The HP-41C Normal Mode Keyboard
The HP-41C ALPHA Mode Keyboard

**ALPHA Operations**

The ALPHA register is independent from the automatic memory stack. To place an ALPHA string into the display, place the HP-41C into ALPHA mode (press \[\text{ALPHA}\]) and press the keys associated with the desired ALPHA characters. Refer to the ALPHA keyboard illustration above, on the back of the calculator, in the Owner’s Handbook for a complete ALPHA keyboard.

There are eight functions on the ALPHA mode keyboard: \[\text{APPEND}\], \[\text{ASTO}\], \[\text{ARCL}\], \[\text{BST}\], \[\text{SST}\], \[\text{CLA}\], \[\text{SHF}\]. Two additional functions, \[\text{ASHF}\] and
are not on the keyboard. \texttt{ASTO} and \texttt{ARCL} are used to store and recall ALPHA strings into the data storage registers. Press \texttt{ASTO} \texttt{nn} in ALPHA mode to store the left-most six characters in the ALPHA register into the indicated register. Press \texttt{ARCL} \texttt{nn} in ALPHA mode to recall the contents of the indicated register into the ALPHA register. \texttt{ASHF} shifts the contents of the ALPHA register six characters to the left.

\texttt{CLA} clears the contents of the ALPHA register, and \texttt{AVIEW} places the contents of the ALPHA register into the display.

Switching out of and into ALPHA mode terminates ALPHA string entry. If you want to add to a string that is in the ALPHA register and ALPHA string entry has been terminated, press \texttt{APPEND} and continue keying in the desired ALPHA characters.

In a program, \texttt{PROMPT} halts program execution and places the contents of the ALPHA register into the display as a prompt for data, etc.
Data Storage Registers and Program Memory

Primary Data Storage Registers (up to 63 on the basic HP-41C; up to 100 on the HP-41CV).

\[
\begin{align*}
R_{00} \\
R_{01} \\
R_{02} \\
\vdots \\
R_{99}
\end{align*}
\]

Extended Data Storage Registers (up to 219 total).

\[
\begin{align*}
R_{(100)} \\
R_{(101)} \\
R_{(102)} \\
\vdots \\
R_{(318)}
\end{align*}
\]

The Automatic Memory Stack Registers

\[
\begin{align*}
T \\
Z \\
Y \\
X \\
\text{ALPHA} \\
\text{LASTX}
\end{align*}
\]

Program Memory

Up to 319 registers of program memory (up to 63 on the basic HP-41C).

Memory Extensions

Caution: Turn the HP-41C off prior to removing or inserting plug-in extensions. MEMORY LOST display indicates that Continuous Memory has been cleared.

The HP-41C can use either one HP 82170A Quad Memory Module or up to four HP 82106A Memory Modules. The HP-41CV does not use any memory modules.
Register Allocation

To determine the number of unused registers presently allocated to program memory, simply press \[ GTO \] \( \rightarrow \) \( \rightarrow \) in PRGM mode. The display will show \( 00 \text{ REG } nn \). The indicated number (nn) is the number of unused registers that remain in program memory.

To determine the total number of registers allocated to data storage registers, recall increasingly higher numbered data storage registers. When the next numbered recall operation results in the \textbf{NONEXISTENT} display, that numbered register represents the number of registers currently allocated to data storage registers. Example:

<table>
<thead>
<tr>
<th>Keystrokes</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCL 19</td>
<td>0.0000</td>
</tr>
<tr>
<td>RCL 20</td>
<td>NONEXISTENT</td>
</tr>
</tbody>
</table>

This register exists...

...but the next numbered register does not. The allocation is 20 registers to data storage registers and the remainder to program memory.

To set the number of registers in data storage and program memory, execute \( \text{SIZE} \) and specify a three-digit register size (000 through 318). This specifies the number of data storage registers. The remainder of registers are allocated to program memory.

Register Specification

Any function that requires a data storage register to be specified can accept a two-number data storage register number (00 through 99). When you supply the register number, pressing \( \) followed by \( X \), \( Y \), \( Z \), \( T \), or \( L \) (for LAST \( X \)) specifies the stack or LAST \( X \) registers. Pressing \( \) followed by a two-digit number specifies an indirect address. Valid indirect addresses are 00 through 99. The indirectly addressed register can be numbered
000 through 318. Pressing \( \Box \Box \Box \) followed by X, Y, Z, T, or L specifies an indirect address in the stack or LAST X registers.

