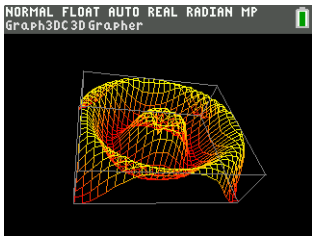

Graph3DC

3D Grapher for the TI-84 Plus C Silver Edition
By Christopher Mitchell ("Kerm Martian")

Graph3DC is a 3D graphing application for the TI-84 Plus C Silver Edition graphing calculator. It integrates with the TI-OS, allowing you to seamlessly switch between graphing 2D and 3D functions on your calculator. Built on the engine developed for Graph3DP for the Casio Prizm, Grap3DC renders fast, accurate 3D wireframe plots on your calculator. You can rotate and zoom functions, trace over the mesh to find Z values at (X,Y) points, graph up to five equations simultaneously, and much more. To avoid teacher and student confusion, it offers a "2D Mode" option in its Z= (Y=) menu to instantly switch back to the TI-OS's 2D function graphing.

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1 Installing Graph3DC

To install Graph3DC on your calculator, you need a TI-84 Plus C Silver Edition and the Graph3DC.8ck file that should have been provided with this manual. Graph3DC will **not** work on the TI-84 Plus CE, or on any of the monochrome TI-83 Plus/TI-84 Plus calculators. A TI-84 Plus CE version of Graph3DC may be available on Cemetech; for the monochrome calculators, Graph3 is an admirable option.

To install Graph3DC on your graphing calculator, you'll need linking software that lets your computer talk to your calculator. Currently-available options are TI Connect, TI Connect CE, or TILP. For each of these pieces of software, you can either drag the Graph3DC.8ck file into the linking software, or do the equivalent of Actions → Send File to Calculator. Refer to your linking software's manual for specifics on how to send a file to your calculator if you're not familiar with this process.

Once you have sent Graph3DC.8ck to your calculator, a new entry entitled `Graph3DC` will appear in your Apps menu. To enable or disable Graph3DC, press the [APPS] key, use the arrow keys to select `Graph3DC`, and press [ENTER]. You will see a menu like the two shown below in Figure 1:

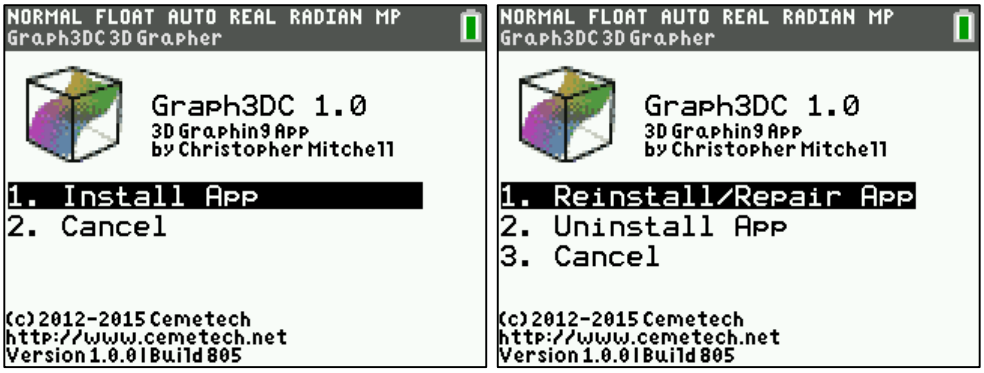

Figure 1: Graph3DC main menu, allowing you to install, reinstall, or uninstall the 3D graphing application. Note that you can still switch between 2D and 3D graphing when Graph3DC is installed. It keeps the TI-OS's 2D graphing functions accessible.

The Install App or Reinstall/Repair App options will make 3D graphing available on your calculator, and the Uninstall App option will remove 3D graphing (but leave Graph3DC in the Apps menu, should you want to re-enable 3D graphing). Selecting Cancel will quit back to the homescreen without changing anything.

Using TI-OS 2D (Function) Graphing with Graph3DC Installed
The TI-OS function graphing tools are **always** available when Graph3DC is installed on your calculator. It does not remove or disable them. To switch between 2D (TI-OS function) graphing and 3D graphing, simply press [Y=], [▲], and choose 2D Mode or 3D Mode.

