**WP34S Complex Mode**

For the following instructions, the following conventions apply:

X, Y, Z, T, A, B, C, D, I, J, K and L refer to the storage registers

x, y, z, t, a, b, c, d, l, i, j, and k refer to the contents of the registers

“f, g, or h +” signifies pressing the specified shift key plus another key

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| MODE CPXYES | This mode setting allows the WP34s to enter complex mode, using the key combination stated below. This does not affect operation of the WP34s in normal or real mode. Pressing CPX prior to executing a function will behave exactly as in the past, by executing a complex version of the specified function (if a complex version is defined) on x and y. Complex mode can be entered only by the key combination below. |
| MODE CPXNO | This mode setting will prevent the WP34s from entering complex mode. This WP34s will operate in all respects as if complex mode is not available. |
| ⇨CPX | Enter or leave complex mode. When in complex mode the small “=” sign is displayed as a visual indication that complex mode is active. The “i" or “angle” indicators will be continuously present in the second line display. Entering complex mode sets stack size to 8 to mimic a 4-level complex stack. Pre-existing values in X, Y, Z, T, A, B, C and D are retained. The original stack size is restored on leaving complex mode. |
| Numeric keys (.0123456789) | * During numeric entry: do the obvious; * Outside of numeric entry: start entry of real part. |
| CPX (in complex mode; operates normally outside this mode) | Terminates the entry of the real or imaginary part of a complex number. In more detail:   * During entry of real part: CPX ends it and starts the entry of the imaginary part; * During entry of imaginary part: CPX terminates it (making it zero if nothing has been entered) and places the real part in the X-register and the imaginary part in the Y-register; enables stack lift; * Outside of numeric entry: respects the stack lift setting, sets the real part to zero, and starts the entry of the imaginary part. (So 0 + i1 may be entered by simply pressing CPX, 1, then CPX.) |

