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fx-50FH

User's Guide

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CASIO

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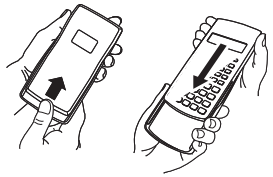
CASIO

Getting Started

Thank you for purchasing this CASIO product.

■ Before using the calculator for the first time...

Turn over the calculator and slide it from the hard case as shown in the illustration. Next, slide the hard case onto the back of the calculator.



◘ After you are finished using the calculator...

Remove the hard case from the back of the calculator, and re-install it onto the front.

■ Resetting the Calculator to Initial Defaults

Perform the operation below when you want to return the calculator's setup to its initial defaults. Note that this procedure will also clear all memory contents (independent memory, variable memory, Answer Memory, statistical calculation sample data, and program data).

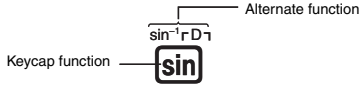
[SHIFT] [9] (CLR) [3] (All) [EXE]

Refer to the following for information about the calculation mode and setup and the various types of memories used by this calculator.

- Calculation Modes and Setup (page 7)
  Clearing the Calculation Mode and Setup Settings (page 10)
- Calculator Memory Operations (page 19)
- Statistical Calculations (SD/REG) (page 38)
- Program Mode (PRGM) (page 62)

■ About this Manual

- Most of the keys perform multiple functions. Pressing [SHIFT] or [ALPHA] and then another key will perform the alternate function of the other key. Alternate functions are marked above the keycap.



Alternate function operations are notated in this manual as shown below.

Example: [SHIFT] [sin] ($\sin^{-1}$) [1] [EXE]

The notation in parentheses indicates the function executed by the preceding key operation.

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This mark applies in EU countries only.

• The following shows the notation used in the manual for menu items that appear on the display (which are executed by pressing a number key).

Example: 1 (Contrast)

The notation in parentheses indicates the menu item accessed by the preceding number key.

• The cursor key is marked with arrows indicating direction as shown in the illustration nearby. Cursor key operations are notated in this manual as: ▲, ▼, ◀, and ▶.

• The displays and illustrations (such as key markings) shown in this User's Guide are for illustrative purposes only, and may differ somewhat from the actual items they represent.
• The contents of this manual are subject to change without notice.
• In no event shall CASIO Computer Co., Ltd. be liable to anyone for special, collateral, incidental, or consequential damages in connection with or arising out of the purchase or use of this product and items that come with it. Moreover, CASIO Computer Co., Ltd. shall not be liable for any claim of any kind whatsoever by any other party arising out of the use of this product and the items that come with it.

Safety Precautions

Be sure to read the following safety precautions before using this calculator. Keep this manual handy for later reference.

⚠ Caution

This symbol is used to indicate information that can result in personal injury or material damage if ignored.

Battery

- After removing the battery from the calculator, put it in a safe place where it will not get into the hands of small children and accidentally swallowed.
- Keep batteries out of the reach of small children. If accidentally swallowed, consult with a physician immediately.
- Never charge the battery, try to take the battery apart, or allow the battery to become shorted. Never expose the battery to direct heat or dispose of it by incineration.
- Improperly using a battery can cause it to leak and damage nearby items, and can create the risk of fire and personal injury.
  - Always make sure that the battery's positive ⊕ and negative ⊖ ends are facing correctly when you load it into the calculator.
  - Use only the type of battery specified for this calculator in this manual.

Disposing of the Calculator

- Never dispose of the calculator by burning it. Doing so can cause certain components to suddenly burst, creating the risk of fire and personal injury.

Operating Precautions

- **Be sure to press the ON key before using the calculator for the first time.**
- **Even if the calculator is operating normally, replace the battery at least once every three years.**
  A dead battery can leak, causing damage to and malfunction of the calculator. Never leave a dead battery in the calculator.
- **The battery that comes with this unit discharges slightly during shipment and storage. Because of this, it may require replacement sooner than the normal expected battery life.**
- **Low battery power can cause memory contents to become corrupted or lost completely. Always keep written records of all important data.**
- **Avoid use and storage of the calculator in areas subjected to temperature extremes.**
  Very low temperatures can cause slow display response, total failure of the display, and shortening of battery life. Also avoid leaving the calculator in direct sunlight, near a window, near a heater or anywhere else it might be exposed to very high temperatures. Heat can cause discoloration or deformation of the calculator's case, and damage to internal circuitry.
- **Avoid use and storage of the calculator in areas subjected to large amounts of humidity and dust.**
  Take care never to leave the calculator where it might be splashed by water or exposed to large amounts of humidity or dust. Such conditions can damage internal circuitry.
- **Never drop the calculator or otherwise subject it to strong impact.**
- **Never twist or bend the calculator.**
  Avoid carrying the calculator in the pocket of your trousers or other tight-fitting clothing where it might be subjected to twisting or bending.
- **Never try to take the calculator apart.**
- **Never press the keys of the calculator with a ballpoint pen or other pointed object.**
- **Use a soft, dry cloth to clean the exterior of the calculator.**
  If the calculator becomes very dirty, wipe it off with a cloth moistened in a weak solution of water and a mild neutral household detergent. Wring out all excess liquid before wiping the calculator. Never use thinner, benzene or other volatile agents to clean the calculator. Doing so can remove printed markings and can damage the case.

Contents

Before starting a calculation...

■ Turning On the Calculator

Press [ON]. The calculator will enter the calculation mode (page 7) that it was in the last time you turned it off.

◘ Adjusting Display Contrast

If the figures on the display become hard to read, try adjusting display contrast.

1. Press [SHIFT] [MODE] (SETUP) ◀ [1] (Contrast).
   - This will display the contrast adjustment screen.

2. Use ◀ and ▶ to adjust display contrast.
3. After the setting is the way you want, press [AC] or [SHIFT] [Prog] (EXIT).

Note

You can also use [+] and [−] to adjust contrast while the calculation mode menu that appears when you press the [MODE] key is on the display.

Important!

If adjusting display contrast does not improve display readability, it probably means that battery power is low. Replace the battery.

◘ Turning Off the Calculator

Press [SHIFT] [AC] (OFF).

The following information is retained when you turn off the calculator.

