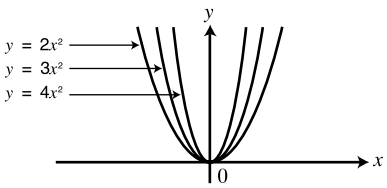
Chapter 13

Dynamic Graph

The Dynamic Graph Mode of this calculator shows you real-time representations of changes in a graph as coefficients and terms are changed. It lets you see what happens to a graph when such changes are made. For example, you can see the graph change as illustrated here as the value of coefficient A changes in the formula $y = Ax^2$.



13-1 Before Using Dynamic Graph

In the Main Menu, select the **DYNA** icon and enter the DYNA Mode. When you do the dynamic function list appears on the screen.

Selected memory area
Press ▼ and ▲ to move.

- {**SEL**} ... {dynamic Graph draw/non-draw status}
- {**DEL**} ... {function delete}
- {**TYPE**} ... {function type specification}
- {**VAR**} ... {coefficient menu}
- {**B·IN**} ... {menu of built-in functions*}
- {**RCL**} ... {recall and execution of Dynamic Graph conditions and screen data}

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* The built-in function menu contains the following seven functions.

- Y=AX+B
- $Y=A(X+B)^2+C$
- $Y=AX^2+BX+C$
- $Y=AX^3+BX^2+CX+D$
- Y=Asin(BX+C)
- Y=Acos(BX+C)
- Y=Atan(BX+C)

13-2 Storing, Editing, and Selecting Dynamic Graph Functions

In addition to the seven built-in functions, you can input 20 of your own Dynamic Functions. Once a function is stored in memory, it can be edited and selected when needed for graphing.

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All of the procedures you need to use for storing, editing, and selecting Dynamic Graph functions are identical to those you use in the **GRAPH Mode**. For details, see “8-3 Graph Function Operations”.

- Dynamic Graphs can be one of the following three types only: rectangular coordinate (Y=), polar coordinate (r=), and parametric.
- You cannot use Dynamic Graph with X=constant or inequality graphs of functions stored in the GRAPH or TABLE Mode.
- If you try to use Dynamic Graph with a function that does not contain a variable, a “No Variable” error occurs. If this happens, press AC to clear the error.

CFX

- Dynamic Graph always uses blue to draw graphs. This cannot be changed.

13-3 Drawing a Dynamic Graph

The following is the general procedure you should use to draw a Dynamic Graph.

1. Select or input a function.

2. Define the dynamic coefficient.
   - This is a coefficient whose value changes in order to produce the different graphs.
   - If the dynamic coefficient is already defined from a previous operation, you can skip this step.

3. Assign values to each of the coefficients of the function.

4. Specify the range of the dynamic coefficient.
   - If the range of the dynamic coefficient is already defined from a previous operation, you can skip this step.

5. Specify the speed of the draw operation.
   - If the speed is already defined from a previous operation, you can skip this step.

6. Draw the Dynamic Graph.

●To set Dynamic Graph conditions

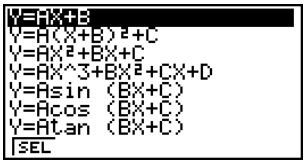
Example **To use Dynamic Graph to graph $y = A(x-1)^2 - 1$ as the value of A changes from 2 to 5 in increments of 1**

Use the following View Window parameters.

Xmin	**= – 6.3**	**Ymin**	**= – 3.1**
Xmax	**= 6.3**	**Ymax**	**= 3.1**
Xscale	**= 1**	**Yscale**	**= 1**

1. Input the function you want to graph. Here we will edit a built-in function to input our function.

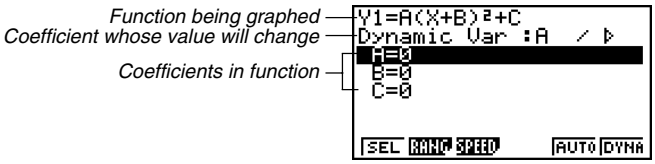
   F5 (B·IN)



