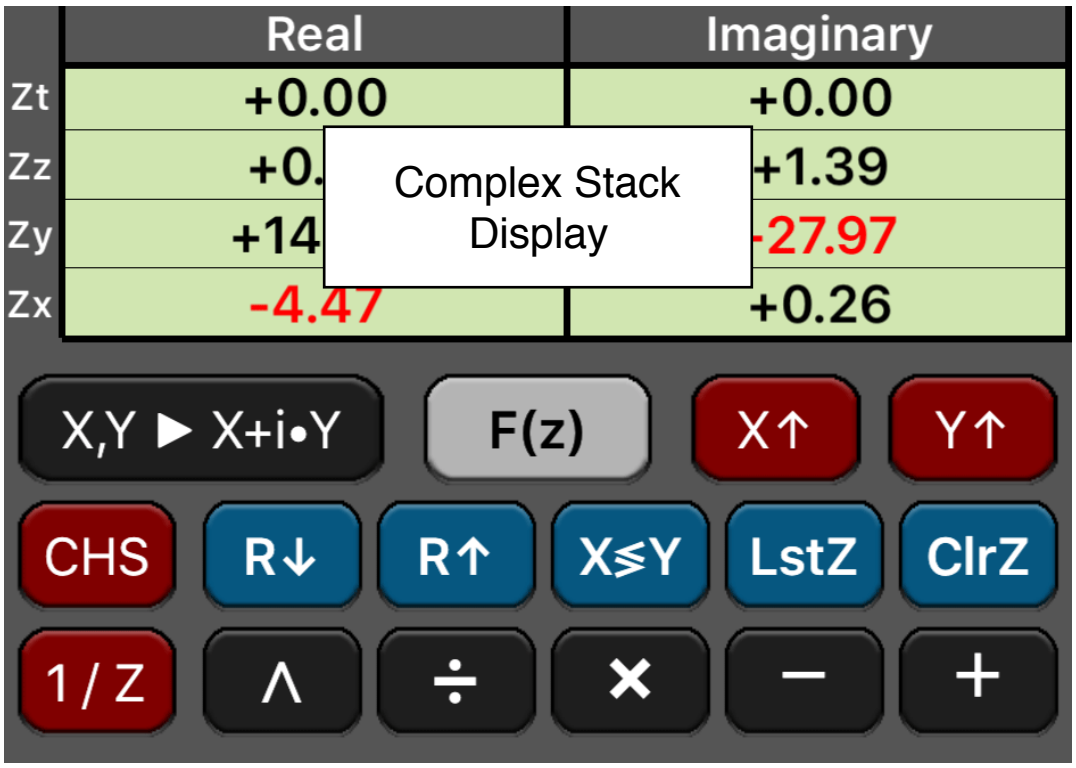
Complex Numbers Menu

This “Complex Numbers” menu implements a complex number stack to perform operations and functions over it. To show it, touch the “**OPT**” key, and in the “**1) Scientific:**” section touch the “**Complex Math**” button.



This Complex-Stack is similar to the normal calculator’s stack, but specially designed for operations with complex numbers. The number are entered in the Complex Stack from the calculator using the **[→X+Y•i]** button, the calculator’s stack-X value is used as the real part and the value in stack-Y is used for the imaginary part.
The Complex Stack, operations and functions are completely independent from the calculator and behaves in RPN logic as well.

Complex Numbers Menu Buttons	
Complex Stack Display	Touching the Complex Stack Display toggles the format from Rectangular to Polar (phasor) or vice-versa.
Input **[X,Y▶X+i•Y]**	Enters the Zx complex number from the calculator's stack X and Y. Also drops the calculator's stack two times.
[X↑] or **[R↑]**	Outputs the Real (or Radius) of the Zx complex to the calculator's stack.
[Y↑] or **[Θ↑]**	Outputs the imaginary (or Angle) of the Zx complex to the calculator's stack.
[F(z)]	Shows up a set of functions buttons to apply to the Zx complex number.
[R↓]	Rolls Down the complex-stack.
[R↑]	Rolls Up the complex-stack.
[X⩤Y]	Swaps the Zx and Zy complex numbers.
[LstZ]	Recalls the last Zx complex number that was just before a Function or operation was performed.
[CLZ]	Clears the Zx complex number to 0 + 0•i.
[∧]	Raises Zy to Zx. => Stores Zx in 'LstZ', drop the complex stack and put the result of Zy ^ Zx in Zx.

Complex Numbers Menu Buttons	
[÷]	Divides Zy by Zx. => Stores Zx in 'LstZ', drop the complex stack and put the result of Zy ÷ Zx in Zx.
[x]	Multiplies Zy by Zx. => Stores Zx in 'LstZ', drop the complex stack and put the result of Zy • Zx in Zx.
[-]	Subtracts Zx from Zy. => Stores Zx in 'LstZ', drop the complex stack and put the result of Zy - Zx in Zx.
[+]	Adds Zx and Zy. => Stores Zx in 'LstZ', drop the complex stack and put the result of Zy + Zx in Zx.
[CHS]	Change the sign of the Zx complex number (change the sign of the real & imaginary part).
[1 / Z]	Stores Zx in 'LstZ', and put (1 / Zx) in Zx.