- Calculation modes and setup (page 7)
- Answer Memory (page 19), independent memory (page 21), and variable memory (page 22) contents

■ Key Markings

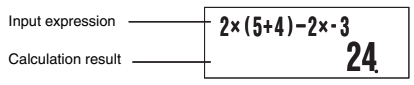
	Function	Colors	To perform the function
①	M+		Press the key.
②	M–	Text: Amber	Press [SHIFT] and then press the key.
③	M	Text: Red	Press [ALPHA] and then press the key.
④	DT	Text: Blue	In the SD or REG Mode, press the key.
⑤	CL	Text: Amber Frame: Blue	In the SD or REG Mode, press [SHIFT] and then press the key.
⑥	∠	Text: Amber Frame: Purple	In the CMPLX Mode, press [SHIFT] and then press the key.

	Function	Colors	To perform the function
⑦	A	Text: Red Frame: Green	Press [ALPHA] and then press the key (variable A). In the BASE Mode, press the key.
⑧	LOGIC	Text: Green	In the BASE Mode, press the key.

■ Reading the Display

◘ Input Expressions and Calculation Results

This calculator can display both the expressions you input and calculation results on the same screen.



◘ Display Symbols

The symbols described below appear on the display of the calculator to indicate the current calculation mode, the calculator setup, the progress of calculations, and more. In this manual, the expression “turn on” is used to mean that a symbol appears on the display, and “turn off” means that it disappears.

The nearby sample screen shows the D symbol.

The D symbol turns on when degrees (Deg) are selected for the default angle unit (page 8). For information about the meaning of each symbol, see the section of this manual that describes each function.

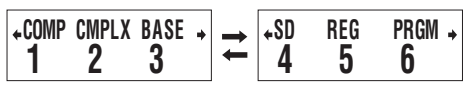
Calculation Modes and Setup

■ Selecting a Calculation Mode

Your calculator has six “calculation modes”.

◘ Selecting a Calculation Mode

1. Press [MODE].
   - This displays the calculation mode menu.
   - The calculation mode menu has two screens. Press [MODE] to toggle between them. You can also switch between menu screens using ◀ and ▶.



2. Perform one of the following operations to select the calculation mode you want.

To select this calculation mode:	Press this key:
COMP (Computation)	[1] (COMP)
CMPLX (Complex Number)	[2] (CMPLX)
BASE (Base *n*)	[3] (BASE)
SD (Single Variable Statistics)	[4] (SD)
REG (Paired Variable Statistics)	[5] (REG)
PRGM (Program)	[6] (PRGM)

- Pressing a number key from [1] to [6] selects the applicable mode, regardless of which menu screen is currently displayed.

■ Calculator Setup

The calculator setup can be used to configure input and output settings, calculation parameters, and other settings. The setup can be configured using setup screens, which you access by pressing [SHIFT] [MODE] (SETUP). There are six setup screens, and you can use ◀ and ▶ to navigate between them.

◘ Specifying the Angle Unit

You can specify degrees, radians, or grads as the angle unit to be applied for trigonometric function calculations.

($90^\circ = \frac{\pi}{2}$ radians = 100 grads)

Angle Unit	Perform this key operation:
Degrees	[SHIFT] [MODE] [1] (Deg)
Radians	[SHIFT] [MODE] [2] (Rad)
Grads	[SHIFT] [MODE] [3] (Gra)

◘ Specifying the Display Digits

You can select any one of three settings for the calculation result display digits: fixed number of decimal places (0 to 9 places), fixed number of significant digits (1 to 10 digits), or exponential display range (a choice of two settings).

Exponential Display	Perform this key operation:
Number of Decimal Places	[SHIFT] [MODE] ▶ [1] (Fix) [0] (0) to [9] (9)
Significant Digits	[SHIFT] [MODE] ▶ [2] (Sci) [1] (1) to [9] (9), [0] (10)
Exponential Display Range	[SHIFT] [MODE] ▶ [3] (Norm) [1] (Norm1) or [2] (Norm2)

The following explains how calculation results are displayed in accordance with the setting you specify.

- From zero to nine decimal places are displayed in accordance with the number of decimal places (Fix) you specify. Calculation results are rounded off to the specified number of digits.

  Example: 100 ÷ 7 = 14.286 (Fix = 3)
  14.29 (Fix = 2)

- After you specify the number of significant digits with Sci, calculation results are displayed using the specified number of significant digits and 10 to the applicable power. Calculation results are rounded off to the specified number of digits.

  Example: $1 \div 7 = 1.4286 \times 10^{-1}$ (Sci = 5)
  1.429×10^{-1} (Sci = 4)

- Selecting Norm1 or Norm2 causes the display to switch to exponential notation whenever the result is within the ranges defined below.

  Norm1: $10^{-2} > |x|, |x| \geqq 10^{10}$

  Norm2: $10^{-9} > |x|, |x| \geqq 10^{10}$

  Example: 100 ÷ 7 = 14.28571429 (Norm1 or Norm2)
  $1 \div 200 = 5. \times 10^{-3}$ (Norm1)
  0.005 (Norm2)

◘ Specifying the Fraction Display Format

You can specify either improper fraction or mixed fraction format for display of calculation results.

Fraction Format	Perform this key operation:
Mixed Fractions	[SHIFT] [MODE] ▶ ▶ [1] (ab/c)
Improper Fractions	[SHIFT] [MODE] ▶ ▶ [2] (d/c)

◘ Specifying the Complex Number Display Format

You can specify either rectangular coordinate format or polar coordinate format for complex number calculation results.

Complex Number Format	Perform this key operation:
Rectangular Coordinates	[SHIFT] [MODE] ▶ ▶ ▶ [1] ($a+bi$)
Polar Coordinates	[SHIFT] [MODE] ▶ ▶ ▶ [2] ($r\angle\theta$)

◘ Specifying the Statistical Frequency Setting

Use the key operations below to turn statistical frequency on or off during SD Mode and REG Mode calculations.

Frequency Setting	Perform this key operation:
Frequency On	[SHIFT] [MODE] ◀ ◀ [1] (FreqOn)
Frequency Off	[SHIFT] [MODE] ◀ ◀ [2] (FreqOff)

■ Clearing the Calculation Mode and Setup Settings

Perform the procedure described below to clear the current calculation mode and all setup settings and initialize the calculator to the following.