   ▼ F1 (SEL)

2. Display the coefficient menu.

   [F4](VAR) or [EXE]



- {**SEL**} ... {selects dynamic coefficient}
- {**RANG**} ... {dynamic coefficient range settings}
- {**SPEED**} ... {dynamic Graph drawing speed}
- {**AUTO**} ... {automatic setting of end and pitch values to match coefficient values}
- {**DYNA**} ... {dynamic Graph draw operation}

- The calculator automatically makes the first variable it finds the dynamic coefficient. To select a different coefficient, use ▼ and ▲ to move the highlighting to the coefficient you want to use, and the press [F1] (SEL).
- The letters representing each coefficient are variables, and so the values that appears on the screen are those currently assigned to each variable. If a complex number is assigned to a variable, only the integer part appears.
- All variables contained in the currently selected function appear on the display in alphabetical order.
- If there is more than one function that can be drawn using Dynamic Graph, the message "**Too Many Functions**" appears on the display.
- If the value of the dynamic variable is zero and you press [F5] (AUTO), the dynamic variable automatically changes to 1 and Dynamic Graphing is performed.

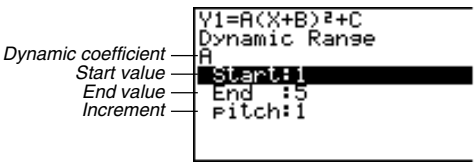
3. Specify the value of each coefficient.

   [2] [EXE] [(-)] [1] [EXE] [(-)] [1] [EXE]

- If there is more than one coefficient, use ▲ and ▼ to move the highlighting to each coefficient and input its value.
- Values you input for coefficients are also assigned to the corresponding variable.

4. Recall the coefficient range menu.

   [F2](RANG)



- The range you set remains in effect until you change it.

5. Change the range settings.

   [2] [EXE] [EXIT]

- If you want to change the Dynamic Graph speed, press [F3] (SPEED).

[F1]

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You can set the Dynamic Graph speed to any one of the following settings.

Stop & Go: Each step of the Dynamic Graph draw operation is performed each time you press [EXE].
Slow: 1/2 Normal
Normal: Default speed
Fast: Double Normal

1. Use [▲] and [▼] to move the highlighting to the speed you want to use.

2. Press [F1] (SEL) to set the highlighted speed.

●To start the Dynamic Graph draw operation

There are four different variations for Dynamic Graphing.

■ 10-time Continuous Drawing

Select "**Stop**" as the draw type (Dynamic Type) to perform 10-time continuous drawing. With this drawing style, 10 versions of the graph are drawn and then the draw operation stops automatically.

Example **To use 10-time continuous drawing to draw the same graph that you drew in the previous example (page 184)**

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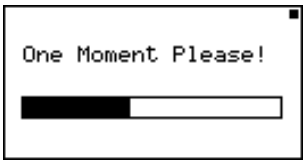
1. Display the coefficient menu. Next, display the set up screen and specify "**Stop**" for Dynamic Type and then press [EXIT].

2. Start drawing of the Dynamic Graph.

   [F6] (DYNA)



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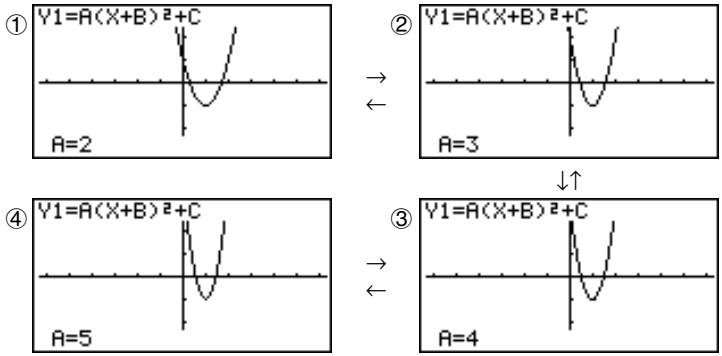

The above sequence continues to repeat from ① through ④.
Graph is drawn 10 times.

