

Chapter 8 / Example 10

Complex numbers

The TI-84 Plus C will not work directly in degrees with the complex number operations of modulus and argument. Enter angles in degrees using the degree symbol.

The voltage of an AC electrical sources can be modelled by the equation $V = a\sin(bt + c)$, where c is the phase shift. Two AC sources with equal frequencies are combined. One has a maximum voltage of 60V and the other of 80V. The amplitude of the sine function gives the maximum voltage of each electrical source. The first electrical source has a phase shift of 30° and the other of 120° . Find the maximum voltage and the phase difference of the combined source.

$$\text{amplitude} = |60e^{30^\circ i} + 80e^{120^\circ i}|$$

Press **MENU** 1 **RUN-MAT** to display the Run-Matrix screen for arithmetical calculations.

To enter the modulus function press **F4** MATH **F3** Abs

To type $60e^{30^\circ i}$

Type 60 and press **SHIFT** **ln** e^x

Type 30 and press **OPTN** **F6** \triangleright **F5** ANGLE **F1** $^\circ$

Press **SHIFT** **0** i

Press **▶** and type $+ 80e^{120^\circ i}$

Press **EXE**.

The calculator screen displays the expression $|60e^{30^\circ i} + 80e^{120^\circ i}|$ and the result 100. The bottom of the screen shows the function menu with options for angle and degree symbols.

$$\text{Phase shift} = \arg 60e^{30^\circ i} + 80e^{120^\circ i}$$

Press **OPTN** **F3** COMPLEX **F3** Arg

Type $60e^{30^\circ i} + 80e^{120^\circ i}$ and press **EXE**.

Remember to enclose the complex number in parentheses.

The calculator screen displays the expression $\text{Arg}(60e^{30^\circ i} + 80e^{120^\circ i})$ and the result 1.450893994. The bottom of the screen shows the function menu with options for angle and degree symbols.

Since the GDC is in radian mode by default, this argument is in radians.

There is a function to convert answers in radians into degrees, but to use this, the calculator must be in degree mode.

An easier method is to multiply by $\frac{180}{\pi}$

Type $\times 180 \div \pi$ and press \cdot .

$$\arg 60e^{30^\circ i} + 80e^{120^\circ i} = 83.1^\circ$$

The calculator screen displays the expression $\text{Arg}(60e^{30^\circ i} + 80e^{120^\circ i})$ and the result 1.450893994. Below it, the expression $\text{Ans} \times 180 \div \pi$ is shown with the result 83.13010235. The bottom of the screen shows the function menu with options for angle and degree symbols.