**Function Index**

Functions with one name for keyboard execution and a second name for assigning and display execution are shown with both names (e.g., \( \sqrt{x} \) on the keyboard and \( \text{SORT} \) in the display). The keyboard name is listed first. Refer to the *HP-41C/41CV Owner’s Handbook and Programming Guide* for complete descriptions of all HP-41C functions. The * indicates functions printed on the normal mode keyboard.

- Absolute value. \( \text{ABS} \)
- Accumulation correction. \( \Sigma^- \)
- Accumulations. \( \Sigma^+ \)
- Addition operator. \( + \)
- Advance paper. \( \text{ADV} \)
- ALPHA mode key. \( \text{ALPHA} \)
- ALPHA mode off. \( \text{AOFF} \)
- ALPHA mode on. \( \text{AON} \)
- ALPHA recall. \( \text{ARCL} \)
- ALPHA shift left. \( \text{ASHF} \)
- ALPHA store. \( \text{ASTO} \)
- ALPHA view. \( \text{AVIEW} \)
- Antilogarithm (common). \( 10^y \) or \( 10+x \)
- Antilogarithm (natural). \( e^x \) or \( e+x \)
- Antilogarithm (for small arguments). \( e^{x-1} \)
- Append display. \( \text{APPEND} \)
- Arc cosine. \( \text{COS}^{-1} \) or \( \text{ACOS} \)
- Arc sine. \( \text{SIN}^{-1} \) or \( \text{ASIN} \)
- Arc tangent. \( \text{TAN}^{-1} \) or \( \text{ATAN} \)
- Assign. \( \text{ASN} \)
- Beeper. \( \text{BEEP} \)
- Back step. \( \text{BST} \)
- Catalog list. \( \text{CATALOG} \) or \( \text{CAT} \)
- Change sign. \( \text{CHS} \)
- Clear all data storage registers. \( \text{CLRG} \)
- Clear ALPHA register. \( \text{CLA} \)
Clear display.
Clear program.
Clear program flag.
Clear automatic memory stack.
Clear statistics registers.
Clear X-register.
Copy (download or copy).
Correction key.
Cosine.

Decimal to octal conversion.
Decrement and skip if equal.
Degrees mode.
Degrees to radians conversion.
Delete program memory lines.
Division operator.

End of program.
Engineering notation display.
Enter exponent.
Enter number in X into Y.
Exchange X- and Y-registers.
Exchange X- and any register.
Execute.
Exponential.
Exponential.

Factorial.
Fixed point display.
"Flag clear" test.
"Flag clear" test and clear.
"Flag set" test.
"Flag set" test and clear.
Fractional portion of number.
Go to.
Go to line or ALPHA label.
Go to end of program memory.
Grads mode.

Hrs. (decimal) to hr., min., s.
Hr., min., s. addition.
Hr., min., s. subtraction.
Hr., min., s. to decimal hrs.
Increment and skip if greater.
Integer portion of number.

Label .
Logarithm (common).
Logarithm (natural).
Logarithm (arguments close to one).
LAST X register recall.

Mean
Modulo (remainder).
Multiplication operator.
Octal to decimal conversion.
Pack program memory.
Pause.
Percent.
Percent of change.
Pi.
Polar to rectangular conversion.
Power off.
Power on/off key.
Power on (continuous) function.
Program mode key.
Prompt.

Radians mode.
Radians to degrees conversion.
Recall.
Reciprocal.
Rectangular to polar conversion.
Return.
Roll down.
Roll up.
Round.
Run/stop.

Set flag.
Scientific notation display.
Shift key.
Sign, unary of x.
Sine.
Size of register configuration.
Single step.
Square.
Square root.
Standard deviation.
Statistical register specification.
Stop.
Store.
Storage register addition.
Storage register division.
Storage register multiplication.
Storage register subtraction.
Subtraction operator.
Tangent.
Tone of beeper.

**USER** mode key.

View register contents.

**X = Y** conditional test.
**X = 0** conditional test.
**X > Y** conditional test.
**X > 0** conditional test.
**X < Y** conditional test.
**X < 0** conditional test.
**X ≤ Y** conditional test.
**X ≤ 0** conditional test.
**X ≠ Y** conditional test.
**X ≠ 0** conditional test.

