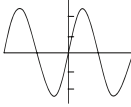


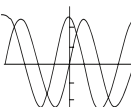
◆ Overdrawing built-in function graphs

Two or more different built-in functions can be drawn together on the same display. Since the range for the first graph is automatically set, all subsequent graphs on the same display are produced according to the range of the first graph (provided that all subsequent graphs are user defined graphs). The first graph is produced by using the previously mentioned operation. Subsequent graphs are produced using the variable "Y" in the operation.

Say, the function Y1 is defined as $Y1 = \sin^2$ for plotting the built-in sine curve.



Then overdrew the graph $Y = \cos^2$ on the graph above. To do so, the function Y2 should be defined as $Y2 = \cos^2$ variable "Y" has to be entered in this case since $Y = \cos^2$ is not a built-in function).



III. User Generated Graphs

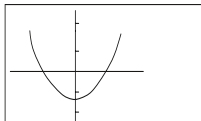
User generated graphs can be divided into function graphing and parametric graphing. In function graphing, the user should input a formula in the format of $y = f(x)$ while in parametric graphing, both $x = f(t)$ and $y = f(t)$ should be defined.

◆ Specifying range parameters

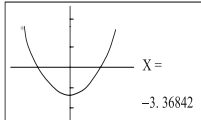
Unlike built-in functions, the ranges of user generated graphs are not set automatically, so graphs produced outside of the display range do not appear on the display. Range parameters are used to define the size of the graph window. The parameters consist of the following -

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For example, graph $y = x^2 - 3$ on the screen.

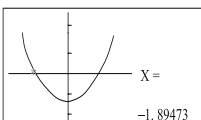


Activate the Trace function by pressing [TRACE]. A blinking pointer will be located on the leftmost of the curve and the corresponding x-coordinate will be shown.

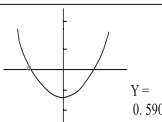


You can use the buttons [←] or [→] to move the pointer along the graph. Each press moves the cursor one point. Holding down either key moves the pointer at high speed. The corresponding coordinate reading shown on the lower right part of the screen will be updated all the way.

Press [→] consecutively.



Besides the x-coordinate, you can also read the y-coordinate of the blinking pointer by pressing [SHIFT][X↔Y] which will toggle the reading of x-coordinate and y-coordinate.



As you trace along the curve, either x-coordinate or y-coordinate will be shown in 7-digit mantissa plus a 2-digit exponent. If you want to get the exact value, you can press [VALUE] to read the value which will be displayed in 11-digit mantissa plus a 2-digit exponent as below.

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Xmin - the minimum value of the x-axis
Xmax - the maximum value of the x-axis
Xscl - scale of the x-axis (distance between hash marks)
Ymin - the minimum value of the y-axis
Ymax - the maximum value of the y-axis
Yscl - scale of the y-axis (distance between hash marks)
Tmax - the minimum value of parameter "t" for parametric graphs
Tmin - the maximum value of parameter "t" for parametric graphs
Pitch - the pitch value for parametric graphs

How to set the range parameters

To set the range parameters, one should press the [RANGE] key (except in the BASIC and OUTPUT mode). The range parameter setting screen appears on the display. Enter the value you want to specify for the displayed parameter and then press [ENTER].

For example, change the range parameters on the left to those on the right as follows -

Xmin: 0 → 5 Ymin: -10 → -5 Tmax: 0
Xmax: 5 → 5 Ymax: 10 → 15 Tmin: 10
Xscl: 4 → 2 Yscl: 4 → 4 Pitch: 0.1

[RANGE]

X min? 0

Specify X for Xmin.

X min? -5

X max? 5

X scl? 4

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Specify 2 for Xscl.

Y min? -10

Specify -5 for Ymin.

Y max? 10

Specify 15 for Ymax.

Y scl? 4

No change for Tmax.

Specify 10 for Tmin.

T min? 0

T max? 10

Pitch? 5

X min? -5

Leave "RANGE" setting, press [RANGE] again.

Besides range values, you can also input range parameters as expressions such as 2x and these expressions are automatically converted to the values.

Remarks -

➢ If you enter a value that is outside the allowable range or if you try to perform some other illegal operations, an error message appears on the

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Press [→] consecutively to select the desired function.

[→]

SKETCH? Plot

[→]

SKETCH? Tangent Horiz

[→]

SKETCH? Tangent Horiz

[→]

SKETCH? Tangent Vert

Pressing [←] lets you go back to the previous item.

SKETCH? Tangent Horiz

As you have chosen the desired function, press [EXEC] for confirmation and exit from SKETCH menu.

III-1. Plot Function

The Plot function is used to mark a point on the screen of a graph display.

Horizontal - Draw a horizontal line

Vertical - Draw a vertical line

Select Plot function in the SKETCH menu. The command "Plot" will be shown on the display as below.

SKETCH? Plot

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Step 1 - Set the range values as below.

Xmin = 0, Xmax = 10, Xscl = 10
Ymin = 0, Ymax = 20, Yscl = 2

Step 2 - Clear the statistical memory by pressing [SHIFT][EXE].

Step 3 - Input the data.

0 [DT]
10 [DT][DT]
20 [DT][DT]
30 [DT][DT]
40 [DT][DT]
50 [SHIFT][5][DT]
60 [SHIFT][6][DT]
70 [SHIFT][7][DT]
80 [SHIFT][8][DT]
90 [SHIFT][9][DT]
100 [DT][DT]

The formula used for normal distribution curves is -

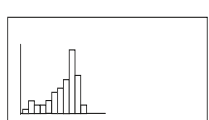
$$y = \frac{1}{\sigma \sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

where μ is the population standard deviation, σ is the mean

Step 4 - Press [DRAW] to draw the graph. You will be asked to select either bar chart or distribution curve by the screen display as below.

