



## hp calculators

### HP 49G+ Working with Polar Plots

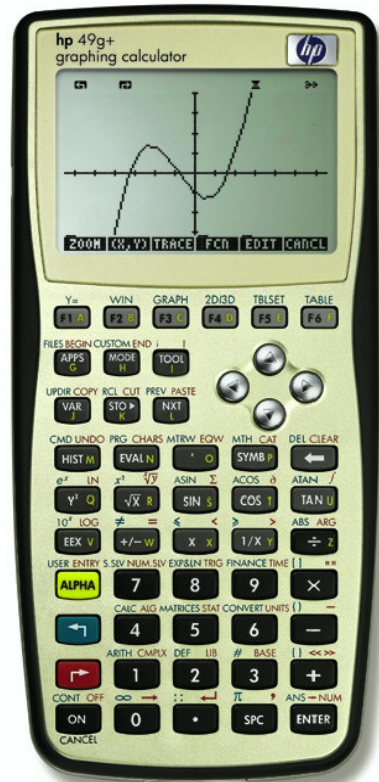
Plotting on the HP 49G+

The 2D/3D (PLOT SETUP) Form

The Y= Form

The WIN Form

Examples of polar plots



## Plotting on the HP 49G+

The HP 49G+ calculator provides a host of plots to allow the user to visualize data or relationships between them. The GREEN shifted functions of the top row of keys on the HP 49G+ allow access to many of the input forms where plotting specifications may be entered.

### The 2D/3D (PLOT SETUP) Form

The 2D/3D (PLOT SETUP) Form is accessed from the LEFT shifted function of the  $\text{F4}$  key by pressing and **holding down**  $\text{F4}$  and then pressing  $\text{F4}$ , to access  $\text{2D/3D}$ . When pressed, a form is displayed with a number of choices related to plotting.

Figure 1

The first choice deals with choosing the plot type. The selections for plot type are displayed by pressing  $\text{F2}$ , which has the label  $\text{TYPE}$  right above it. The plot types include plotting functions, polar plots, parametric plots, differential equation plots, conic plots, truth plots, histograms, bar charts, scatter charts, slopefield charts, fast 3D charts, wireframe plots, Ps-contour plots, Y-slice plots, gridmap plots, and Pr-surface plots. A CHOOSE Box appears as shown below.

Figure 2

The Plot Setup form also allows the user to specify the equation being plotted if the cursor is placed on the EQ: field and the  $\text{EQW}$  menu label is pressed – this invokes the EquationWriter to allow for the construction of the equation to be plotted. The form also allows the angle measure used and the independent variable to be specified (note: the default is often 'X', but for polar plots, this will be changed to  $\theta$  (theta)). In addition, several check boxes that are used to indicate whether the plotted points should be automatically connected together by the calculator and the horizontal and vertical tick marks used for the graph. The form also allows for the plotting of more than one function at a time.

### The Y= Form

The Y= form provides another way to enter your equation or function to plot. Press and **hold down**  $\text{F4}$  and then press  $\text{F1}$ , which is  $\text{Y=}$ . The following form appears:

Figure 3

Press  $\text{F2}$ , with label  $\text{TYPE}$  above it, to add a function using the equation writer.

## The WIN Form

The WIN form allows for the plot window specifications to be entered and changed. The lower and upper horizontal and vertical values displayed on the graph can be changed. The lower and upper value for the independent variable can also be specified on this form. To open the WIN form, press and hold down  $\leftarrow$  and press  $F2$ , which is  $\underline{WIN}$ . The following form appears:

```

PLOT WINDOW - FAST3D
X-Left:-1.    X-Right:1.
Y-Near:-1.    Y-Far: 1.
Z-Low: -1.    Z-High: 1.

Step Indep:10. Depnd:2.
Enter indep var sample count
EDIT          ERASE DRAW

```

Figure 4

The menu label  $\left[ \text{FAST3D} \right]$  will discard the results of a previous plot and the menu label  $\left[ \text{DRAW} \right]$  will begin the plot.