Complex Functions:
Additionally to the arithmetic operations for complex numbers, touching the **[F(z)]** button, brings up a list with a complete set of functions that can be applied to the Complex-Stack X-value.

Note: Before applying the function, the number currently in stack-X is copied to the LstZ)

The Complex functions included in the calculator are:

[R ⩹ I]	Swaps the real and imaginary parts of the Zx complex number.
[Z*]	Conjugates Zx value (change the sign of the imaginary part).
[√z]	Stores Zx in 'LstZ', and put √(Zx) in Zx.
[z^2]	Stores Zx in 'LstZ', and put (Zx)^2 in Zx.
[LN]	Stores Zx in 'LstZ', and put the Natural Logarithm of Zx in Zx.
[LOG]	Stores Zx in 'LstZ', and put the Common Logarithm of Zx in Zx.
[Log_2]	Stores Zx in 'LstZ', and put the Logarithm base-2 of Zx in Zx.
[e^x]	Stores Zx in 'LstZ', and put the Exponential of Zx in Zx.
[10^x]	Stores Zx in 'LstZ', and put the Common Anti-Logarithm of Zx in Zx.
[2^x]	Stores Zx in 'LstZ', and put the base-2 Anti-Logarithm of Zx in Zx.
[SIN]	Stores Zx in 'LstZ', and put the Sine of Zx in Zx.
[COS]	Stores Zx in 'LstZ', and put the Cosine of Zx in Zx.
[TAN]	Stores Zx in 'LstZ', and put the Tangent of Zx in Zx.

[SIN^{-1}]	Stores Zx in 'LstZ', and put the Arc-Sine of Zx in Zx.
[COS^{-1}]	Stores Zx in 'LstZ', and put the Arc-Cosine of Zx in Zx.
[TAN^{-1}]	Stores Zx in 'LstZ', and put the Arc-Tangent of Zx in Zx.
[Sinh]	Stores Zx in 'LstZ', and put the Hyperbolic Sine of Zx in Zx.
[Cosh]	Stores Zx in 'LstZ', and put the Hyperbolic Cosine of Zx in Zx.
[Tanh]	Stores Zx in 'LstZ', and put the Hyperbolic Tangent of Zx in Zx.
[Sinh^{-1}]	Stores Zx in 'LstZ', and put the Hyperbolic Arc-Sine of Zx in Zx.
[Cosh^{-1}]	Stores Zx in 'LstZ', and put the Hyperbolic Arc-Cosine of Zx in Zx.
[Tanh^{-1}]	Stores Zx in 'LstZ', and put the Hyperbolic Arc-Tangent of Zx in Zx.

Example 1: (Arithmetic calculation, Rectangular form)
Evaluate the following expression:

$$\frac{2i \bullet (-8 + 6i)^3}{(4 - i\bullet 2\bullet\sqrt{5}) \bullet (2 - i\bullet 4\bullet\sqrt{5})}$$

Solution:

"2" **[ENTER]** "0" **[X,Y ▶X+Y•i]**	Enter the first complex number "2i" into the Complex Stack.

”6” **[ENTER]** “8” **[CHS] [X,Y ►X+Y•i]**	Enter the second complex number “-8+6i” into the Complex Stack.
”0” **[ENTER]** “3” **[X,Y►X+Y•i]**	Enter the exponent number “3+0i” into the Complex Stack.
Menu key **[∧]**	Calculate $(-8 + 6i)^3 = (352 + i•936)$
Menu key **[x]**	Calculate $2i•(-8 + 6i)^3 = (-1{,}872 + i•704)$
[OPT]	Hide the menu to access “√ “key.
”5” **[√x]** “2” **[x] [CHS]** “4” **[ENTER]**	Calculates -2•√5 in stack-Y and put 4 in stack-X.
”5” **[√x]** “4” **[x] [CHS]** “2”	Calculates -4•√5 in stack-Y and put 2 in stack-X.
[OPT] [Complex Math]	Display the Complex Math menu
[X,Y►X+Y•i] **[X,Y►X+Y•i]**	Enter (2 - i•4•√5). Enter (4 - i•2•√5).
Menu key **[x]**	Calculates (4-i•2•√5)•(2-i•4•√5) = 32 + i•44.72
Menu key **[÷]**	Final operation. **Result = 9.3982 - i•35.1344**
[Y↑] [X↑]	Output the complex stack-X to the calculator stack-X = Real part; stack-Y = Imaginary.