Calculation Mode ..... COMP (Computation Mode)
Angle Unit ..... Deg (Degrees)
Exponential Display Norm1
Fraction Format ..... ab/c (Mixed Fractions)
Complex Number Format ..... $a+bi$ (Rectangular Coordinates)
Frequency Setting ..... FreqOn (Frequency On)

Perform the following key operation to clear the calculation mode and setup settings.

SHIFT 9 (CLR) 2 (Setup) EXE

If you do not want to clear the calculator's settings, press AC in place of EXE in the above operation.

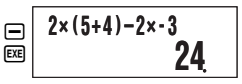
Inputting Calculation Expressions and Values

■ Inputting a Calculation Expression (Natural Input)

The natural input system of your calculator lets you input a calculation expression just as it is written and execute it by pressing EXE. The calculator determines the proper priority sequence for addition, subtraction, multiplication, division, functions and parentheses automatically.

Example: 2 × (5 + 4) – 2 × (–3) =

2 × (5 + 4) − 2 × (↔) 3 EXE



◘ Inputting Scientific Functions with Parentheses (sin, cos, √, etc.)

Your calculator supports input of the scientific functions with parentheses shown below. Note that after you input the argument, you need to press) to close the parentheses.

sin(, cos(, tan(, $\sin^{-1}$(, $\cos^{-1}$(, $\tan^{-1}$(, sinh(, cosh(, tanh(, $\sinh^{-1}$(, $\cosh^{-1}$(, $\tanh^{-1}$(, log(, ln(, $e^{\wedge}$(, 10^(, $\sqrt{\ }$(, $\sqrt[3]{\ }$(, Abs(, Pol(, Rec(, arg(, Conjg(, Not(, Neg(, Rnd(

Example: sin 30 =

sin 3 0) EXE

◘ Omitting the Multiplication Sign

You can omit the multiplication sign in the following cases.

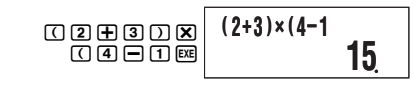
- Immediately before an open parenthesis: 2 × (5 + 4)
- Immediately before a scientific function with parentheses: 2 × sin(30), 2 × √(3)
- Before a prefix symbol (excluding the minus sign): 2 × h123
- Before a variable name, constant, or random number: 20 × A, 2 × π, 2 × i

◘ Final Closed Parenthesis

You can omit one or more closed parentheses that come at the end of a calculation, immediately before the EXE key is pressed.

Example: (2 + 3) × (4 – 1) = 15

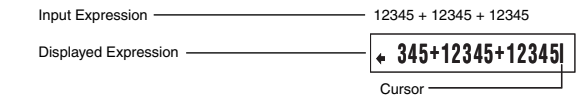
(2 + 3) × (4 − 1 EXE



- Simply press EXE without closing the parentheses. The above applies to the closing parentheses at the end of the calculation only. Your calculation will not produce the correct result if you forget the closing parentheses that are required before the end.

◘ Scrolling the Screen Left and Right

Inputting a mathematical expression that has more than 16 characters in it will cause the screen to scroll automatically, causing part of the expression to move off of the display. The "◀" symbol on the left edge of the screen indicates that there is additional data off the left side of the display.



- While the ◀ symbol is on the screen, you can use the ◀ key to move the cursor to the left and scroll the screen.
- Scrolling to the left causes part of the expression to run off the right side of the display, which is indicated by the ▶ symbol on the right. While the ▶ symbol is on the screen, you can use the ▶ key to move the cursor to the right and scroll the screen.
- You can also press ▲ to jump to the beginning of the expression, or ▼ to jump to the end.

◘ Number of Input Characters (Bytes)

As you input a mathematical expression, it is stored in memory called an "input area," which has a capacity of 99 bytes. This means you can input up to 99 bytes for a single mathematical expression.

Normally, the cursor that indicates the current input location on the display is either a flashing vertical bar (▮) or horizontal bar (▂). When the remaining capacity of the input area is 10 bytes or less, the cursor changes to a flashing box (■).

If this happens, stop input of the current expression at some suitable location and calculate its result.

■ Editing a Calculation

◘ Insert Mode and Overwrite Mode

The calculator has two input modes. The insert mode inserts your input at the cursor location, shifting anything to the right of the cursor to make room. The overwrite mode replaces the key operation at the cursor location with your input.

	Original Expression	Pressing +
Insert Mode	1+2▮34 (Cursor)	1+2+▮34
Overwrite Mode	1+2 3 4 (Cursor)	1+2 + 4

A vertical cursor (▮) indicates the insert mode, while a horizontal cursor (▂) indicates the overwrite mode.

Selecting an Input Mode

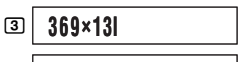
The initial default input mode setting is insert mode.
To change to the overwrite mode, press: SHIFT DEL (INS).

◘ Editing a Key Operation You Just Input

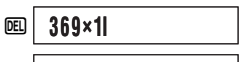
When the cursor is located at the end of the input, press DEL to delete the last key operation you performed.

Example: To correct 369 × 13 so it becomes 369 × 12

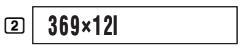
3 6 9 × 1 3



DEL



2



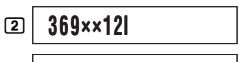
◘ Deleting a Key Operation

With the insert mode, use ◀ and ▶ to move the cursor to the right of the key operation you want to delete and then press DEL. With the overwrite mode, move the cursor to the key operation you want to delete and then press DEL. Each press of DEL deletes one key operation.

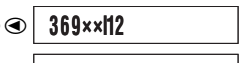
Example: To correct 369 × × 12 so it becomes 369 × 12

Insert Mode

3 6 9 × × 1 2



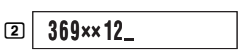
◀ ◀



DEL

Overwrite Mode

3 6 9 × × 1 2



◀ ◀ ◀

DEL

◘ Editing a Key Operation within an Expression

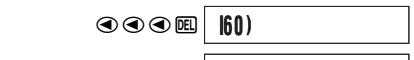
With the insert mode, use ◀ and ▶ to move the cursor to the right of the key operation you want to edit, press DEL to delete it, and then perform the correct key operation. With the overwrite mode, move the cursor to the key operation you want to correct and then perform the correct key operation.

