Chapter 4



# Graphing

A collection of versatile graphing tools plus a large 79 × 47-dot display makes it easy to draw a variety of function graphs quickly and easily. This calculator is capable of drawing the following types of graphs.

- Rectangular coordinate (Y =) graphs
- Parametric graphs
- Inequality graphs

- A selection of graph commands also makes it possible to incorporate graphing into programs.

1. **Before Trying to Draw a Graph**
2. **View Window (V-Window) Settings**
3. **Graph Function Operations**
4. **Drawing Graphs Manually**
5. **Other Graphing Functions**

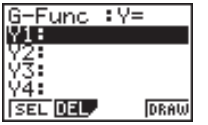
# 1. Before Trying to Draw a Graph

## ■ Entering the Graph Mode

On the Main Menu, select the **GRAPH** icon and enter the GRAPH Mode. When you do, the Graph Function (G-Func) menu appears on the display. You can use this menu to store, edit, and recall functions and to draw their graphs.

*Memory area*

*Use ▲ and ▼ to change selection.*




F1 (SEL) ..... Draw/non-draw status

F2 (DEL) ..... Graph delete

F4 (DRAW) .... Draws graph

# 2. View Window (V-Window) Settings

Use the View Window to specify the range of the *x*-and *y*-axes, and to set the spacing between the increments on each axis. You should always set the View Window parameters you want to use before drawing a graph. Press SHIFT F3 to display the View Window.

1. Press SHIFT F3 to display the View Window.

SHIFT F3 (V-Window)

F1 (INIT) ..... View Window initial settings

F2 (TRIG) ..... View Window initial settings using specified angle unit

F3 (Sto) ..... Store View Window settings to View Window memory.

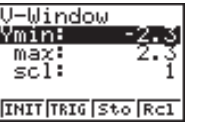
F4 (Rcl) ..... Recall View Window settings from View Window memory.

Xmin..... Minimum *x*-axis value

Xmax..... Maximum *x*-axis value

Xscl ..... Spacing of *x*-axis increments

2. Input a value for a parameter and press [EXE]. The calculator automatically selects the next parameter for input.
   - You can also select a parameter using the ▼ and ▲ keys.

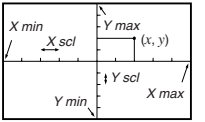



Ymin ..... Minimum $y$-axis value

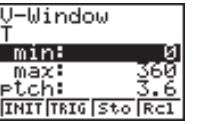
Ymax ..... Maximum $y$-axis value

Yscl ..... Spacing of $y$-axis increments

The following illustration shows the meaning of each of these parameters.




3. Input a value for a parameter and press [EXE]. The calculator automatically selects the next parameter for input.
   - There are actually nine View Window parameters. The remaining three parameters appear on the display when you move the highlighting down past the Y scale parameter by inputting values and pressing ▼.

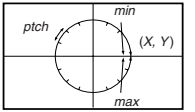



Tmin ..... T minimum values

Tmax ..... T maximum values

Tptch ..... T pitch

The following illustration shows the meaning of each of these parameters.



4. To exit the View Window, press [QUIT].
   • Pressing [EXE] without inputting any value also exits the View Window.

- The following is the input range for View Window parameters.
  –9.99E+97 to 9.999E+97
- You can input parameter values up to 7 digits long. Values greater than $10^6$ or less than $10^{-1}$, are automatically converted to a 4-digit mantissa (including negative sign) plus a 2-digit exponent.
- The only keys that enabled while the View Window is on the display are: [0] to [9], [·], [EXP], [(–)], [▲], [▼], [◀], [▶], [+], [–], [×], [÷], [(], [)], [SHIFT] [π], [QUIT]. You can use [(–)] or [–] to input negative values.
- The existing value remains unchanged if you input a value outside the allowable range or in the case of illegal input (negative sign only without a value).
- Inputting a View Window range so the min value is greater than the max value, causes the axis to be inverted.
- You can input expressions (such as 2π) as View Window parameters.
- When the View Window setting 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 View Window values are changed, the graph display is cleared and the newly set axes only are displayed.
- View Window setting may cause irregular scale spacing.
- Setting maximum and minimum values that create too wide of a View Window range can result in a graph made up of disconnected lines (because portions of the graph run off the screen), or in graphs that are inaccurate.
- The point of deflection sometimes exceeds the capabilities of the display with graphs that change drastically as they approach the point of deflection.
- Setting maximum and minimum values that create to narrow of a View Window range can result in an error (Ma ERROR).

