Entering and Using Complex Numbers

Complex-Number Modes

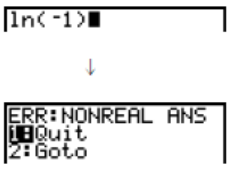
The TI-84 Plus displays complex numbers in rectangular form and polar form. To select a complex-number mode, press MODE, and then select either of the two modes.

- **a+b***i* (rectangular-complex mode)
- **re^θ***i* (polar-complex mode)

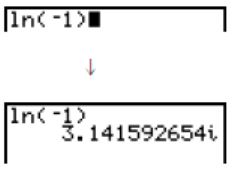
On the TI-84 Plus, complex numbers can be stored to variables. Also, complex numbers are valid list elements.

In Real mode, complex-number results return an error, unless you entered a complex number as input. For example, in Real mode **ln(-1)** returns an error; in **a+b***i* mode **ln(-1)** returns an answer.

Real mode



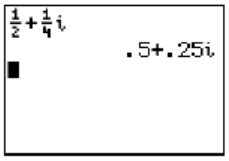
a+b*i* mode



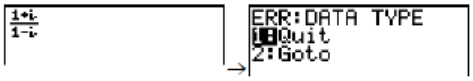
Entering Complex Numbers

Complex numbers are stored in rectangular form, but you can enter a complex number in rectangular form or polar form, regardless of the mode setting. The components of complex numbers can be real numbers or expressions that evaluate to real numbers; expressions are evaluated when the command is executed.

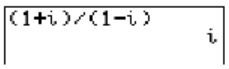
You can enter fractions in complex numbers, but the output will always be a decimal value.



When you use the n/d template, a fraction cannot contain a complex number.



You can use division to compute the answer:



Note about Radian Versus Degree Mode

Radian mode is recommended for complex number calculations. Internally, the TI-84 Plus converts all entered trigonometric values to radians, but it does not convert values for exponential, logarithmic, or hyperbolic functions.

In degree mode, complex identities such as $e^{(i\theta)} = \cos(\theta) + i\sin(\theta)$ are not generally true because the values for cos and sin are converted to radians, while those for e^( ) are not. For example, $e^{(i45)} = \cos(45) + i\sin(45)$ is treated internally as $e^{(i45)} = \cos(\pi/4) + i\sin(\pi/4)$. Complex identities are always true in radian mode.

Interpreting Complex Results

Complex numbers in results, including list elements, are displayed in either rectangular or polar form, as specified by the mode setting or by a display conversion instruction. In the example below, polar-complex (**re^θ*i***) and Radian modes are set.

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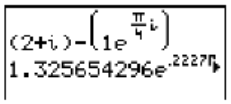

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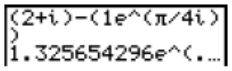
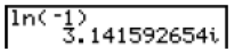


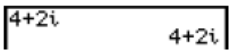
Rectangular-Complex Mode

Rectangular-complex mode recognizes and displays a complex number in the form **a+b*i***, where **a** is the real component, **b** is the imaginary component, and *i* is a constant equal to $\sqrt{-1}$.



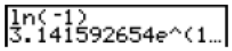
To enter a complex number in rectangular form, enter the value of *a* (*real component*), press + or −, enter the value of *b* (*imaginary component*), and press 2nd [*i*] (constant).

real component(**+** or **−**)*imaginary component i*



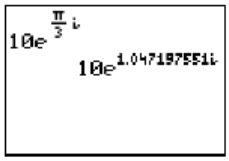
Polar-Complex Mode

Polar-complex mode recognizes and displays a complex number in the form $re^{\wedge}\theta i$, where *r* is the magnitude, *e* is the base of the natural log, θ is the angle, and *i* is a constant equal to $\sqrt{-1}$.



To enter a complex number in polar form, enter the value of r (*magnitude*), press 2nd [e^x] (exponential function), enter the value of θ (*angle*), press 2nd [i] (constant), and then press).