Example: To correct cos(60) so it becomes sin(60)

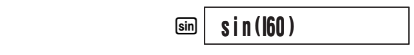
Insert Mode

cos 6 0)

◀ ◀ ◀ DEL



sin

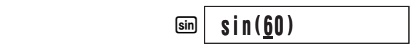


Overwrite Mode

cos 6 0)

◀ ◀ ◀ ◀

sin



◘ Inserting Key Operations into an Expression

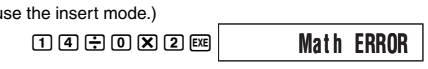
Be sure to select the insert mode whenever you want to insert key operations into an expression. Use ◀ and ▶ to move the cursor to the location where you want to insert the key operations, and then perform them.

■ Finding the Location of an Error

If your calculation expression is incorrect, an error message will appear on the display when you press EXE to execute it. After an error message appears, press the ◀ or ▶ key and the cursor will jump to the location in your calculation that caused the error so you can correct it.

Example: When you input 14 ÷ 0 × 2 = instead of 14 ÷ 10 × 2 =
(The following examples use the insert mode.)

1 4 ÷ 0 × 2 EXE



▶ or ◀

◀ 1 → 14÷10×2

EXE → 14÷10×2 = 2.8

• Instead of pressing ▶ or ◀ while an error message is displayed to find the location of the error, you could also press AC to clear the calculation.

Basic Calculations

Unless otherwise noted, the calculations in this section can be performed in any of the calculator's calculation mode, except for the BASE Mode.

■ Arithmetic Calculations

Arithmetic calculations can be used to perform addition (+), subtraction (−), multiplication (×), and division (÷).

Example 1: 2.5 + 1 − 2 = 1.5

2 · 5 + 1 − 2 EXE → 2.5+1−2 = 1.5

Example 2: 7 × 8 − 4 × 5 = 36

7 × 8 − 4 × 5 EXE → 7×8−4×5 = 36.

• The calculator determines the proper priority sequence for addition, subtraction, multiplication, and division automatically. See "Calculation Priority Sequence" on page 71 for more information.

■ Fractions

Fractions are input using a special separator symbol (⌟).

Key Operation		Display
Improper Fraction	7 a b/c 3	7⌟3 (Numerator, Denominator)
Mixed Fraction	2 a b/c 1 a b/c 3	2⌟1⌟3 (Integer, Numerator, Denominator)

Note

• Under initial default settings, fractions are displayed as mixed fractions.
• Fraction calculation results are always reduced automatically before being displayed. Executing 2 ⌟ 4 = for example, will display the result 1 ⌟ 2.

✪ Fraction Calculation Examples

Example 1: $3\frac{1}{4} + 1\frac{2}{3} = 4\frac{11}{12}$

3 a b/c 1 a b/c 4 + 1 a b/c 2 a b/c 3 EXE → 3⌟1⌟4+1⌟2⌟3 = 4⌟11⌟12

Example 2: $4 - 3\frac{1}{2} = \frac{1}{2}$

4 − 3 a b/c 1 a b/c 2 EXE → 4−3⌟1⌟2 = 1⌟2

Example 3: $\frac{2}{3} + \frac{1}{2} = \frac{7}{6}$ (Fraction Display Format: d/c)

2 a b/c 3 + 1 a b/c 2 EXE → 2⌟3+1⌟2 = 7⌟6

Note

• If the total number of elements (integer + numerator + denominator + separator symbols) of a fraction calculation result is greater than 10, the result will be displayed in decimal format.
• If an input calculation includes a mixture of fraction and decimal values, the result will be displayed in decimal format.
• You can input integers only for the elements of a fraction. Inputting non-integers will produce a decimal format result.

✪ Switching between Mixed Fraction and Improper Fraction Format

To convert a mixed fraction to an improper fraction (or an improper fraction to a mixed fraction), press SHIFT a b/c (d/c).

✪ Switching between Decimal and Fraction Format

Use the procedure below to toggle a displayed calculation result between decimal and fraction format.

Example: $1.5 = 1\frac{1}{2}$, $1\frac{1}{2} = 1.5$

1 · 5 EXE → 1.5

a b/c → 1⌟1⌟2

The current fraction display format setting determines if a mixed or improper fraction is displayed.

a b/c → 1.5

Note

The calculator cannot switch from decimal to fraction format if the total number of fraction elements (integer + numerator + denominator + separator symbols) is greater than 10.

■ Percent Calculations

Inputting a value and with a percent (%) sign makes the value a percent. The percent (%) sign uses the value immediately before it as the argument, which is simply divided by 100 to get the percentage value.

✪ Percent Calculation Examples

Example 1: 2 % = 0.02 $(\frac{2}{100})$

2 SHIFT ((%) EXE → 2% = 0.02

Example 2: 150 × 20% = 30 $(150 \times \frac{20}{100})$

1 5 0 × 2 0 SHIFT ((%) EXE → 150×20% = 30.

Example 3: What percent of 880 is 660?

6 6 0 ÷ 8 8 0 SHIFT ((%) EXE → 660÷880% = 75.

Example 4: Increase 2,500 by 15%.

2 5 0 0 + 2 5 0 0 × 1 5 SHIFT ((%) EXE → 2500+2500×15% = 2875.

Example 5: Reduce 3,500 by 25%.

3 5 0 0 − 3 5 0 0 × 2 5 SHIFT ((%) EXE → 3500−3500×25% = 2625.

Example 6: Reduce the sum of 168, 98, and 734 by 20%.

1 6 8 + 9 8 + 7 3 4 EXE → 168+98+734 = 1000.

− Ans × 2 0 SHIFT ((%) EXE → Ans−Ans×20% = 800.

Example 7: If 300 grams are added to a test sample originally weighing 500 grams, what is the percentage increase in weight?

(5 0 0 + 3 0 0) ÷ 5 0 0 SHIFT ((%) EXE → (500+300)÷500% = 160.

Example 8: What is the percentage change when a value is increased from 40 to 46? How about to 48?

Insert Mode

(4 6 − 4 0) ÷ 4 0 SHIFT ((%) EXE → (46−40)÷40% = 15.

▶ ▶ ▶ ▶ DEL 8 EXE → (48−40)÷40% = 20.