## ■ Initializing and Standardizing the View Window

### ●To initialize the View Window

a. Press [SHIFT] [F3] (V-Window) [F1] (INIT) to initialize the View Window to the following settings.

| | | | |
|---|---|---|---|
| Xmin | = –3.9 | Ymin | = –2.3 |
| Xmax | = 3.9 | Ymax | = 2.3 |
| Xscl | = 1 | Yscl | = 1 |

b. Press SHIFT F3 (V-Window) F2 (TRIG) to initialize the View Window to the following settings.

Deg Mode

| | | | |
|---|---|---|---|
| Xmin | = –360 | Ymin | = –1.6 |
| Xmax | = 360 | Ymax | = 1.6 |
| Xscl | = 90 | Yscl | = 0.5 |

Rad Mode

| | |
|---|---|
| Xmin | = –6.28318 |
| Xmax | = 6.28318 |
| Xscl | = 1.57079 |

Gra Mode

| | |
|---|---|
| Xmin | = –400 |
| Xmax | = 400 |
| Xscl | = 100 |

- The settings for Ymin, Ymax, Ypitch, Tmin, Tmax, and Tpitch remain unchanged when you press F2 (TRIG).

## ■ View Window Memory

You can store a set of View Window settings in View Window memory for recall when you need them.

### ●To save View Window settings

While the View Window setting screen is on the display, press F3 (Sto) to save the current settings.

- Whenever you save View Window settings, any settings previously stored in memory are replaced.

### ●To recall View Window settings

While the View Window setting screen is on the display, press F4 (Rcl) to recall the View Window settings stored in memory.

- Whenever you recall View Window settings, the settings on the View Window are replaced by the recalled settings.

- You can change View Window settings in a program using the following syntax.

  View Window [Xmin value], [Xmax value], [Xscl value],
  [Ymin value], [Ymax value], [Yscl value],
  [Tmin value], [Tmax value], [Tptch value]

# 3. Graph Function Operations

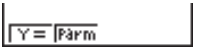
You can store up to 10 functions in memory. Functions in memory can be edited, recalled, and graphed. The types of functions that can be stored in memory are: rectangular coordinate functions, parametric functions, and inequalities.

## ■ Specifying the Graph Type

Before you can store a graph function in memory, you must first specify its graph type.

1. While the Graph Function Menu is on the display, press [▷] to display a Graph Type Menu.

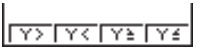
[▷]




[F1] [F2] [▷]

[F1] (Y =) ..... Rectangular coordinate graph
[F2] (Parm) ..... Parametric graph

[▷]




[F1] [F2] [F3] [F4] [▷]

[F1] (Y >) ..... Y > $f(x)$ inequality
[F2] (Y <) ..... Y < $f(x)$ inequality
[F3] (Y ≥) ..... Y ≧ $f(x)$ inequality
[F4] (Y ≤) ..... Y ≦ $f(x)$ inequality

Press [▷] to return to the previous menu

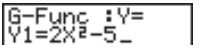
2. Press the function key that corresponds to the graph type you want to specify.

## ■ Storing Graph Functions

**●To store a rectangular coordinate function (Y =)**

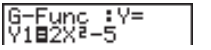
**Example** **To store the following expression in memory area Y1:**
$y = 2x^2 - 5$

[▷] [F1] (Y =)
(Specifies rectangular coordinate expression.)




[2] [x,t,θ] [x²] [−] [5]
(Inputs expression.)

[EXE]
(Stores expression.)



- You will not be able to store the expression in an area that already contains a parametric function. Select another area to store your expression or delete the existing parametric function first. This also applies when storing inequalities.

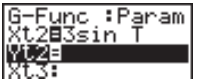
### ●To store a parametric function

**Example** **To store the following functions in memory areas Xt2 and Yt2:**

$x = 3 \sin T$
$y = 3 \cos T$

▷ F2 (Parm)
(Specifies parametric expression.)

3 sin X,T EXE
(Inputs and stores $x$ expression.)




3 cos X,T EXE
(Inputs and stores $y$ expression.)

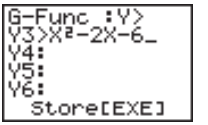
- You will not be able to store the expression in an area that already contains a rectangular coordinate expression or inequality. Select another area to store your expression or delete the existing expression first.

### ●To store an inequality

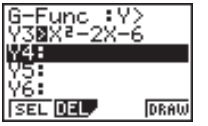
**Example** **To store the following inequality in memory area Y3:**

$y > x^2 - 2x - 6$

▷ ▷ F1 (Y>)
(Specifies an inequality.)
X,T x² − 2 X,T − 6
(Inputs expression.)