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**The Catalog**

Press **CATALOG** 1 to review all of the program names that you have stored into program memory.

Press **CATALOG** 2 to review all of the functions associated with currently plugged-in extensions.

Press **CATALOG** 3 to review all of the standard HP-41C functions.

You can stop the catalog listing by pressing **R/S**. You can then use **SST** and **BST** to step through the catalogs.
manually. Press \texttt{R/S} again to restart the listing. Stop the listing and press \texttt{←} to get out of a catalog listing operation.

As the listing of catalog 1 progresses the HP-41C is automatically set to the location in program memory of the currently displayed program name.

**Function Execution and Assignment**

To execute a normal mode function, simply press the corresponding key in normal mode. To execute any valid function, press \texttt{XEQ} \texttt{ALPHA} name \texttt{ALPHA} and supply the proper function name (refer to the function index).

Most standard HP-41C functions can be assigned to a key location for execution in USER mode (refer to the Function Index in the back of the owner's handbook). All key locations except \texttt{ON}, \texttt{USER}, \texttt{PRGM}, \texttt{ALPHA}, and \texttt{ } will accept function assignments.

All ALPHA program labels that you have written and stored into program memory can be assigned to a key location.

To assign a function or a program to a key location, press \texttt{ASN} \texttt{ALPHA} name \texttt{ALPHA} and supply the function or program name. Then press the key or \texttt{ASN} and the key to which you wish the function or program to be assigned. The key location is identified in the assignment function execution by a row-column keycode (shifted locations are indicated by a minus sign before the keycode).

To return to the normal mode function for any key, press \texttt{ASN} \texttt{ALPHA} \texttt{ALPHA} and that key.

To execute any reassigned function or program, simply place the HP-41C into USER mode (press \texttt{USER}) and press the reassigned key. The name of the function will appear in the display if you hold the key down momentarily. If you hold the key down for more than about a half
second, the function is nullified (\textbf{NULL}) and is not executed when you release the key.

**Statistics Operations**

There are six statistical registers used for accumulations and by the statistical functions. The location of these six registers is controlled by the \texttt{ΣREG} function. When you execute \texttt{ΣREG} and supply a two-digit register address, that address specifies the beginning of the six-register statistical register block. Initially the statistical registers are $R_{11}$ through $R_{16}$. Pressing \texttt{Σ+} accumulates and pressing \texttt{Σ=} deletes accumulations from the registers:

- First Register: $Σ_x$
- Second Register: $Σ_x^2$
- Third Register: $Σ_y$
- Fourth Register: $Σ_y^2$
- Fifth Register: $Σ_{xy}$
- Sixth Register: $n$

**Flags**

The HP-41C has 30 user flags and 26 system flags. The user flags can be set, tested and cleared. System flags can be tested only. The keyboard flag functions are \texttt{SF} (set flag), \texttt{CF} (clear flag), and \texttt{FS?} ('flag set' test). The non-keyboard flag functions are \texttt{FC?} ('flag clear' test), \texttt{FS?C} ('flag set' test and clear), and \texttt{FC?C} ('flag clear' test and clear). If the answer to a flag "test" is yes, program execution continues with the next line. If no, the next line in the program is skipped before execution continues. Manually from the keyboard, test function answers are displayed as \texttt{YES} and \texttt{NO}, and no program lines are executed or skipped. Display annunciators 0 through 4 turn on when flags 00 through 04 are set.