- While the message "**One Moment Please!**" is shown on the display, you can press [AC] to interrupt drawing of the graph and return to the coefficient range setting display.
- Pressing [AC] while the Dynamic Graph is being drawn changes to the drawing speed setting display. The draw operation is suspended at this time, and you can view the graph by pressing [SHIFT] [F6] (G ↔ T).

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- If you do not want the function and coefficient values shown on the display with the graph, use the graph function set up display to switch Graph Func "**Off**".
- Pressing [F5] (AUTO) draws up to 11 versions of the Dynamic Graph, starting from the start (Start) value of the dynamic coefficient.

■ Continuous Drawing

When the Dynamic Graph draw type (Dynamic Type) is set to "**Cont**" (continuous), drawing of the Dynamic Graph continues until you press [AC].

Example **To continuously draw the same graph that you input in the previous example (page 184)**

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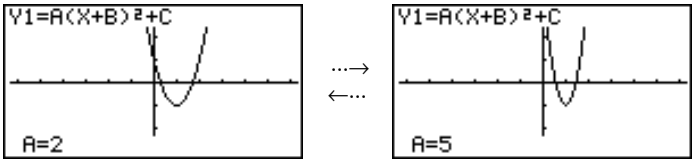
1. Display the coefficient menu. Next, display the set up screen and specify "**Cont**" for Dynamic Type and then press [EXIT].

2. Start drawing of the Dynamic Graph.

   [F6] (DYNA)



- Pressing [AC] while the Dynamic Graph is being drawn changes to the drawing speed setting display. The draw operation is suspended at this time, and you can view the graph by pressing [SHIFT] [F6] (G ↔ T).
- Selecting "Cont" and then executing a Dynamic Graph operation causes the graphing operation to repeat until you press [AC]. Be sure that you do not forget to stop the Dynamic Graph operation after you are finished. Allowing it to continue will run down the batteries.

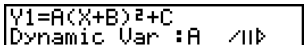
■ Stop & Go Drawing

By selecting "**STOP & GO ||▷**" as the graph drawing speed, you can draw graphs one by one. A graph is drawn each time you press [EXE].

Example **To use Stop & Go to draw the same graph that you drew in the previous example (page 184)**

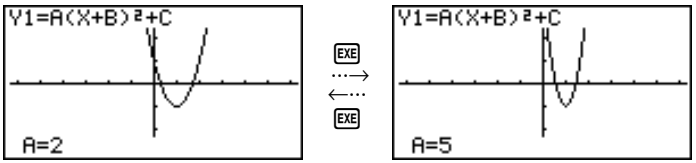
1. Display the coefficient value specification display and press [F3] (SPEED).

2. Use ▲ and ▼ to select "**STOP & GO** (||▷)" and press [F1] (SEL) [EXIT].



3. Start drawing of the Dynamic Graph.

[F6] (DYNA)



- Pressing [AC] while the Dynamic Graph is being drawn changes to the drawing speed setting display. The draw operation is suspended at this time, and you can view the graph by pressing [SHIFT] [F6] (G ↔ T).

CFX

■ Overwriting

By turning "**On**" the locus (Locus) setting of the Dynamic Graph, graphs are sequentially drawn on the same display. The newest graph drawn is easily identifiable because its color is different from graphs that were previously on the display.

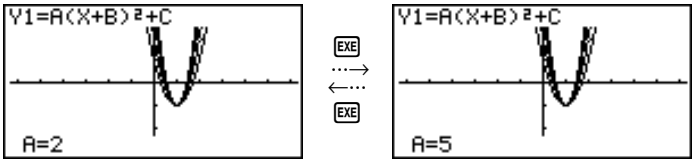
Example **To switch the locus setting on and draw the same graph that you drew in the previous example (page 184)**

1. Display the coefficient menu. Next, display the set up screen and specify "**On**" for Locus and then press [EXIT].

CFX

2. Start drawing of the Dynamic Graph.

   F6 (DYNA)



- Pressing AC while the Dynamic Graph is being drawn changes to the drawing speed setting display. The draw operation is suspended at this time, and you can view the graph by pressing SHIFT F6 (G↔T).

