AOFF
23 "⊢ "
24 -1
25 AROT
26 X<>Y
27 CRFLAS
28 GETAS
29 CLX
30 SEEKPT
31 ASTO X
32 ASHF
33 ASTO Y
34 SF 21
35 SF 25

36♦LBL 01
37 GETREC
38 FS? 25
39 GTO 02
40 CLA
41 ARCL X
42 ARCL Y
43 PURFL
44 CLX
45 RTN

46♦LBL 02
47 FS? 55
48 PRA
49 FC? 55
50 AVIEW
51 GTO 01
52 END
```

Here are two short routines (111 bytes each) to facilitate storing documentation files on mini data cassettes. An HP-IL Module, 82161A Digital Cassette Drive and an Extended Functions Module are required. No data registers are used and only Flags 12, 21, 23 and 25 are affected.

The format of the text within the file is entirely determined by the needs of the user. By using these or similar routines and storing the "Help" files adjacent to their associated program files, program instructions, reminders, warnings and notes can be easily retrieved. As the "Help" file takes essentially the same name as the program it describes, the user is only required to xeq HELP and input the program name. As there is no way at this time to determine the size in registers of a file on tape, that information must also be provided to the program.

If a Printer is present in the system, the option of printing a double-wide title is given. An 82162A HP-IL Printer is assumed as are text lines averaging 24 or less characters.

To create a "Help" file: xeq REMFL. "N LINES?" Input the estimated number of text lines to be in the file. (Each 9 full lines occupy 1 record on the tape). R/S. "TEXT?" The program stops in Alpha mode. Input text and R/S till done. When finished, R/S without alpha input. "FILE NAME?" Input the name of the associated program. R/S. The "Help" file will take the same name offset by one space. This feature makes these files distinctive in the Directory listing. If the file is satisfactory, respond to the prompt, "SAVE?" by R/S.

When the "Help" file is called by the HELP program the space in front of the program name is automatically inserted.

If no Printer is in the system, the file will be AVIEW'ed. Continue reading by pressing R/S. If there is a Printer, tedious scrolling is avoided.

POSTFIX

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