EXE
(Stores expression.)

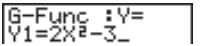


## ■ Editing Functions in Memory

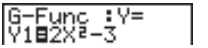
### ●To edit a function in memory

**Example** **To change the expression in memory area Y1 from $y = 2x^2 - 5$ to $y = 2x^2 - 3$**

▶
(Displays cursor.)
▶▶▶▶ 3
(Changes contents.)




EXE
(Stores new graph function.)




### ●To delete a function

1. While the Graph Function Menu is on the display, press ▲ or ▼ to display the cursor and move the highlighting to the area that contains the function you want to delete.

2. Press F2 (DEL).

3. Press F1 (YES) to delete the function or F4 (NO) to abort the procedure without deleting anything.

## ■ Drawing a Graph

Before actually drawing a graph, you should first make the draw/non-draw status.

### ●To specify the draw/non-draw status of a graph

You can specify which functions out of those stored in memory should be used for a draw operation.

- Graphs for which there is no draw/non-draw status specification are not drawn.

**Example** **To select the following functions for drawing:**

**Y1 : $y = 2x^2 - 5$**
**X*f*2: $x = 3 \sin T$**
**Y*f*2: $y = 3 \cos T$**

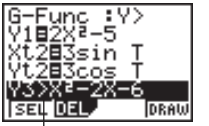
Use the following View Window parameters.

| | | | |
|---|---|---|---|
| **Xmin** | **= –5** | **Ymin** | **= –5** |
| **Xmax** | **= 5** | **Ymax** | **= 5** |
| **Xscl** | **= 1** | **Yscl** | **= 1** |

▼▼▼
(Select a memory area that contains a function for which you want to specify non-draw.)

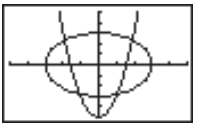
F1

F1 (SEL)
(Specify non-draw.)




*Unhighlights* F4

F4 (DRAW) or EXE
(Draws the graphs.)



- Pressing G-T or AC returns to the Graph Function Menu.

- A parametric graph will appear coarse if the settings you make in the View Window cause the pitch value to be too large, relative to the differential between the min and max settings. If the settings you make cause the pitch value to be too small relative to the differential between the min and max settings, on the other hand, the graph will take a very long time to draw.

# 4. Drawing Graphs Manually

After you select the **RUN** icon in the Main Menu and enter the RUN Mode, you can draw graphs manually. First press SHIFT F4 (SKTCH) F2 (GRPH) to recall the Graph Command Menu, and then input the graph function.

SHIFT F4 (SKTCH) F2 (GRPH)

F1 F2 ▷

F1 (Y =) ..... Rectangular coordinate graph
F2 (Parm) ..... Parametric graph

▷

F1 (Y >) ..... $Y > f(x)$ inequality
F2 (Y <) ..... $Y < f(x)$ inequality
F3 (Y ≥) ..... $Y \geqq f(x)$ inequality
F4 (Y ≤) ..... $Y \leqq f(x)$ inequality

Press ▷ to return to the previous menu.

### ●To graph using rectangular coordinates (Y =)

You can graph functions that can be expressed in the format $y = f(x)$.

**Example** **To graph $y = 2x^2 + 3x - 4$**

Use the following View Window parameters.

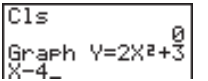
| | | | |
|---|---|---|---|
| **Xmin** | **= –5** | **Ymin** | **= –10** |
| **Xmax** | **= 5** | **Ymax** | **= 10** |
| **Xscl** | **= 2** | **Yscl** | **= 5** |

1. In the set-up screen, specify the appropriate graph type for F-Type.

   SHIFT SET UP F1 (Y =) QUIT

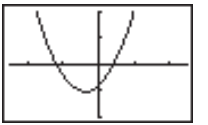
2. Input the rectangular coordinate (Y =) expression.

   AC SHIFT F4 (SKTCH) F1 (Cls) EXE
   F2 (GRPH) F1 (Y =)
   2 X,T $x^2$ + 3 X,T − 4




3. Press EXE to draw the graph.

   EXE



- You can draw graphs of the following built-in scientific functions.

| | | | | |
|---|---|---|---|---|
| • sin $x$ | • cos $x$ | • tan $x$ | • $\sin^{-1} x$ | • $\cos^{-1} x$ |
| • $\tan^{-1} x$ | • $\sqrt{x}$ | • $x^2$ | • log $x$ | • ln $x$ |
| • $10^x$ | • $e^x$ | • $x^{-1}$ | • $\sqrt[3]{x}$ | |

View Window settings are made automatically for built-in graphs.