![Flag Test Diagram](image)
<table>
<thead>
<tr>
<th>User Flags</th>
<th>System Flags</th>
</tr>
</thead>
<tbody>
<tr>
<td>(00 through 29)</td>
<td>(30 through 55)</td>
</tr>
<tr>
<td><strong>Flag Name</strong></td>
<td><strong>Flag Name</strong></td>
</tr>
<tr>
<td>Flag Number</td>
<td>Flag Number</td>
</tr>
<tr>
<td>General Purpose</td>
<td>Catalog Flag 30</td>
</tr>
<tr>
<td>User Flags (11)</td>
<td>Peripheral Flags</td>
</tr>
<tr>
<td>through 10</td>
<td>(5) through 35</td>
</tr>
<tr>
<td>Special Purpose</td>
<td>Number of Digits</td>
</tr>
<tr>
<td>User Flags (10)</td>
<td>Flags (4) through</td>
</tr>
<tr>
<td>through 20</td>
<td>36 through 39</td>
</tr>
<tr>
<td>Automatic</td>
<td>Display Format</td>
</tr>
<tr>
<td>Execution Flag</td>
<td>(Special Purpose</td>
</tr>
<tr>
<td>(Special Purpose</td>
<td>Flag 11) through</td>
</tr>
<tr>
<td>Flag 11)</td>
<td>31 through 35</td>
</tr>
<tr>
<td>Printer Enable</td>
<td>Grads Mode Flag 42</td>
</tr>
<tr>
<td>Flag 21</td>
<td>Radians Mode Flag</td>
</tr>
<tr>
<td>Numeric Input</td>
<td>Continuous On Flag</td>
</tr>
<tr>
<td>Flag 22</td>
<td>Data Entry Flag 45</td>
</tr>
<tr>
<td>ALPHA Input Flag</td>
<td>Partial Key</td>
</tr>
<tr>
<td>23</td>
<td>Sequence Flag 46</td>
</tr>
<tr>
<td>Range Error</td>
<td>Shift Set Flag 47</td>
</tr>
<tr>
<td>Ignore Flag</td>
<td>ALPHA Mode Flag 48</td>
</tr>
<tr>
<td>24</td>
<td>Low Battery Flag 49</td>
</tr>
<tr>
<td>Error Ignore Flag</td>
<td>Message Flag 50</td>
</tr>
<tr>
<td>25</td>
<td>SST Flag 51</td>
</tr>
<tr>
<td>Audio Enable Flag</td>
<td>PRGM Mode Flag 52</td>
</tr>
<tr>
<td>26</td>
<td>I/O Flag 53</td>
</tr>
<tr>
<td>USER Mode Flag</td>
<td>Pause Flag 54</td>
</tr>
<tr>
<td>27</td>
<td>Printer Existence</td>
</tr>
<tr>
<td>Decimal Point Flag</td>
<td>Flag 55</td>
</tr>
<tr>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Digit Grouping Flag</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>

**Programming Information**

To begin a new program, press `GTO` (Go). This sets the calculator to the end of program memory and tells you the number of unused registers left in program memory (`REG nn`).

To key in a program, place the HP-41C into program
mode (press PRGM) and press the keys associated with the desired functions. Functions not on the keyboard are keyed in just as you would execute them from the keyboard (press XEQ ALPHA name ALPHA). In USER mode, reassigned functions are loaded into program memory as you press the associated keys. When you are finished keying in a program, press ▼GTO △ △ to place an END instruction at the end of the program (also sets the HP-41C to the end of program memory).

Programs must be named with up to seven ALPHA characters. To execute the program, press XEQ ALPHA name ALPHA, supplying the program name. The program is executed when you have keyed in the name and pressed ALPHA. Programs can also be executed by assigning the name to a key (press ▼ASN ▲ALPHA name ALPHA), and then pressing that key in USER mode.

**Controlled Looping**

[INSG] (increment and skip if greater) and [DSE] (decrement and skip if equal) use a number that is interpreted in a special way to control program loops. The number is stored into any data storage register. The format of the number is: iiiii.fffcc where:

- iiiii is the current counter value,
- fff is the counter test value, and
- cc is the increment value.

The iiiii portion of the number tells the HP-41C that you wish to count the number of passes through the loop beginning with that number. When the iiiii portion exceeds five digits, the decimal portion of the number (.fffcc) is truncated on the right for each excess iiiii character.

The fff portion of the number tells the HP-41C that you wish to stop the counting at that number. The fff value must always be specified as a three-digit number (e.g., an fff value of 10 would be specified as 010).
The **cc** portion of the number tells the calculator how you wish to count. Current counter value **iiiii** is incremented or decremented by the increment value of **cc**. If you do not specify a **cc** value, the HP-41C assumes you wish to count by one's (**cc=01**). A **cc** value must be specified as two digits (e.g., 01, 03, 55).

Using [**ISG**](#), when **iiiii** is greater than **fff**, the HP-41C skips the next line in the program. If **iiiii** is not greater than **fff**, no lines are skipped. Using [**DSE**](#), when **iiiii** is less than or equal to **fff**, the next line in the program is skipped. If **iiiii** is not less than or equal to **fff**, no lines are skipped.