- Depending on the complexity of the graphs being drawn, it may take some time for them to appear on the display.
- Trace and zoom features cannot be used on a Dynamic Graph screen.

●To adjust the Dynamic Graph speed

You can use the following procedure to adjust the Dynamic Graph speed while the draw operation is taking place.

1. While a Dynamic Graph draw operation is being performed, press AC to change to the speed adjustment menu.

- {⏭} ... {Each step of the Dynamic Graph draw operation is performed each time you press EXE.}
- {>}/{▷}/{≫} ... {slow (1/2 speed)}/{normal (default speed)}/{fast (double speed)}
- {**STO**} ... {stores graph conditions and screen data in Dynamic Graph memory}
- {**DEL**} ... {deletes Dynamic Graph screen data}

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2. Press the function key (F1 to F4) that corresponds to the speed you want to change to.

- To clear the speed adjustment menu without changing anything, press EXE.
- Press SHIFT F6 (G↔T) to return to the graph screen.

13-4 Using Dynamic Graph Memory

You can store Dynamic Graph conditions and screen data in Dynamic Graph memory for later recall when you need it. This lets you save time, because you can recall the data and immediately begin a Dynamic Graph draw operation. Note that you can store one set of data in memory at any one time.

The following is all of the data that makes up a set.

- Graph functions (up to 20)
- Dynamic Graph conditions
- Set up screen settings
- View Window contents
- Dynamic Graph screen

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●To save data in Dynamic Graph memory

1. While a Dynamic Graph draw operation is being performed, press [AC] to change to the speed adjustment menu.

2. Press [F5] (STO) to store the data.
   - If there is already data stored in Dynamic Graph memory, the above operation replaces it with the new data.

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●To recall data from Dynamic Graph memory

1. Display the Dynamic Graph function list.

2. Press [F6] (RCL) to recall all the data stored in Dynamic Graph memory.
   - Data recalled from Dynamic Graph memory replaces the calculator's current graph functions, draw conditions, and screen data. The previous data is lost when it is replaced.

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●To delete Dynamic Graph screen data

1. Press [AC] [F6] (DEL).

2. Press [F1] (YES) to delete the Dynamic Graph screen data, or [F6] (NO) to abort the operation without deleting anything.

13-5 Dynamic Graph Application Examples

Example **To use Dynamic Graph to graph the parabolas produced by balls thrown in the air at an initial velocity of 20m/second, at angles of 30, 45, and 60 degrees. (Angle: Deg)**

Use the following View Window parameters.

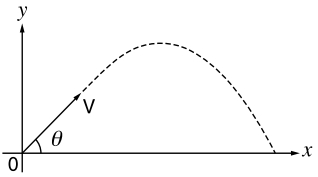
Xmin = –1	**Ymin = –1**	**Tθmin = 0**
Xmax = 42	**Ymax = 16**	**Tθmax = 6**
Xscale = 5	**Yscale = 2**	**pitch = 0.1**

With the initial velocity defined as V and the angle defined as θ, the parabolas can be obtained using the following expressions.

$X = V\cos\theta T$

$Y = V\sin\theta T - (1/2)gT^2$

g = 9.8 meters per second



1. Input the functions, making sure to specify them a "**Param**" (parametric) type.

2. Display the coefficient menu and specify the dynamic coefficient.

F4 (VAR) 3 0 EXE

3. Display the coefficient range menu and specify the range values.

F2 (RANG)

3 0 EXE 6 0 EXE 1 5 EXE

4. Start the Dynamic Graph draw operation.

EXIT F6 (DYNA)