### ●To graph parametric functions

You can graph parametric functions that can be expressed in the following format.

(X, Y) = ($f$(T), $g$(T))

**Example** **To graph the following parametric functions:**

$x$ = 7 cos T – 2 cos 3T

$y$ = 7 sin T – 2 sin 3T

Use the following View Window parameters.

| | | | | | |
|---|---|---|---|---|---|
| **Xmin** | = | **–20** | **Ymin** | = | **–12** |
| **Xmax** | = | **20** | **Ymax** | = | **12** |
| **Xscl** | = | **5** | **Yscl** | = | **5** |
| **Tmin** | = | **0** | **Tmax** | = | **2π** |
| **Tptch** | = | **π÷36** | | | |

1. In the set-up screen, specify the appropriate graph type for F-Type.

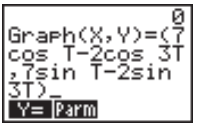
   [SHIFT] [SETUP] [F2](Parm)

2. Set the default angle unit to radians (Rad).

   [▼] [▼] [F2](Rad) [QUIT]

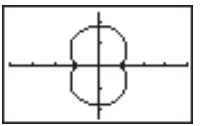
3. Input the parametric functions.

   [AC] [SHIFT] [F4](SKTCH) [F1](Cls) [EXE]
   [F2](GRPH) [F2](Parm)
   [7] [cos] [X,T] [−] [2] [cos] [3] [X,T] [▶]
   [7] [sin] [X,T] [−] [2] [sin] [3] [X,T] [)]




4. Press [EXE] to draw the graph.

   [EXE]



### ●To graph inequalities

You can graph inequalities that can be expressed in the following four formats.

- $y > f(x)$
- $y < f(x)$
- $y \geqq f(x)$
- $y \leqq f(x)$

**Example** **To graph the inequality $y > x^2 - 2x - 6$**

Use the following View Window parameters.

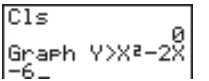
| | | | |
|---|---|---|---|
| **Xmin** | **= –6** | **Ymin** | **= –10** |
| **Xmax** | **= 6** | **Ymax** | **= 10** |
| **Xscl** | **= 1** | **Yscl** | **= 5** |

1. In the set-up screen, specify the appropriate graph type for F-Type.

   [SHIFT] [SETUP] [▷] [F1] (Y>) [QUIT]

2. Input the inequality.

   [AC] [SHIFT] [F4] (SKTCH) [F1] (Cls) [EXE]
   [F2] (GRPH) [▷] [F1] (Y>)
   [X,T] [x²] [−] [2] [X,T] [−] [6]




3. Press [EXE] to draw the graph.

   [EXE]

# 5. Other Graphing Functions

The functions described in this section tell you how to read the $x$- and $y$-coordinates at a given point, and how to zoom in and zoom out on a graph.

- These functions can be used with rectangular coordinate, parametric, and inequality graphs only.

P.7

## ■ Connect Type and Plot Type Graphs (D-Type)

You can use the D-Type setting of the set-up screen to specify one of two graph types.

- Connect type (Conct)

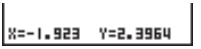
  Points are plotted and connected by lines to create a curve.
- Plot

  Points are plotted without being connected.

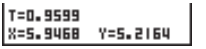
## ■ Trace

With trace, you can move a flashing pointer along a graph with the ▲, ▼, ◀, and ▶ cursor keys and obtain readouts of coordinates at each point. The following shows the different types of coordinate readouts produced by trace.

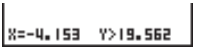
- Rectangular Coordinate Graph




- Parametric Function Graph




- Inequality Graph




### ●To use trace to read coordinates

**Example** **To determine the points of intersection for graphs produced by the following functions:**

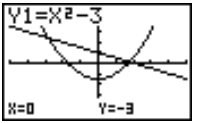
**Y1:** $y = x^2 - 3$
**Y2:** $y = -x + 2$

Use the following View Window parameters.

| | | | |
|---|---|---|---|
| **Xmin** | **= –5** | **Ymin** | **= –10** |
| **Xmax** | **= 5** | **Ymax** | **= 10** |
| **Xscl** | **= 1** | **Yscl** | **= 2** |

1. After drawing the graphs, press F1 (TRCE) to display the pointer in the center of the graph.

F1 (TRCE)

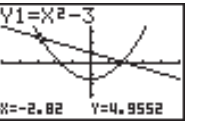



- The pointer may not be visible on the graph when you press F1 (TRCE).