SD
DRAW? Bar

Press either [1] or [2] to select the type of graphs. Then press [EXEC] to start the drawing. Say, bar chart has been chosen.



If normal distribution graph is to be drawn, select "Line" above and press [EXEC].

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III. Paired-Variable Statistical Graphs

Paired-variable graphs are drawn in REG mode. When data is input in LR mode, points will be displayed immediately and data is input to the statistical memory.

Example -> Perform linear regression on the following data and draw a regression line graph.

x	9	5	3	1	4	7
y	2	-1	2	3	5	8

Step 1 - Specify the range values as below.

Xmin = -10, Xmax = 10, Xscl = 2
Ymin = -5, Ymax = 15, Yscl = 5

Step 2 - Press [SHIFT][EXE] to clear the statistical memories.

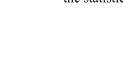
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Step 2 - Input the data.

[SHIFT][SHIFT][SHIFT][SHIFT][DT]
[SHIFT][SHIFT][SHIFT][SHIFT][DT]
[SHIFT][SHIFT][SHIFT][SHIFT][DT]
[SHIFT][SHIFT][SHIFT][SHIFT][DT]
[SHIFT][SHIFT][SHIFT][SHIFT][DT]
[SHIFT][SHIFT][SHIFT][SHIFT][DT]

For each data input, the point is displayed immediately on the screen.

If the data value exceeds the window size, the corresponding data point will not appear on the display but the data will be stored into the statistical memory.



Step 1 - As all the data have been input, press [DRAW] to draw the regression line.



Note - When data input is outside the present range values, the point will not appear.

To read the coefficients of the regression lines, A, B, C, or X, you can press [SHIFT][A], or [SHIFT][B], or [SHIFT][C] respectively.

Step 2 - Press [SHIFT][EXE] to clear the statistical memories.

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display. When this happens, press [←] or [→] to locate the error in the calculation and make the necessary corrections.

➢ Inputting 0 for Xscl or Yscl doesn't set any scales.

➢ Inputting a maximum value that is less than the minimum value will reverse the respective axes.

➢ If the maximum and minimum values of an axis are equal, an error will be generated.

➢ When a range setting is used that does not allow display of the axes, the scale for the y-axis is indicated on either the left or right edge of the display, while that for the x-axis is indicated on either the top or bottom edge.

➢ When the range values are changed or reset, the graph display is cleared and the newly set axes only are displayed.

➢ If the range is set wide or narrow, the graph produced may not fit on the display.

How to check the range parameters

If you want to check all the range parameters, you can press [RANGE] to switch to parameter setting screen. Then press [EXEC] to scroll through the range parameter settings without changing them.

[RANGE]

X min? -5

X max? 5

X scl? 2

Y min? -5

Y max? 15

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[EXEC]

Y scl? 4

[EXEC]

T min? 0

T max? 10

[EXEC]

Pitch? 0.1

[EXEC]

Y min? -5

Y max? 5

[EXEC]

X min? -5

X max? 5

[EXEC]

Y min? -5

Y max? 15

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◆ Generation of Function Graphs

After specifying the range parameters as described above, user generated graphs can be drawn simply by defining the functions (formula) in "FUNC" menu as described above.

For example, the graph for $y = 2x^2 + 3x - 4$ is to be drawn.

Finally, set the ranges to the values shown below.

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You have to specify the x- and y-coordinates after the command "Plot".

For example - Plot a point at x=2 and y=2 on the axes created by the following range values.

Xmin = -5, Xmax = 5, Xscl = 1
Ymin = -10, Ymax = 10, Yscl = 2

Press [SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

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[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

[SHIFT][SKETCH][EXEC][SHIFT][EXEC]

When the pointer is at the location you want, press [EXEC] to plot a point. At this time, the pointer returns to the original point you specified ((-2, 2) in this example).

Now, you can input a new coordinate value to create a new blinking pointer without clearing the present pointer. The present pointer will become a fixed point as shown below.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Xmin = -5, Xmax = 5, Xscl = 2, Ymin = -10, Ymax = 10, Yscl = 4

Then open the "FUNC" menu, select "Y1" and define the function formula of "Y1".

Enter the formula by keying in [2][X][+][3][X][-][4]

Press [EXEC] to go back "FUNC" menu.

Draw the graph by pressing [DRAW]. The graph will be displayed as below.

Press [EXEC] to go back "FUNC" menu.

Draw the graph by pressing [DRAW]. The graph will be displayed as below.

Range values are reset to their initial values by pressing [SHIFT][MC] or [SHIFT][SCL] during range display.

The initial values are as follows -

Xmin: -4.6, Xmax: 4.6, Xscl: 1, Ymin: -2.0, Ymax: 2.0, Yscl: 1, Tmax: 2x, Tmin: 0, Pitch: 2x/45

When parametric graph has been selected in "MODE" menu, you can draw parametric graphs. Similar to function graphs, users should specify the range parameters first to define the graph window. Then be able to input the formula in "FUNC" menu.

Press [SHIFT][FUNC] to open the "FUNC" menu. "PARAM?" is displayed instead of "FUNC" to indicate the parametric function is to be defined.

Finally, set the ranges to the values shown below.

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Draw perpendiculars from the point (2, 0) on the x-axis to its intersection with the graph for $y = 3x$. Then draw a line from the point of intersection to the y-axis.

Let the range values be -

Xmin = -2, Xmax = 5, Xscl = 1, Ymin = -2, Ymax = 10, Yscl = 2

Clear the graph display and draw the graph for $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).

Now plot a point at (2, 0) again and use the cursor key [←] to move the pointer up to the graph of $y = 3x$.

Next, use the Plot function to locate a point at (2, 0).