1.1 Switching Between 2D and 3D Graphing

When Graph3DC is installed, you always have the option of using its 3D graphing tools or instantly switching back to the TI-OS's 2D function graphing tools. If you installed Graph3DC as in the previous section, you can switch between 2D and 3D mode from the Y= menu. Press the [Y=] button, and you will be at one of the two menus shown below in . Use the arrow keys to move the cursor to either 2D Mode or 3D Mode, then press [ENTER] to switch into that mode. Note that the mode that you're in will affect what the Window, Graph Format, Zoom, Calc, Trace, and Graph tools do. If you don't see

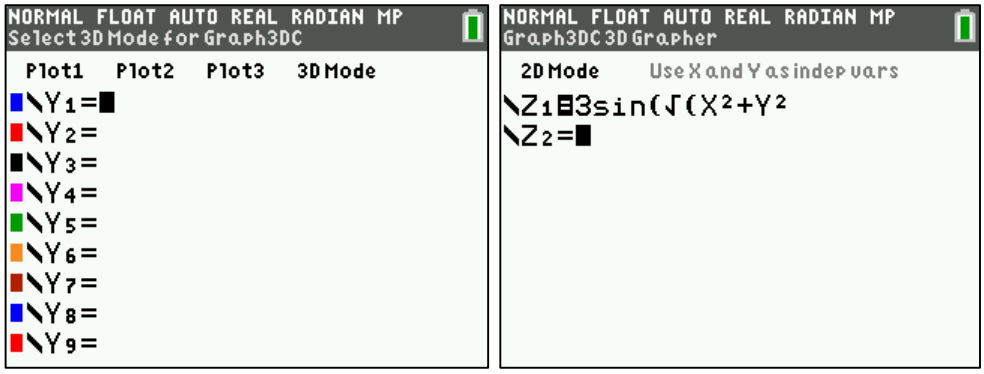

Figure 2: Switching between 2D mode (left) and 3D mode (right) from the Y= menu. Normal TI-OS 2D mode can be used even when Graph3DC is installed. To switch, go to the Y= menu with [Y=], then use the arrow keys to move the cursor to 3D Mode or 2D Mode, and press [ENTER].

2 Using Graph3DC

Using Graph3DC to graph 3D functions is very similar to using the TI-OS tools to graph 2D functions. You enter equations in the Y= menu, change the window in the Window menu, set the graph formatting options in the Graph Format menu, and examine the graph with [GRAPH] and [TRACE]. This section will give you a brief overview of using those specific features.

Accessing 3D Graphing Tools
The menus and tools described in this section are only available in 3D graphing mode. If you are in 2D mode, then you won't be able to find the tools described in this section. To find them, switch to 3D mode as explained in Section 1.1.

2.1 Entering Equations to Graph

Before you can graph any equations, you need to enter those equations. Make sure that Graph3DC is installed, as discussed in Section 1. Press [Y=], and if you're in the normal Y= menu (that is, Y_1 through Y_0, X_{1T} and Y_{1T}, r_1 through r_6, or *n*Min and others are visible), you can switch to 3D mode by using the arrows to move the flashing cursor to 3D Mode and pressing [ENTER]. You will be in the 3D Z= menu, where you can define Z_1 through Z_5 as Z_n=f(X,Y). Enter your equation for Z as a function of X and Y. Here are some sample equations (choose one or more) you may wish to try:

- $Z_1=3\sin(\sqrt{(X^2+Y^2)})$
- $Z_1=9\sin(\sqrt{(X^2+Y^2)})/\sqrt{(X^2+Y^2)}$ *("Sombrero Function")*
- $Z_1=3\sqrt{(X/Y)}$
- $Z_1=\sqrt{(81-X^2-Y^2)}$ *and* $Z_2=-\sqrt{(81-X^2-Y^2)}$ *(Sphere. Note negative symbol in Z_2)*
- $Z_1=\sin(.5X)+\sin(.5Y)$

Figure 3: Entering an equation to graph in Graph3DC's Z= menu

After entering an equation, press GRAPH to graph the equation. The following section walks you through manipulating a graph.

2.2 Viewing 3D Graphs

After you have entered equation(s) in the Z= menu and pressed GRAPH, Graph3DC will perform an initial computation to find the Z value of the equation(s) at each test (X, Y) point. It will then display a graph of the equation(s) that you can rotate with the arrow keys (▲ ▼ ◀ ▶) and zoom with + and −.