■ Degree, Minute, Second (Sexagesimal) Calculations

You can perform calculations using sexagesimal values, and you can convert between sexagesimal and decimal.

✪ Inputting Sexagesimal Values

The following is basic syntax for inputting a sexagesimal value.

{Degrees} °‘“ {Minutes} °‘“ {Seconds} °‘“

Example: To input 2°30′30″

2 °‘“ 3 0 °‘“ 3 0 °‘“ EXE → 2°30′30″ = 2°30′30.

• Note that you must always input something for the degrees and minutes, even if they are zero.

Example: To input 0°00′30″, press 0 °‘“ 0 °‘“ 3 0 °‘“.

✪ Sexagesimal Calculation Examples

The following types of sexagesimal calculations will produce sexagesimal results.
• Addition or subtraction of two sexagesimal values
• Multiplication or division of a sexagesimal value and a decimal value

Example 1: 2°20′30″ + 39′30″ = 3°00′00″

2 °‘“ 2 0 °‘“ 3 0 °‘“ + 0 °‘“ 3 9 °‘“ 3 0 °‘“ EXE → 2°20′30″+0°39′30″ = 3°0′0.

Example 2: 2°20′00″ × 3.5 = 8°10′00″

2 °‘“ 2 0 °‘“ × 3 · 5 EXE → 2°20°×3.5 = 8°10′0.

✪ Converting between Sexagesimal and Decimal

Pressing °‘“ while a calculation result is displayed will toggle the value between sexagesimal and decimal.

Example: To convert 2.255 to sexagesimal

[2] [•] [2] [5] [5] [EXE] → 2.255

[SHIFT] [,,,] → 2°15°18.

[SHIFT] [,,,] → 2.255

Calculation History and Replay

Calculation history maintains a record of each calculation you perform, including the expressions you input and calculation results. You can use calculation history in the COMP, CMPLX, and BASE Modes.

■ Accessing Calculation History

The ▲ symbol in the upper right corner of the display indicates that there is data stored in calculation history. To view the data in calculation history, press ▲. Each press of ▲ will scroll upwards (back) one calculation, displaying both the calculation expression and its result.

Example:

[1] [+] [1] [EXE] [2] [+] [2] [EXE] [3] [+] [3] [EXE]

3+3
6.

▲

2+2
4.

▲

1+1
2.

While scrolling through calculation history records, the ▼ symbol will appear on the display, which indicates that there are records below (newer than) the current one. When this symbol is turned on, press ▼ to scroll downwards (forward) through calculation history records.

Important!

- Calculation history records are all cleared whenever you press [ON], when you change to a different calculation mode, and whenever you perform any reset operation.
- Calculation history capacity is limited. Whenever you perform a new calculation while calculation history is full, the oldest record in calculation history is deleted automatically to make room for the new one.

■ Using Replay

While a calculation history record is on the display, press ◀ or ▶ to display the cursor and enter the editing mode. Pressing ▶ displays the cursor at the beginning of the calculation expression, while ◀ displays it at the end. After you make the changes you want, press [EXE] to execute the calculation.

Example: 4 × 3 + 2.5 = 14.5
4 × 3 – 7.1 = 4.9

[4] [×] [3] [+] [2] [•] [5] [EXE]

4×3+2.5
14.5

◀

4×3+2.5
14.5

[DEL] [DEL] [DEL] [DEL]

4×3
14.5

[–] [7] [•] [1] [EXE]

4×3–7.1
4.9

Calculator Memory Operations

Your calculator includes the types of memory described below, which you can use for storage and recall of values.

Memory Name	Description
Answer Memory	Answer Memory contains the result of the last calculation you performed.
Independent Memory	Independent memory can be used in all calculation modes, except for the SD Mode and the REG Mode.
Variables	Six variables named A, B, C, D, X, and Y can be used for temporary storage of values. Variables can be used in all calculation modes.

The types of memory described above are not cleared when you press the [AC] key, change to another mode, or turn off the calculator.

■ Using Answer Memory (Ans)

The result of any new calculation you perform on the calculator is stored automatically in Answer Memory (Ans).

◘ Ans Update and Delete Timing

When using Ans in a calculation, it is important to keep in mind how and when its contents change. Note the following points.

- The contents of Ans are replaced whenever you perform any of the following operations: calculate a calculation result, add a value to or subtract a value from independent memory, assign a value to a variable or recall the value of a variable, or input statistical data in the SD Mode or REG Mode.
- In the case of a calculation that produces more than one result (like coordinate calculations), the value that appears first on the display is stored in Ans.
- The contents of Ans do not change if the current calculation produces an error.
- When you perform a complex number calculation in the CMPLX Mode, both the real part and the imaginary part of the result are stored in Ans. Note, however, that the imaginary part of the value is cleared if you change to another calculation mode.

◘ Automatic Insertion of Ans in Consecutive Calculations

If you start a new calculation while the result of a previous calculation is still on the display, the calculator will insert Ans into the applicable location of the new calculation automatically.

Example 1: To divide the result of 3 × 4 by 30

[3] [×] [4] [EXE]

3×4
12.

(Next) [÷] [3] [0] [EXE]

Ans÷30
0.4

Pressing [÷] inputs Ans automatically.

Example 2: To determine the square root of the result of $3^2 + 4^2$

[3] [x^2] [+] [4] [x^2] [EXE]

3^2+4^2
25.

[√] [EXE]

√(Ans
5.

Note

- As in the above examples, the calculator automatically inserts Ans as the argument of any calculation operator or scientific function you input while a calculation result is on the display.
- In the case of a function with parenthetical argument (page 10), Ans automatically becomes the argument only in the case that you input the function alone and then press [EXE].
- Basically, Ans is inserted automatically only when the result of the previous calculation is still on the display, immediately after you executed the calculation that produced it. See the next section for information about inserting Ans into a calculation manually with the [Ans] key.

◘ Inserting Ans into a Calculation Manually

You can insert Ans into a calculation at the current cursor location by pressing the [Ans] key.

Example 1: To use the result of 123 + 456 in another calculation as shown below
123 + 456 = 579 789 – 579 = 210

[1] [2] [3] [+] [4] [5] [6] [EXE]

579.

[7] [8] [9] [–] [Ans] [EXE]

789–Ans
210.

Example 2: To determine the square root of $3^2 + 4^2$, and then add 5 to the result

[3] [x^2] [+] [4] [x^2] [EXE]

3^2+4^2
25.