2. Use ◀ to move the pointer to the first intersection.

◀ ~ ◀

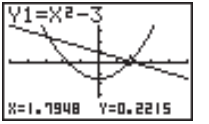
*x*/*y* coordinate values



- Pressing ◀ and ▶ moves the pointer along the graph. Holding down either key moves the pointer at high speed.

3. Use ▲ and ▼ to move the pointer between the two graphs.
4. Use ▶ to move the pointer to the other intersection.

▶ ~ ▶




- To quit the trace operation, press F1 (TRCE) again.

**●Scrolling**

When the graph you are tracing runs off the display along either the *x*- or *y*-axis, pressing the ▶ or ◀ cursor key causes the screen to scroll in the corresponding direction eight dots.

- You can scroll only rectangular coordinate and inequality graphs while tracing. You cannot scroll parametric function graphs.

- Trace can be used only immediately after a graph is drawn. It cannot be used after changing the settings of a graph.
- You cannot incorporate trace into a program.
- You can use trace on a graph that was drawn as the result of an output command (◢), which is indicated by the "-Disp-" indicator on the screen.

## ■ Scroll

You can scroll a graph along its *x*- or *y*-axis. Each time you press ▲, ▼, ◀, or ▶, the graph scrolls 12 dots in the corresponding direction.

## ■ Overwrite

Using the following syntax to input a graph causes multiple versions of the graph to be drawn using the specified values. All versions of the graph appear on the display at the same time.

<function with one variable> , SHIFT [ <variable name> SHIFT =
<value> , <value> , .... <value> SHIFT ] EXE

**Example** **To graph $y = Ax^2 - 3$, substituting 3, 1, and –1 for the value of A**

Use the following View Window parameters.

| | | | |
|---|---|---|---|
| **Xmin** | **= –5** | **Ymin** | **= –10** |
| **Xmax** | **= 5** | **Ymax** | **= 10** |
| **Xscl** | **= 1** | **Yscl** | **= 2** |

[▷] [F1] (Y =)

(Specifies graph type.)

[ALPHA] [A] [X,T] [$x^2$] [−] [3] [▸]

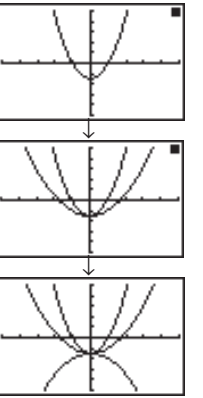
[SHIFT] [(] [ALPHA] [A] [SHIFT] [=] [3] [▸]

[1] [▸] [(−)] [1] [SHIFT] [)] [EXE]

(Stores expression.)

[F4] (DRAW) or [EXE]

(Draws graph.)



- The function that is input using the above syntax can have only one variable.
- You cannot use X, Y or T as the variable name.
- You cannot assign a variable to the variable in the function.
- When the set-up screen's Simul-G item is set to "**On**," the graphs for all the variables are drawn simultaneously.

P.8

## ■ Zoom

The zoom feature lets you enlarge and reduce a graph on the display.

### ●Before using zoom

Immediately after drawing a graph, press SHIFT F2 (ZOOM) to display the Zoom Menu.

SHIFT F2 (ZOOM)

F1 (BOX) ..... Graph enlargement using box zoom
F2 (FACT) ..... Displays screen for specification of zoom factors
F3 (IN) ..... Enlarges graph using zoom factors
F4 (OUT) ..... Reduces graph using zoom factors

▷

F1 (ORIG) ..... Original size

Press ▷ to return to the previous menu

### ●To use box zoom

With box zoom, you draw a box on the display to specify a portion of the graph, and then enlarge the contents of the box.

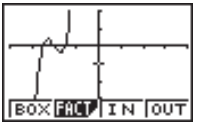
**Example** **To use box zoom to enlarge a portion of the graph $y = (x + 5)(x + 4)(x + 3)$**

Use the following View Window parameters.

| | | | |
|---|---|---|---|
| **Xmin** | **= –8** | **Ymin** | **= –4** |
| **Xmax** | **= 8** | **Ymax** | **= 2** |
| **Xscl** | **= 2** | **Yscl** | **= 1** |

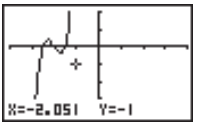
1. After graphing the function, press SHIFT F2 (ZOOM).