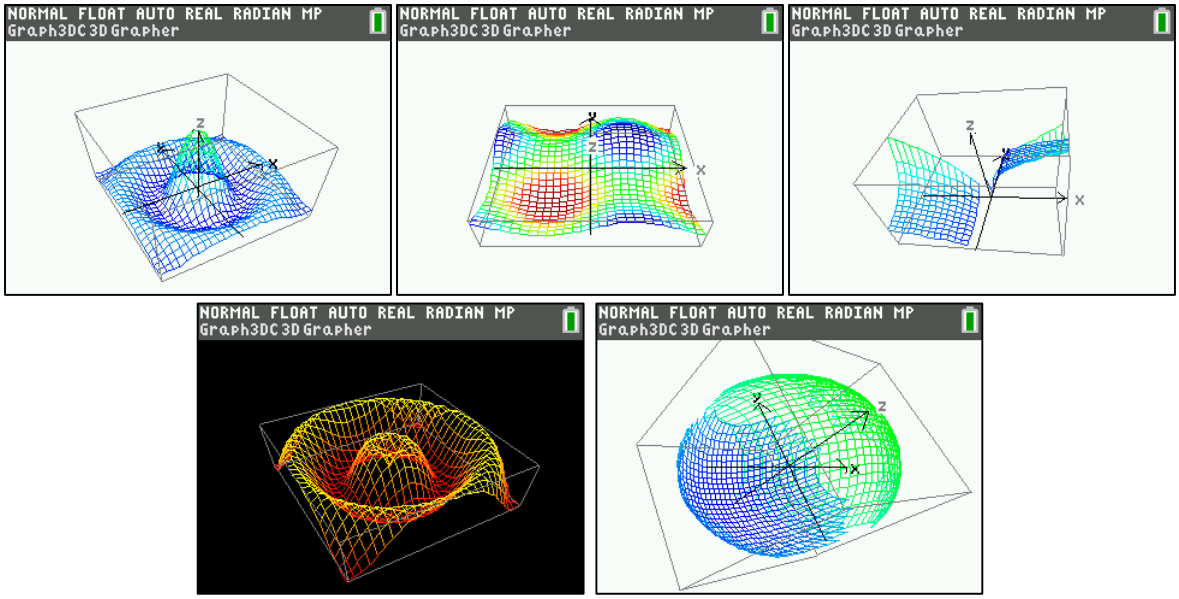

Figure 4: Sample graphs drawn from the equations listed in Section 2.1. A variety of the available graph formatting options from the Graph Format menu (2nd ZOOM) have been applied, including turning the axes and labels on and off, changing the plot color, and changing the background color.

2.3 Examining Graphs with Trace

You can explore the (X, Y, Z) coordinates of the points in the graph with the Trace tool. Press TRACE from any menu, including the Y= menu and the Graph tool, and the graph will be shown with a trace cursor. Use the arrow keys (▲ ▼ ◀ ▶) to move the trace cursor around the graph. If you want to change the rotation of the graph to get a different perspective, press GRAPH, rotate the graph as desired, then press TRACE again to resume tracing.

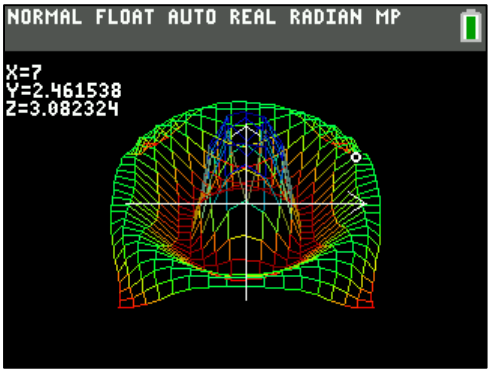

Figure 5: Tracing over the points in a 3D graph's mesh. The trace cursor is a white circle at upper-right, and the (X, Y, Z) coordinates of the current point are shown in the top-left corner of the graph.

2.4 Changing 3D Window Bounds

Just as the TI-OS lets you change the bounds of the window (the coordinates of the edges of the graph screen) for 2D functions, Graph3DC lets you change the bounds of the window for 3D functions. Access the 3D Window menu with the WINDOW key, and you'll see something like Figure 6.