[√] [Ans] [)] [+] [5] [EXE]

√(Ans)+5
10.

■ Using Independent Memory

Independent memory (M) is used mainly for calculating cumulative totals.
If you can see the M symbol on the display, it means there is a non-zero value in independent memory.

M symbol

M
10M+
10.

◘ Adding to Independent Memory

While a value you input or the result of a calculation is on the display, press [M+] to add it to independent memory (M).

Example: To add the result of 105 ÷ 3 to independent memory (M)

[1] [0] [5] [÷] [3] [M+]

M
105÷3M+
35.

◘ Subtracting from Independent Memory

While a value you input or the result of a calculation is on the display, press [SHIFT] [M+] (M–) to subtract it from independent memory (M).

Example: To subtract the result of 3 × 2 from independent memory (M)

[3] [×] [2] [SHIFT] [M+] (M–)

M
3×2M–
6.

Note
Pressing [M+] or [SHIFT] [M+] (M–) while a calculation result is on the display will add it to or subtract it from independent memory.

Important!
The value that appears on the display when you press [M+] or [SHIFT] [M+] (M–) at the end of a calculation in place of [EXE] is the result of the calculation (which is added to or subtracted from independent memory). It is not the current contents of independent memory.

Viewing Independent Memory Contents

Press [RCL] [M+] (M).

Clearing Independent Memory Contents (to 0)

[0] [SHIFT] [RCL] (STO) [M+] (M)

Clearing independent memory will cause the M symbol to turn off.

Calculation Example Using Independent Memory

If the M symbol is displayed on your calculator screen, press [0] [SHIFT] [RCL] (STO) [M+] (M) to clear independent memory contents before performing the following operation.

Example:

	23 + 9 = 32	[2] [3] [+] [9] [M+]
	53 – 6 = 47	[5] [3] [–] [6] [M+]
–)	45 × 2 = 90	[4] [5] [×] [2] [SHIFT] [M+] (M–)
	99 ÷ 3 = 33	[9] [9] [÷] [3] [M+]
	(Total) 22	[RCL] [M+] (M)

(Recalls value of M.)

■ Using Variables

The calculator supports six variables named A, B, C, D, X, and Y, which you can use to store values as required.

Assigning a Value or Calculation Result to a Variable

Use the procedure shown below to assign a value or a calculation expression to a variable.

Example: To assign 3 + 5 to variable A
[3] [+] [5] [SHIFT] [RCL] (STO) [(–)] (A)

Viewing the Value Assigned to a Variable

To view the value assigned to a variable, press [RCL] and then specify the variable name.

Example: To view the value assigned to variable A
[RCL] [(–)] (A)

Using a Variable in a Calculation

You can use variables in calculations the same way you use values.

Example: To calculate 5 + A
[5] [+] [ALPHA] [(–)] (A) [EXE]

Clearing the Value Assigned to a Variable (to 0)

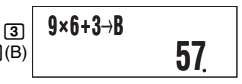
Example: To clear variable A
[0] [SHIFT] [RCL] (STO) [(–)] (A)

Calculation Example Using Variables

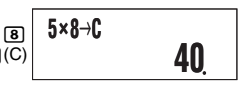
Example: To perform calculations that assign results to variables B and C, and then use the variables to perform another calculation

$$\frac{9 \times 6 + 3}{5 \times 8} = 1.425$$

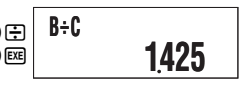
[9] [×] [6] [+] [3] [SHIFT] [RCL] (STO) [•,•] (B)



[5] [×] [8] [SHIFT] [RCL] (STO) [hyp] (C)



[ALPHA] [•,•] (B) [÷] [ALPHA] [hyp] (C) [EXE]



■ Clearing All Memory Contents

Perform the following key operation when you want to clear the contents of independent memory, variable memory, and Answer Memory.

[SHIFT] [9] (CLR) [1] (Mem) [EXE]

- If you do not want to clear the calculator's settings, press [AC] in place of [EXE] in the above operation.

Using π, *e*, and Scientific Constants

■ Pi (π) and Natural Logarithm Base *e*

The calculator supports input of pi (π) and natural logarithm base *e* into calculations. π and *e* are supported in all modes, except for the BASE Mode. The following are the values that the calculator applies for each of the built-in constants.

π = 3.14159265358980 ([SHIFT] [EXP] (π))
e = 2.71828182845904 ([ALPHA] [ln] (*e*))

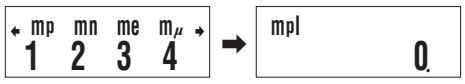
■ Scientific Constants

Your calculator has 40 often-used scientific constants built in. Like π and *e*, each scientific constant has a unique display symbol. Scientific constants are supported in all modes, except for the BASE Mode.

Inputting a Scientific Constant

1. Press [SHIFT] [7] (CONST).
   - This displays page 1 of the scientific constant menu.

   - There are 10 scientific command menu screens, and you can use [▶] and [◀] to navigate between them. For more information, see "Table of Scientific Constants" on page 25.
2. Use [▶] and [◀] to scroll through the pages and display the one that contains the scientific constant you want.
3. Press the number key (from [1] to [4]) that corresponds to the scientific constant you want to select.
   - This will input the scientific constant symbol that corresponds to the number key you press.



   - Pressing [EXE] here will display the value of the scientific constant whose symbol is currently on the screen.

Example Calculations Using Scientific Constants

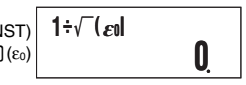
Example 1: To input the constant for the speed of light in a vacuum

[SHIFT] [7] (CONST) [◀] [◀] [◀] [◀] [4] (c_0) [EXE]

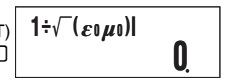
Example 2: To calculate the speed of light in a vacuum ($c_0 = 1/\sqrt{\varepsilon_0 \mu_0}$)

[1] [÷] [√]

[SHIFT] [7] (CONST) [◀] [◀] [◀] [4] (ε_0)



[SHIFT] [7] (CONST) [◀] [◀] [1] (μ_0) [▷]



[EXE]

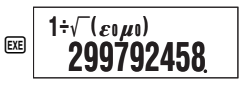


Table of Scientific Constants

The numbers in the "No." column show the scientific constant menu page number on the left and the number key you need to press to select the constant when the proper menu page is displayed.