SHIFT F2 (ZOOM)



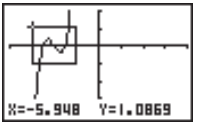
2. Press [F1] (BOX), and then use the cursor keys (◀, ▶, ▲, ▼) to move the pointer to the location of one of the corners of the box you want to draw on the screen. Press [EXE] to specify the location of the corner.

   [F1](BOX)
   ◀ ~ ◀ [EXE]



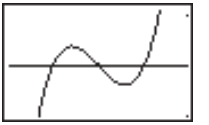

3. Use the cursor keys to move the pointer to the location of the corner that is diagonally across from the first corner.

   ▲ ~ ▲ ◀ ~ ◀




4. Press [EXE] to specify the location of the second corner. When you do, the part of the graph inside the box is immediately enlarged so it fills the entire screen.

   [EXE]



- To return to the original graph, press [F2] (ZOOM) ▷ [F1] (ORIG).

- Nothing happens if you try to locate the second corner at the same location or directly above the first corner.
- You can use box zoom for any type of graph.

### ●To use factor zoom

With factor zoom, you can zoom in or zoom out on the display, with the current pointer location being at the center of the new display.

- Use the cursor keys (◀, ▶, ▲, ▼) to move the pointer around the display.

**Example** **Graph the two functions below, and enlarge them five times in order to determine whether or not they are tangential:**

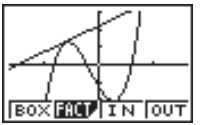
**Y1:** $y = (x + 4)(x + 1)(x - 3)$
**Y2:** $y = 3x + 22$

Use the following View Window parameters.

| | | | |
|---|---|---|---|
| **Xmin** | **= –8** | **Ymin** | **= –30** |
| **Xmax** | **= 8** | **Ymax** | **= 30** |
| **Xscl** | **= 5** | **Yscl** | **= 10** |

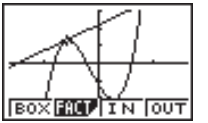
1. After graphing the functions, press [SHIFT] [F2] (ZOOM), and the pointer appears on the screen.

   [SHIFT] [F2] (ZOOM)




2. Use the cursor keys ([◀], [▶], [▲], [▼]) to move the pointer to the location that you want to be the center of the new display.

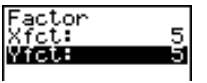
   [◀] ~ [◀] [▲] ~ [▲]




[F2]

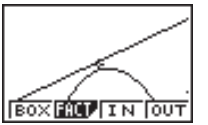
3. Press [F2] (FACT) to display the factor specification screen, and input the factor for the *x*- and *y*-axes.

   [F2] (FACT)
   [5] [EXE] [5] [EXE]




4. Press [QUIT] to return to the graphs, and then press [F3] (IN) to enlarge them.

   [QUIT] [F3] (IN)




This enlarged screen makes it clear that the graphs of the two expressions are not tangential.

- Note that the above procedure can also be used to reduce the size of a graph (zoom out). In step 4, press [F4] (OUT).

- The above procedure automatically converts the *x*-range and *y*-range View Window values to 1/5 of their original settings.
- You can repeat the factor zoom procedure more than once to further enlarge or reduce the graph.

### ●To initialize the zoom factor

Press [SHIFT] [F2] (ZOOM) [F2] (FACT) [F1] (INIT) to initialize the zoom factor to the following settings.

Xfct = 2 Yfct = 2

- You can use the following syntax to incorporate a factor zoom operation into a program.

  Factor <X factor>, <Y factor>
- You can use factor zoom for any type of graph.

## ■ Sketch Function

The sketch function lets you draw lines and graphs on an existing graph.

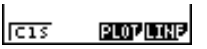
- Note that Sketch function operation in the **STAT, GRAPH** or **TABLE Mode** is different from Sketch function operation in the **RUN** or **PRGM Mode**.

### ●Before using the Sketch Function

Press [SHIFT] [F4] (SKTCH) to display the sketch menu.

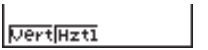
**In the STAT, GRAPH or TABLE Mode**

[SHIFT] [F4] (SKTCH)




[F1] (Cls) ..... Clears drawn line and point
[F3] (PLOT) ..... Displays plot menu
[F4] (LINE) ..... Displays line menu

[▷]




[F1] (Vert) ..... Vertical line
[F2] (Hztl) ..... Horizontal line

Press [▷] to return to the previous menu

**In the RUN or PRGM Mode**

[SHIFT] [F4] (SKTCH)

▷

• Other menu items are identical to those in the STAT, GRAPH, TABLE Mode menu.