*magnitude***e^(***anglei***)**



MathPrint™

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10e^(π/3i)
10e^(1.04719755…
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Classic

MATH CPX (Complex) Operations

MATH CPX Menu

To display the **MATH CPX** menu, press MATH ▸ ▸.

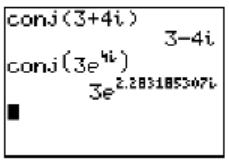
MATH NUM CPX PRB		
1:	conj(	Returns the complex conjugate.
2:	real(	Returns the real part.
3:	imag(	Returns the imaginary part.
4:	angle(	Returns the polar angle.
5:	abs(	Returns the magnitude (modulus).
6:	▸Rect	Displays the result in rectangular form.
7:	▸Polar	Displays the result in polar form.

conj(

conj((conjugate) returns the complex conjugate of a complex number or list of complex numbers.

conj(*a***+***bi***)** returns $a-bi$ in **a+b***i* mode.
conj(*r***e^(**θ*i*))** returns $re^{(-\theta i)}$ in **re^**θ*i* mode.

MathPrint™



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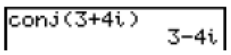
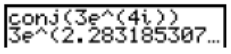


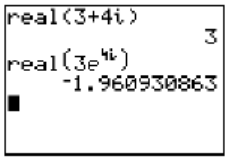


real(

real((real part) returns the real part of a complex number or list of complex numbers.

real(*a***+***bi***)** returns *a*.
real(*r***e^(**θ*i***))** returns *r*•*cos*(θ).

MathPrint™



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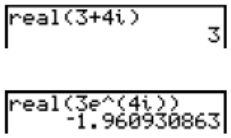
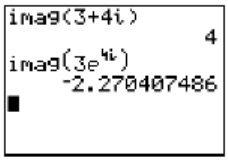


imag(

imag((imaginary part) returns the imaginary (nonreal) part of a complex number or list of complex numbers.

imag(*a***+***bi***)** returns *b*.
imag(*r***e^(**θ*i***))** returns *r*•*sin*(θ).

MathPrint™



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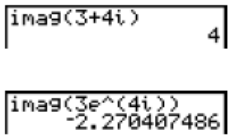
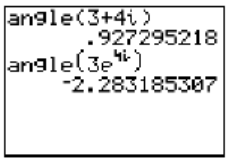


angle(

angle(returns the polar angle of a complex number or list of complex numbers, calculated as $\tan^{-1}$ (b/a), where b is the imaginary part and a is the real part. The calculation is adjusted by $+\pi$ in the second quadrant or $-\pi$ in the third quadrant.

angle(*a***+***bi***)** returns $\tan^{-1}(b/a)$.
angle(*r***e^(**θ*i***))** returns θ, where $-\pi<\theta<\pi$.

MathPrint™



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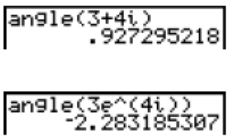
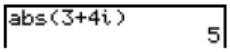


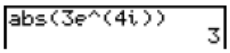
abs(

abs((absolute value) returns the magnitude (modulus), $\sqrt{real^2+imag^2}$, of a complex number or list of complex numbers. You can also access **abs(** from the **FUNC** shortcut menu (ALPHA [F2] **1**).

abs(*a***+***bi***)** returns $\sqrt{a^2+b^2}$.
abs(*r***e^(**θ*i*))** returns *r* (magnitude).

$\sqrt{real^2+imag^2}$

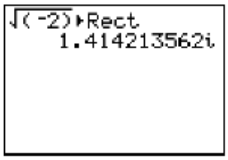




▸Rect

▸Rect (display as rectangular) displays a complex result in rectangular form. It is valid only at the end of an expression. It is not valid if the result is real.

complex result▸**Rect** returns *a*+*bi*.



▸Polar

▸Polar (display as polar) displays a complex result in polar form. It is valid only at the end of an expression. It is not valid if the result is real.

complex result▸**Polar** returns *r***e^(**θ*i*).