No.	Scientific Constant	Symbol	Value	Unit
1-1	Proton mass	m_p	1.67262171×10^{-27}	kg
1-2	Neutron mass	m_n	1.67492728×10^{-27}	kg
1-3	Electron mass	m_e	9.1093826×10^{-31}	kg
1-4	Muon mass	m_μ	1.8835314×10^{-28}	kg
2-1	Bohr radius	a_0	$0.5291772108\times10^{-10}$	m
2-2	Planck constant	h	6.6260693×10^{-34}	J s
2-3	Nuclear magneton	μ_N	5.05078343×10^{-27}	$J\,T^{-1}$
2-4	Bohr magneton	μ_B	927.400949×10^{-26}	$J\,T^{-1}$
3-1	Planck constant, rationalized	$\hbar$	1.05457168×10^{-34}	J s
3-2	Fine-structure constant	α	7.297352568×10^{-3}	–
3-3	Classical electron radius	r_e	$2.817940325\times10^{-15}$	m
3-4	Compton wavelength	λ_c	$2.426310238\times10^{-12}$	m
4-1	Proton gyromagnetic ratio	γ_p	2.67522205×10^{8}	$s^{-1}\,T^{-1}$
4-2	Proton Compton wavelength	λ_{cp}	$1.3214098555\times10^{-15}$	m
4-3	Neutron Compton wavelength	λ_{cn}	$1.3195909067\times10^{-15}$	m
4-4	Rydberg constant	R_∞	10973731.568525	m^{-1}
5-1	Atomic mass constant	u	1.66053886×10^{-27}	kg
5-2	Proton magnetic moment	μ_p	1.41060671×10^{-26}	$J\,T^{-1}$
5-3	Electron magnetic moment	μ_e	$-928.476412\times10^{-26}$	$J\,T^{-1}$
5-4	Neutron magnetic moment	μ_n	$-0.96623645\times10^{-26}$	$J\,T^{-1}$
6-1	Muon magnetic moment	μ_μ	$-4.49044799\times10^{-26}$	$J\,T^{-1}$
6-2	Faraday constant	F	96485.3383	$C\,mol^{-1}$
6-3	Elementary charge	e	1.60217653×10^{-19}	C

No.	Scientific Constant	Symbol	Value	Unit
6-4	Avogadro constant	N_A	6.0221415×10^{23}	mol^{-1}
7-1	Boltzmann constant	k	1.3806505×10^{-23}	$J\ K^{-1}$
7-2	Molar volume of ideal gas	V_m	22.413996×10^{-3}	$m^3\ mol^{-1}$
7-3	Molar gas constant	R	8.314472	$J\ mol^{-1}\ K^{-1}$
7-4	Speed of light in vacuum	C_0	299792458	$m\ s^{-1}$
8-1	First radiation constant	C_1	3.74177138×10^{-16}	$W\ m^2$
8-2	Second radiation constant	C_2	1.4387752×10^{-2}	m K
8-3	Stefan-Boltzmann constant	σ	5.670400×10^{-8}	$W\ m^{-2}\ K^{-4}$
8-4	Electric constant	ε_0	$8.854187817\times10^{-12}$	$F\ m^{-1}$
9-1	Magnetic constant	μ_0	12.56637061×10^{-7}	$N\ A^{-2}$
9-2	Magnetic flux quantum	ϕ_0	2.06783372×10^{-15}	Wb
9-3	Standard acceleration of gravity	g	9.80665	$m\ s^{-2}$
9-4	Conductance quantum	G_0	7.748091733×10^{-5}	S
10-1	Characteristic impedance of vacuum	Z_0	376.730313461	Ω
10-2	Celsius temperature	t	273.15	K
10-3	Newtonian constant of gravitation	G	6.6742×10^{-11}	$m^3\ kg^{-1}\ s^{-2}$
10-4	Standard atmosphere	atm	101325	Pa

• Source: 2000 CODATA recommended values

Scientific Function Calculations

Unless otherwise noted, the functions in this section can be used in any of the calculator's calculation modes, except for the BASE Mode.

Scientific Function Calculation Precautions

- When performing a calculation that includes a built-in scientific function, it may take some time before the calculation result appears. Do not perform any key operation on the calculator until the calculation result appears.
- To interrupt and on-going calculation operation, press [AC].

Interpreting Scientific Function Syntax

- Text that represents a function's argument is enclosed in braces ({ }). Arguments are normally {value} or {expression}.
- When braces ({ }) are enclosed within parentheses, it means that input of everything inside the parentheses is mandatory.

■ Trigonometric and Inverse Trigonometric Functions

sin(, cos(, tan(, $\sin^{-1}$(, $\cos^{-1}$(, $\tan^{-1}$(

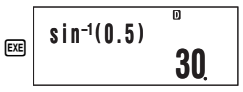
Syntax and Input

sin({*n*}), cos({*n*}), tan({*n*}), $\sin^{-1}$({*n*}), $\cos^{-1}$({*n*}), $\tan^{-1}$({*n*})

Example: sin 30 = 0.5, $\sin^{-1}0.5 = 30$ (Angle Unit: Deg)

[sin] [3] [0] [)] [EXE]

[SHIFT] [sin] ($\sin^{-1}$) [0] [•] [5] [)] [EXE]



Notes

- These functions can be used in the CMPLX Mode, as long as a complex number is not used in the argument. A calculation like $i \times \sin(30)$ is supported for example, but $\sin(1 + i)$ is not.
- The angle unit you need to use in a calculation is the one that is currently selected as the default angle unit.

■ Angle Unit Conversion

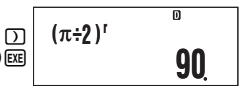
You can convert a value that was input using one angle unit to another angle unit.
After you input a value, press [SHIFT] [Ans] (DRG▶) to display the menu screen shown below.

[1] (D): Degrees
[2] (R): Radians
[3] (G): Grads

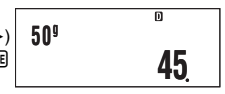
Example: To convert $\frac{\pi}{2}$ radians and 50 grads both to degrees

The following procedure assumes that Deg (degrees) is currently specified for the default angle unit.