The Sketch function lets you draw lines and plot points on a graph that is already on the screen.

All the examples in this section that show operations in the STAT, GRAPH or TABLE Mode are based on the assumption that the following function has already been graphed in the **GRAPH Mode**.

Memory Area Y1: $y = x(x + 2)(x - 2)$

The following are the View Window parameters used when drawing the graph.

| | | | |
|---|---|---|---|
| Xmin | = –5 | Ymin | = –5 |
| Xmax | = 5 | Ymax | = 5 |
| Xscl | = 1 | Yscl | = 1 |

### ●To plot points

**In the STAT, GRAPH or TABLE Mode**

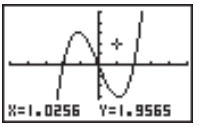
**Example** **To plot a point on the graph of $y = x(x + 2)(x - 2)$**

1. After graphing the function, display the sketch menu and perform the following operation to cause the pointer to appear on the graph screen.

   SHIFT F4 (SKTCH) F3 (PLOT) F1 (Plot)

2. Use the cursor keys (▲, ▼, ◀, ▶) to move the pointer the locations of the points you want to plot and press EXE to plot.
   • You can plot as many points as you want.

   ▶ ~ ▶ ▲ ~ ▲
   EXE



• The current $x$- and $y$-coordinate values are assigned respectively to variables X and Y.

**In the RUN or PRGM Mode**

The following is the syntax for plotting points in these modes.

Plot <*x*-coordinate>, <*y*-coordinate>

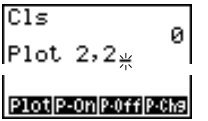
**Example** **To plot a point at (2, 2)**

Use the following View Window parameters.

| | | | |
|---|---|---|---|
| **Xmin** | **= –5** | **Ymin** | **= –10** |
| **Xmax** | **= 5** | **Ymax** | **= 10** |
| **Xscl** | **= 1** | **Yscl** | **= 2** |

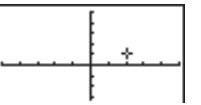
1. After entering the RUN Mode, display the sketch menu and perform the following operation.

   [SHIFT] [F4] (SKTCH) [F1] (Cls) [EXE]
   [F3] (PLOT) [F1] (Plot) [2] [,] [2]




2. Press [EXE].

   [EXE] [EXE]



- You can use the cursor keys (▲, ▼, ◀, ▶) to move the pointer around the screen.

- If you do not specify coordinates, the pointer is located in the center of the graph screen when it appears on the display.
- If the coordinates you specify are outside the range of the View Window parameters, the pointer will not be on the graph screen when it appears on the display.
- The current *x*- and *y*-coordinate values are assigned respectively to variables X and Y.

### ●To turn plot points on and off in the STAT, GRAPH and TABLE Modes

**• To turn a plot point on**

1. After drawing a graph, display the sketch menu and then perform the following operation to make the pointer appear at the center of the screen.

   [SHIFT] [F4] (SKTCH) [F3] (PLOT) [F2] (P-On)

2. Use the cursor keys ([▲], [▼], [◀], [▶]) to move the pointer to the location where you want to plot a point and then press [EXE].

**• To turn a plot point off**

Perform the same procedure as described under "To turn a plot point on" above, except press [F3] (P-Off) in place of [F2] (P-On).

**• To change the on/off status of a plot point**

Perform the same procedure as described under "To turn a plot point on" above, except press [F4] (P-Chg) in place of [F2] (P-On).

### ●To turn plot points on and off in the RUN or PRGM Mode

The following are the syntax for turning plot points on and off in these modes.

**• To turn a plot point on**

PlotOn <*x*-coordinate>, <*y*-coordinate>

**• To turn a plot point off**

PlotOff <*x*-coordinate>, <*y*-coordinate>

**• To change the on/off status of a plot point**

PlotChg <*x*-coordinate>, <*y*-coordinate>

## ●To draw a line between two plotted points

**In the STAT, GRAPH or TABLE Mode**

**Example** **To draw a line between the two points of inflection on the graph of $y = x(x + 2)(x - 2)$**

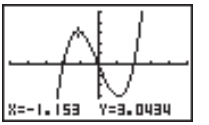
Use the same View Window parameters as in the example on page 66.

1. After graphing the function, display the sketch menu and perform the following operation to cause the pointer to appear on the graph screen.

   SHIFT F4 (SKTCH) F3 (PLOT) F1 (Plot)

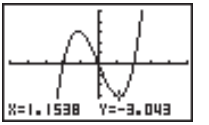
2. Use the cursor keys (▲, ▼, ◀, ▶) to move the pointer to one of the points of inflection and press EXE to plot it.