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| ENTER: | Terminates the entry of a number, puts it on the stack and duplicates it. In more detail:   * During entry of real part: finishes real part, sets imaginary part to zero, puts the number into (X, Y) and (Z, T), pushes previous (z, t) into (A, B), pushes previous (a, b) into (C, D), previous contents of (C, D) lost; disables stack lift. * During entry of imaginary part: finishes imaginary part, puts the number into (X, Y) and (Z, T), pushes previous (z, t) into (A, B), pushes previous (a, b) into (C, D), previous contents of (C, D) lost; disables stack lift. * Outside of numeric entry: duplicates (x, y) into (Z, T), pushes previous (z, t) into (A, B), pushes previous (a, b) into (C, D), previous contents of (C, D) lost; disables stack lift. |
| CHS: | * During numeric entry: changes the sign of the real or imaginary part being entered; * Outside of numeric entry: changes the sign of both x and y registers. |
| EEX: | * During numeric entry: starts entry of exponent; * Outside of numeric entry: enters 1 E000, waits for entry of exponent. |
| General functions on the keyboard – e.g., arithmetic, trigonometric, STO, RCL, logarithms, ... | * During numeric entry of real part: entry is terminated, the function is executed on the value x + i 0, i.e. y automatically set to zero. * During numeric entry of imaginary part: entry is terminated, the function is executed on the value x + i y, no need to press CPX or ENTER to terminate entry of complex value. * Outside of numeric entry: carry out operation on the values in x and y using the defined complex version of the function (same as accomplished in normal mode by preceding the desired operation with CPX.) All trigonometric functions work in and supply results in radians, except R⇨P and P⇨R as described above. |
| STO nn, RCL nn | Allows storage of x and y to or recall from a pair of registers nn and nn+1. To prevent inadvertent overwriting of components by multiple STO operations (e.g., STO 00 will store the real and imaginary parts in 00 and 01; subsequent STO 01 of a second value would overwrite the imaginary part of the first stored value with the real part of the second value) only even values may be specified for nn. If an odd value is entered, the message “Use even reg For Complex” will appear. Pressing ⇦ will revert back to STO n\_ or RCL n\_ and allow an even register to be specified. Pressing STO or RCL will restart the operation. Pressing EXIT will revert to the prior stack display with no STO or RCL operation performed. Stack registers X, Z, A and C, plus lettered registers L and J are considered even. |
| π (h + EEX) | Enters the complex value of 3.1415… + i 0 into x and y, pushes stack. |
| π (f + EEX) | * If pressed before numeric entry begins, pi is put into the real part of the new number. This can be overwritten by entering digits, or the imaginary part can be entered by pressing CPX. * If pressed immediately after CPX, pi is put into the imaginary part of the new number. It can be overwritten with digits or entry can be completed by pressing CPX, ENTER, or any operator in the usual way. * If f+EEX is pressed **after** entering some digits into the real or imaginary part, those digits are **multiplied** by pi. So “2 CPX .5 f+EEX” enters the number 2 + i 0.5 π. * Note that if you want a fractional multiple of pi such as pi/12 + i4 this can be done by entering 1/12 as a fraction in the real part and then pressing f+EEX. |
| R⇨P and P⇨R: | Convert form of complex number using current angular mode setting. E.g., if DEG mode is chosen, 3 + i 4 will be converted to 5 / 53.13 by R⇨P. The / symbol will be temporarily displayed. As soon as this value is worked with, or EXIT is pressed, the / symbol will revert to i. It is up to the user to remember that the i value represents an angle in the current angular mode setting. 5 + i 53.13 will be converted to 3 + i4 by P⇨R . |
| Polar entry / display mode:  g + up-arrow (Px,y) | This allows the entry and display of complex numbers in polar form. MOD (for modulus) and ARG (for argument) are displayed in place of REAL and IMAG during numeric entry. Calculation results are displayed in polar form too, but are stored in (x, y) form internally so that all complex functions work as they should. Contrast this with R⇨P, which actually replaces the (x, y) form with the polar form in the X and Y registers. |
| Rectangular entry / display mode:  f + up-arrow (Cx,y) | Returns from polar entry / display mode to rectangular entry / display mode, with REAL and IMAG parts. |
| ⇦ | * During numeric entry: deletes preceding digit; * Outside of numeric entry: deletes x and y leaving stack lift disabled. |
| EXIT | * During numeric entry of real or imaginary part: value entry is cancelled and former stack contents restored. * Outside of numeric entry: same as in normal mode, will exit out of a catalog, exit out of an uncompleted STO or RCL, exit SHOW mode, exit temporary VIEW, etc. * Will not exit complex mode. |
| X.FCN (h + 3) | * Enters x-functions menu. Only functions defined for complex operation, i.e., those in the full catalog preceded by the superscript c, are displayed. Pressing ENTER executes the displayed function. |
| X⬄Y | Swaps (X, Y) with (Z, T) – i.e., complex swap |
| (f or g) + X⬄Y | Swaps real and imaginary parts of number (i.e., swaps x and y) |
| f + CHS | Changes sign of y only (i.e., complex conjugate, x + i y becomes x – i y) |
| h + CHS | Changes sign of x only (x + i y becomes -x + i y) |
| IP (f + decimal point) | Sets x to zero (i.e., takes imaginary part, x + i y becomes 0 + i y) |
| FP (g + decimal point) | Sets y to zero (i.e., takes real part, x + i y becomes x + i 0) |
| A | Enters cHyp prefix for complex hyperbolic functions |
| B, C, D | Executes default function even if there is a resident program defined by LBL A, etc. Program operation is not available in complex mode. |
| RND (g + 0) | Rounds X and Y (real and imaginary) to the number of digits specified by the current display setting. |
| |x| (f + 0) | Returns the magnitude of x + i y to X; y set to zero. |
| CONST (h + ENTER) | Enters constants menu. If a constant is selected by pressing ENTER, chosen constant is copied to X, y set to zero. If a number is being entered when this key is pressed the entry of the number is completed before the constant is entered. |
| CONST (f + ENTER) | Use this for entering a constant into the real or imaginary part of a complex number,   * If no number is being entered, begins complex entry and enters the constant into the real part of the number. * If the real part of a number is being entered, overwrites it with the constant. * If CPX has been pressed so that the imaginary part is being entered, the constant is entered into the imaginary part of the complex number without clearing the real part. |
| MATRIX (h + “x”) | Returns z\*x to X, y\*t to Y, consuming former x + iy and z + it values, drops stack. (Matrix functions not defined for complex values. DOT and CROSS product functions available in X.FCN menu.) |
| RMDR (h + “/”) | Returns z/x to X, y/t to Y, consuming former x + iy and z + it values, drops stack. |
| h + ⇦ | Deletes x value, begins real value entry. Pressing CPX completes entry of new x value, begins imaginary value entry. Prior y value will be displayed. Pressing CPX will terminate entry, with former y value retained. Useful for changing only the real part of an existing complex value. Imaginary part can be changed by pressing f + X⬄Y prior to and after this function. (Prior to pressing CPX the second time, a new y value may be keyed in and terminated with CPX. This will result in the same completely new x + i y as can be obtained by pressing ⇦ by itself at the start.) |
| MODE CPXI | Second line of display preceded by “i" to indicate the imaginary part of the x + i y value represented by the contents of X and Y. |
| MODE CPXJ | Second line of display preceded by “j" to indicate the imaginary part of the x + j y value represented by the contents of X and Y. |
| XEQ, GTO, R/S, P/R, LBL, RTN, DSE, ISG, PSE, SF, CF | No action taken. Program operation is not available in complex mode. |
| Σ+, Σ-, STATUS, AND, OR, NOT, etc. | No action taken. |

All newly defined and existing functions will show the function name if the key is held down, and null out if the key is held down long enough.