## Examples of Polar Plotting

Example 1: Plot the equation below as a polar plot.

```

PLOT - POLAR
R1(θ)=
3
√COS(θ)²+2·SIN(θ)²

```

EDIT ADD DEL CHOOSE ERASE DRAW

Figure 5

Solution:  $\leftarrow$  2D/3D  $\left[ \text{FAST3D} \right]$   $\rightarrow$   $\uparrow$   $\downarrow$  ENTER (do not forget to press AND hold the  $\leftarrow$  key while pressing the 2D/3D key)

```

PLOT SETUP
Type:Polar      d:Rad
EQ:

Indep:'θ'      _Simult  ✓Connect
H-Tick:10.    V-Tick:10. ✓Pixels

```

CANCEL OK

Figure 6

$\downarrow$   $\downarrow$   $\left[ \text{FAST3D} \right]$   $\leftarrow$   $\leftarrow$  ALPHA  $\rightarrow$  T  $\left[ \text{OK} \right]$  (this sets the independent variable to theta for a polar plot)

```

PLOT SETUP
Type:Polar      d:Rad
EQ:

Indep:'θ'      _Simult  ✓Connect
H-Tick:10.    V-Tick:10. ✓Pixels
Connect plot points?

```

EDIT ✓CHK  $\left[ \text{AXES} \right]$  ERASE DRAW

Figure 7

$\leftarrow$   $\underline{Y=}$   $\left[ \text{FAST3D} \right]$  3  $\div$   $\sqrt{x}$  COS ALPHA  $\rightarrow$  T  $\uparrow$   $\uparrow$

$$R1(\theta) = \frac{3}{\sqrt{\cos(\theta)}}$$

EDIT CURS  $\left[ \text{BIG} \right]$  EVAL FACTO SIMP

Figure 8

$\underline{Y^x}$  2  $\uparrow$   $\uparrow$  + 2 SIN ALPHA  $\rightarrow$  T  $\uparrow$   $\uparrow$   $\underline{Y^x}$  2 ENTER

$$R1(\theta) = \frac{3}{\sqrt{\cos(\theta)^2 + 2\sin(\theta)^2}}$$

EDIT ADD DEL CHOOSE ERASE DRAW

Figure 9

ERASE DRAW

Answer: The polar plot is displayed. . An ellipse will be drawn.

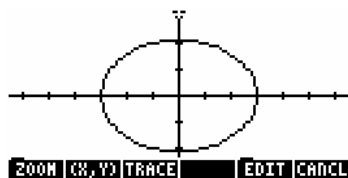


Figure 10

To get out of the Plot Environment press **EXIT**.

Example 2: Plot the equation below as a polar plot.

Solution: 2D/3D ENTER (do not forget to press AND hold the key while pressing the 2D/3D key)

$$R1(\theta) = 2 \cdot \cos(4 \cdot \theta)$$

EDIT CURS BIG = EVAL FACTO SIMP

Figure 11

ALPHA (this sets the independent variable to theta for a polar plot)  
 2 COS 4 ALPHA ENTER

$$R1(\theta) = 2\cos(4\theta)$$

EDIT ADD DEL CHOOSE ERASE DRAW

Figure 12

ERASE DRAW

Answer: The polar plot is displayed.

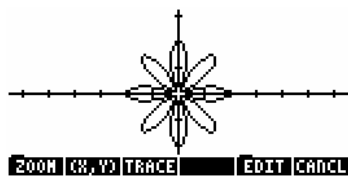


Figure 13

To get out of the Plot Environment press **EXIT**.































Example 3: Plot the equation below as a polar plot.

$$R_2(\theta) = 2 \cdot (1 - \sin(\theta/2))$$

EDIT CURS BIG = EVAL FACTO SIMP

Figure 14

Solution:

      (do not forget to press AND hold the  key while pressing the  key)  
         (this sets the independent variable to theta for a polar plot)  
            

```

PLOT - POLAR
R1(θ)=2·COS(4·θ)
R2(θ)=20(1-SIN(θ))

```

EDIT	ADD	DEL	CHOO3	ERASE	DRAN
------	-----	-----	-------	-------	------

Figure 15

← WIN 8 +/- ENTER 8 ENTER 6 +/- ENTER 6 ENTER 0 ENTER 2 ←  $\pi$  × →  $\rightarrow$ NUM

```

PLOT WINDOW - POLAR
H-View:-8.      8.
V-View:-6.      6.
Indep Low: 0.    High:8.
Step: Default    Pixels

```

2 π \* 

Figure 16

$$\boxed{\curvearrowright} \rightarrow \underline{NUM}$$

```

PLOT WINDOW - POLAR
H-View:-8.      8.
V-View:-6.      6.
Indep Low: 0.    High:6.28318
Step: Default   _Pixels

```

Enter indep var increment

Figure 17

~~SECRET~~ ~~ORCON~~

Answer: The polar plot is displayed. This shape is called a cardioid.

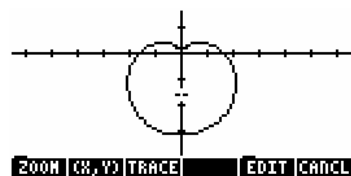


Figure 18

To get out of the Plot Environment press **Ctrl**.