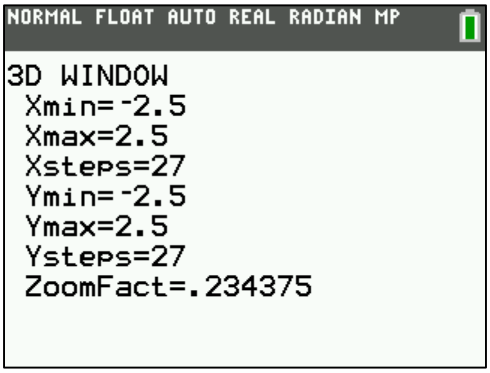

Figure 6: The 3D Window menu, where you can set the minimum and maximum values for X and Y used for graphing each function, the granularity of the grid, and how dramatically to change the window when zooming in and out.

The individual options in the 3D Window menu:

- `Xmin`: The lowest X value plugged into Z=f(X,Y) functions.
- `Xmax`: The highest X value plugged into Z=f(X,Y) functions.
- `Xsteps`: The number of lines used to generate the mesh from `Xmin` to `Xmax`. The larger this value, the more detailed the graph, but the longer the initial computation takes. In normal resolution mode, the maximum `Xsteps` value is 17. In high resolution mode, the maximum `Xsteps` value is 27.
- `Ymin`: The lowest Y value plugged into Z=f(X,Y) functions.
- `Ymax`: The highest Y value plugged into Z=f(X,Y) functions.
- `Ysteps`: The number of lines used to generate the mesh from `Ymin` to `Ymax`. The larger this value, the more detailed the graph, but the longer the initial computation takes. In normal resolution mode, the maximum `Ysteps` value is 17. In high resolution mode, the maximum `Ysteps` value is 27.

- `ZoomFact`: The scaling factor (between 0 and 1) applied to `Xmin`, `Xmax`, `Ymin`, and `Ymax` when zooming. The default is 0.75: the X and Y spans will get 25% smaller when zooming in, and (1/0.75) = 33% larger when zooming out. The closer to 0 the `ZoomFact`, the more dramatic zooming will be, while the closer to 1 it is, the more gradual zooming will be.

2.5 Changing 3D Graph Format Settings

You can tweak graph format settings to change the appearance of graphed functions and to switch between high and normal resolution modes. To access the graph format settings, press 2nd ZOOM; you'll see a menu like Figure 7. The Axes, Bounds, Color, Background, and Label options are self-explanatory; experiment with them and check GRAPH to see what settings look good to you. The Resolution option lets you switch between a normal resolution setting that lets you graph up to 5 equations simultaneously, and a high resolution setting that lets you graph up to 2 equations simultaneously.

Figure 7: The 3D Graph Format menu, which lets you change the appearance and resolution of graphs.

2.6 Zooming a 3D Graph

Graph3DC offers an abbreviated set of the zoom functions that the TI-OS provides for 2D graphs. You can access the Zoom menu with the ZOOM key, then choose to Zoom In, Zoom Out, or reset to the default ZoomStandard settings. You can also press CLEAR or 2nd MODE to quit from the Zoom menu without choosing any of its options.

Figure 8: The 3D Zoom menu, from which you can zoom the 3D graph in or out, or reset the window back to defaults.

3 More Information

If you have questions, you can post on the Cemetech Forum at https://www.cemetech.net/forum. Alternatively, you can contact the author at graph3dc@cemetech.net, on Twitter as @Cemetech or @KermMartian, or on Facebook at https://www.facebook.com/Cemetech.

4 Acknowledgments

A number of people contributed to making Graph3DC possible. I owe both an ideological and engineering tip of the hat to Kirk Meyer and Martin Warmer, authors of Graph3 for the monochrome TI-83 Plus/TI-84 Plus calculators. Their work and open source allowed me to resolve some finer points of interacting with the TI-OS via hooks that was not documented elsewhere. My Cemetech administrators encouraged me to continue working on this software when it was clear making it a TI-84 Plus CE App would not be allowed, especially Daniel “tifreak8x” Thorneycroft; the moral support was key in motivating me to complete it. Graph3DC’s tireless beta-testers helped me make it as stable and bug-free as possible, including readroof2, Noah “Ivoah” Rosamilia, and Peter “PT_” Tillema. Finally, I’d like to thank and apologize to TW and JL for my time with them that this project stole.