Example 2: (Arithmetic calculation)
Calculate the phasor expression: $2 \angle 65^o + 3 \angle 40^o = ?$

Solution: (assumes DEG angular units already set)

Keystrokes	Description
Complex Stack Display	Touch the display to set display format to Polar (phasor) coordinates (Radius, Angle).
”65” **[ENTER]** “2”	Enter the 1st phasor and convert it to rectangular coordinates.
[X,Y ▶X∢Y]	Enter the coordinates in the Complex Stack.
”40” **[INPUT]** “3”	Enter the 2nd phasor and convert it to rectangular coordinates.
[X,Y ▶X∢Y]	Enter the coordinates in the Complex Stack.
Menu key **[+]**	Adds the complex numbers. **Result = 4.8863∢49.9612°**
[R↑] [Θ↑]	Output the complex stack-X to the calculator stack-X = Radius; stack-Y = Angle.

Example 3: (Arithmetic calculation)
Calculate the phasor expression:
calculate all the following functions:
a) Reciprocal, the square and the square root of (4.5 + 3.2•i);
b) Sine, Cosine and Tangent of the (3 + 4•i);
c) ASine, ACosine and ATangent of (2.5 + 4.2•i)
d) Log, Ln and Log_2 of (5 - 3•i);
e) Hyperbolic Sine, Cosine and Tangent of the (1.3 + 2.4•i);
f) Hyperbolic ASine, ACosine and ATangent of (2.3 + 4.1•i)
g) ALog, ALn and $ALog_2$ of (1.5 - 3.2•i);

Solution: (assumes FIX 2 number format)

Keystrokes	Description
Complex Stack Display	Touch the display to set display format to Rectangular coordinates (X, Y).
3.2 **[ENTER]** 4.5 **[X,Y ▶ X+i•Y]**	Enter the a) complex number
[1 / Z] **[LstZ] [F(z)] [INV] [Z^2]** **[LstZ] [F(z)] [√z]**	Calculates 1/z = **0.15 - 0.10•i** Calculates z^2 = **10.01 + 28.80•i** Calculates √z = **2.24 - 0.71•i**
4 **[ENTER]** 3 **[X,Y ▶ X+i•Y]**	Enter the b) complex number
[F(z)] [SIN] **[LstZ] [F(z)] [COS]** **[LstZ] [F(z)] [TAN]**	Calculates Sin = **3.85 - 27.02•i** Calculates Cos = **-27.03 - 3.85•i** Calculates Tan = **-1.87E-04 - 1.00•i**
4.2 **[ENTER]** 2.5 **[X,Y ▶ X+i•Y]**	Enter the c) complex number
[F(z)] [INV] [SIN^{-1}] **[LstZ] [F(z)] [INV] [COS^{-1}]** **[LstZ] [F(z)] [INV] [TAN^{-1}]**	Calculates ASin = **0.53 + 2.28•i** Calculates ACos = **1.04 - 2.28•i** Calculates ATan = **1.46 + 0.18•i**
3 **[CHS] [ENTER]** 5 **[X,Y ▶ X+i•Y]**	Enter the d) complex number
[F(z)] [LOG] **[LstZ] [F(z)] [LN]** **[LstZ] [F(z)] [Log_2]**	Calculates Log = **0.77 - 0.23•i** Calculates Ln = **1.76 - 0.54•i** Calculates Log_2 = **2.54 - 0.78•i**
2.4 **[ENTER]** 1.3 **[X,Y ▶ X+i•Y]**	Enter the e) complex number
[F(z)] [Sinh] **[LstZ] [F(z)] [Cosh]** **[LstZ] [F(z)] [Tanh]**	Calc. Hyp Sin = **-1.25 + 1.33•i** Calc. Hyp Cos = **-1.45 - 1.15•i** Calc. Hyp Tan = **0.98 - 0.15•i**

Keystrokes	Description
4.1 **[ENTER]** 2.3 **[X,Y ▶ X+i•Y]**	Enter the f) complex number
[F(z)] [INV] [Sinh^{-1}] **[LstZ] [F(z)] [INV] [Cosh^{-1}]** **[LstZ] [F(z)] [INV] [Tanh^{-1}]**	Calc. Hyp Sin = **2.24 + 1.05•i** Calc. Hyp Cos = **2.25 + 1.07•i** Calc. Hyp Tan = **0.10** + **1.39•i**
3.2 **[CHS] [ENTER]** 1.5 **[X,Y ▶ X+i•Y]**	Enter the g) complex number
[F(z)] [INV] [10^{x}] **[LstZ] [F(z)] [INV] [e^{x}]** **[LstZ] [F(z)] [INV] [2^{x}]**	Calc. 10^{x} = **14.76 - 27.97•i** Calc. e^{x} = **-4.47 + 0.26•i** Calc. 2^{x} = **-1.71** - **2.26•i**