   ◀ ~ ◀ ▲ ~ ▲
   EXE



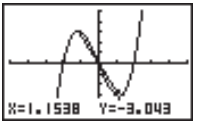

3. Use the cursor keys to move the pointer to the other point of inflection.

   ▶ ~ ▶ ▼ ~ ▼




4. Display the sketch menu and perform the following operation to draw a line between the two points.

   SHIFT F4 (SKTCH) F4 (LINE) F1 (Line)



### ●To draw a line in the STAT, GRAPH and TABLE Modes

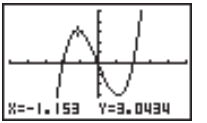
**Example** **To draw a line between two points of inflection on the graph of $y = x(x + 2)(x - 2)$**

1. After graphing the function, display the sketch menu and perform the following operation to cause the pointer to appear on the graph screen.

   SHIFT F4 (SKTCH) F4 (LINE) F2 (F-Lin)

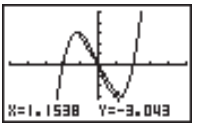
2. Use the cursor keys (▲, ▼, ◀, ▶) to move the pointer to one of the points of inflection and press EXE.

   ◀ ~ ◀ ▲ ~ ▲
   EXE




3. Use the cursor keys to move the pointer to the other point of inflection and press EXE to draw the line.

   ▶ ~ ▶ ▼ ~ ▼
   EXE




### ●To draw a line in the RUN or PRGM Mode

The following is the syntax for drawing lines in these modes.

F-Line <*x*-coordinate 1>, <*y*-coordinate 1>, <*x*-coordinate 2>, <*y*-coordinate 2>

**In the RUN or PRGM Mode**

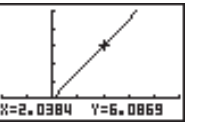
**Example** **To draw a line perpendicular to the $x$-axis from point $(x, y) = (2, 6)$ on the graph $y = 3x$**

Use the following View Window parameters:

| | | | |
|---|---|---|---|
| **Xmin** | **= –2** | **Ymin** | **= –2** |
| **Xmax** | **= 5** | **Ymax** | **= 10** |
| **Xscl** | **= 1** | **Yscl** | **= 2** |

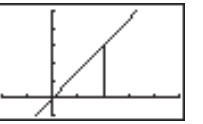
1. After drawing the graph, use the procedure under "To plot points" to move the pointer to $(x, y) = (2, 0)$, then use the cursor key (▲) to move the pointer on the graph $y = 3x$.

   G↔T
   SHIFT F4 (SKTCH) F3 (PLOT) F1 (Plot)
   2 ▼ 0 EXE EXE ▲ ~ ▲




2. Display the sketch menu and perform the following operation to draw a straight line between the two points.

   G↔T
   SHIFT F4 (SKTCH) F4 (LINE) F1 (Line) EXE



- The above draws a straight line between the current pointer location and the previous pointer location.

## ●To draw vertical and horizontal lines

The procedures presented here draw vertical and horizontal lines that pass through a specific coordinate.

**In the STAT, GRAPH or TABLE Mode**

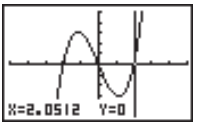
**Example** **To draw a vertical line on the graph of $y = x(x + 2)(x - 2)$**

1. After graphing the function, display the sketch menu and perform the following operation to display the pointer and draw a vertical line through its current location.

   SHIFT F4 (SKTCH) ▷ F1 (Vert)

2. Use the ◀ and ▶ cursor keys to move the line left and right, and press EXE to draw the line at the current location.

▶ ~ ▶ EXE




• To draw a horizontal line, simply press F2 (Hztl) in place of F1 (Vert), and use the ▲ and ▼ cursor keys to move the horizontal line on the display.

**In the RUN or PRGM Mode**

The following is the syntax for drawing vertical and horizontal lines in these modes.

**• To draw a vertical line**

Vertical <*x*-coordinate>

**• To draw a horizontal line**

Horizontal <*y*-coordinate>

### ●To clear drawn lines and points

The following operation clears all drawn lines and points from the screen.

**In the STAT, GRAPH or TABLE Mode**

Lines and points drawn using sketch menu functions are temporary. Display the sketch menu and press F1 (Cls) to clear drawn lines and points, leaving only the original graph.

**In the RUN or PRGM Mode**

The following is the syntax for clearing drawn lines and points, as well as the graph itself.

Cls