**Conditionals**

The conditional operations on your HP-41C are useful as program instructions to allow your programs to make decisions. The 10 conditionals available in the HP-41C are shown in the function index on page 9.

Two of these conditionals, **[x=y?]** and **[x#y?]** can be used to compare ALPHA strings as well as numbers. All of the other conditionals compare only numbers. If two strings are "equal" (**[x=y?]**), then they are exactly equal in length and have identical characters.

Conditionals follow the "do if true" rule. If the conditional test is true, the next program line is executed. If false, the next line is skipped. Executed manually from the keyboard, these conditionals return an answer to the display: **YES** if true, and **NO** if false. No program lines are executed or skipped.

**Indirect Operations**

An indirect address is selected by following a function with the shift key, [SHIFT], and then a register address. The function then uses the number in the specified register as an **address**. Pressing [SHIFT] and X, Y, T, Z or L (for LAST X) specifies an indirect stack address.
Valid indirect address specifications are 00 through 99 and X, Y, Z, T, L. The indirectly addressed register can be numbered 000 through 318. Here is a complete listing of all HP-41C functions that can be used with indirect addresses (valid parameters are given where applicable):

- **STO** nn | Store.
- **STO+** nn | Store add (keyboard form).
- **STO-** nn | Store subtract (keyboard form).
- **STO×** nn | Store multiply (keyboard form).
- **STO÷** nn | Store divide (keyboard form).
- **ST+** nn | Store add (display form).
- **ST-** nn | Store subtract (display form).
- **ST×** nn | Store multiply (display form).
- **ST÷** nn | Store divide (display form).
- **ASTO** nn | ALPHA store.
- **RCL** nn | Recall.
- **ARCL** nn | ALPHA recall.
- **VIEW** nn | View register contents.
- **GTO** nn | Go to (00 through 99).
- **XEQ** nn | Execute (00 through 99 or ALPHA name).
- **FIX** nn | FIX display format (0 through 9).
- **SCI** nn | SCI display format (0 through 9).
- **ENG** nn | ENG display format (0 through 9).
- **DSE** nn | Controlled decrement loop.
- **ISG** nn | Controlled increment loop.
- **TONE** nn | Audible tone pitch (0 through 9).
- **ΣREG** nn | Define accumulation registers.
- **SF** nn | Set flag (00 through 29).
- **CF** nn | Clear flag (00 through 29).
- **FS?** nn | "Flag set" test (00 through 55).
- **FC?** nn | "Flag clear" test (00 through 55).
- **FS?C** nn | "Flag set" test and clear (00 through 29).
- **FC?C** nn | "Flag clear" test and clear (00 through 29).
- **X<>** nn | Exchange X and any register.
- **CATALOG** nn | Catalog List (1, 2, or 3).

### The **COPY** Function

Functions in application modules may be executed by following the instructions given in the corresponding application book. However, if you wish to alter the way
a program works, use \texttt{COPY} to copy it from an application module into program memory. These programs can be altered and the altered programs executed only while they are in program memory. They cannot be saved in the application module. With the application module in place and the desired program name in mind, execute \texttt{COPY} and spell out the program name (\texttt{ALPHA} name \texttt{ALPHA}).

Here is what happens when you execute \texttt{COPY}:

1. The HP-41C searches for the specified name. If not found the display will show \texttt{NONEXISTENT}.

2. If the unused portion of program memory is large enough to accept the entire application program, it is copied into program memory.

3. If there is not enough room, the HP-41C will pack program memory. You will momentarily see \texttt{PACKING} and then \texttt{TRY AGAIN} in the display: reenter the \texttt{COPY} function.

4. If there is enough room after packing, the application program will be copied into program memory. If there is still not enough room, the calculator will again display \texttt{PACKING} and \texttt{TRY AGAIN}; when this happens you must clear programs from program memory or (in the HP-41C only) insert a memory module.

Attempting to \texttt{COPY} a program from program memory to another location in program memory will result in the \texttt{RAM} message. Attempting to \texttt{DEL}, \texttt{CLP}, \texttt{←}, or insert into a program that is currently in an application module will result in the \texttt{ROM} display. \texttt{COPY} \texttt{ALPHA} \texttt{ALPHA} copies the application module program that the calculator is currently positioned to into program memory.