[(] [SHIFT] [EXP] (π) [÷] [2] [)]
[SHIFT] [Ans] (DRG▶) [2] (R) [EXE]



[5] [0] [SHIFT] [Ans] (DRG▶)
[3] (G) [EXE]



■ Hyperbolic and Inverse Hyperbolic Functions

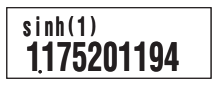
sinh(, cosh(, tanh(, $\sinh^{-1}$(, $\cosh^{-1}$(, $\tanh^{-1}$(

Syntax and Input

sinh({*n*}), cosh({*n*}), tanh({*n*}), $\sinh^{-1}$({*n*}), $\cosh^{-1}$({*n*}), $\tanh^{-1}$({*n*})

Example: sinh 1 = 1.175201194

[hyp] [sin] (sinh) [1] [)] [EXE]



Notes

- After pressing [hyp] to specify a hyperbolic function or [SHIFT] [hyp] to specify an inverse hyperbolic function, press [sin], [cos], or [tan].
- These functions can be used in the CMPLX Mode, but complex number arguments are not supported.

■ Exponential and Logarithmic Functions

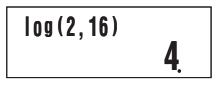
10^(, e^(, log(, ln(,

Syntax and Input

10^({*n*})	$10^{\{n\}}$	(Same applies to e^(.)
log({*n*})	$\log_{10}\{n\}$	(Common Logarithm)
log({*m*},{*n*})	$\log_{\{m\}}\{n\}$	(Base {*m*} Logarithm)
ln({*n*})	$\log_e\{n\}$	(Natural Logarithm)

Example 1: $\log_2 16 = 4$, log16 = 1.204119983

[log] [2] [,] [1] [6] [)] [EXE]



[log] [1] [6] [)] [EXE]

Base 10 (common logarithm) is assumed when no base is specified.

Example 2: ln 90 ($\log_e 90$) = 4.49980967

[ln] [9] [0] [)] [EXE]

Example 3: e^{10} = 22026.46579

[SHIFT] [ln] (e^x) [1] [0] [)] [EXE]

■ Power Functions and Power Root Functions

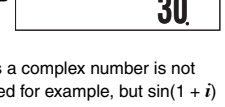
x^2, x^3, x^{-1}, ^(, √(, $\sqrt[3]{}$(, $\sqrt[x]{}$(

Syntax and Input

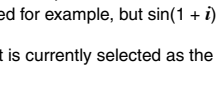
{*n*} x^2	$\{n\}^2$	(Square)
{*n*} x^3	$\{n\}^3$	(Cube)
{*n*} x^{-1}	$\{n\}^{-1}$	(Reciprocal)
{*m*)^({*n*})	$\{m\}^{\{n\}}$	(Power)
√({*n*})	$\sqrt{\{n\}}$	(Square Root)
$\sqrt[3]{}$({*n*})	$\sqrt[3]{\{n\}}$	(Cube Root)
({*m*}) $\sqrt[x]{}$({*n*})	$\sqrt[\{m\}]{\{n\}}$	(Power Root)

Example 1: $(\sqrt{2} + 1)(\sqrt{2} - 1) = 1$, $(1 + 1)^{2+2} = 16$

[(] [√] [2] [)] [+] [1] [)]
[(] [√] [2] [)] [−] [1] [)] [EXE]

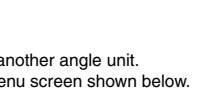


[(] [1] [+] [1] [)] [^] [2] [+] [2] [)] [EXE]



Example 2: $-2^{\frac{2}{3}} = -1.587401052$

[(−)] [2] [^] [2] [a⅔] [3] [)] [EXE]



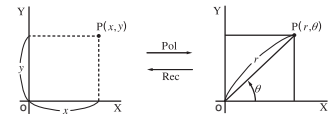
Notes

- The functions x^2, x^3, and x^{-1} can be used in complex number calculations in the CMPLX Mode. Complex number arguments are also supported for these functions.
- ^(, √(, $\sqrt[3]{}$(, $\sqrt[x]{}$(are also supported in the CMPLX Mode, but complex number arguments are not supported for these functions.

■ Coordinate Conversion (Rectangular ↔ Polar)

Pol(, Rec(

Your calculator can convert between rectangular coordinates and polar coordinates.



Rectangular Coordinates (Rec) Polar Coordinates (Pol)

Syntax and Input

Rectangular-to-Polar Coordinate Conversion (Pol)

Pol(x, y)
x: Rectangular coordinate x-value
y: Rectangular coordinate y-value

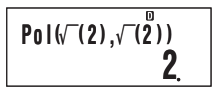
Polar-to-Rectangular Coordinate Conversion (Rec)

Rec(r, θ)
r: Polar coordinate r-value
θ: Polar coordinate θ-value

Example 1: To convert the rectangular coordinates ($\sqrt{2}$, $\sqrt{2}$) to polar coordinates

(Angle Unit: Deg)

[SHIFT] [+] (Pol) [√] [2] [)] [▸] [√] [2] [)] [)] [EXE]



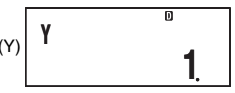
(View the value of θ) [RCL] [▸] (Y)

Example 2: To convert the polar coordinates (2, 30°) to rectangular coordinates

(Angle Unit: Deg)

[SHIFT] [−] (Rec) [2] [▸] [3] [0] [)] [EXE]

(View the value of y) [RCL] [▸] (Y)



Notes

- These functions can be used in the COMP, SD, and REG Modes.
- Calculation results show the first r value or x value only.
- The r-value (or x-value) produced by the calculation is assigned to variable X, while the θ-value (or y-value) is assigned to variable Y (page 22). To view the θ-value (or y-value), display the value assigned to variable Y, as shown in the example.
- The values obtained for θ when converting from rectangular coordinates to polar coordinates is within the range $-180° < \theta \leqq 180°$.
- When executing a coordinate conversion function inside of a calculation expression, the calculation is performed using the first value produced by the conversion (r-value or x-value).
  Example: Pol ($\sqrt{2}$, $\sqrt{2}$) + 5 = 2 + 5 = 7

■ Other Functions

x!, Abs(, Ran#, nPr, nCr, Rnd(

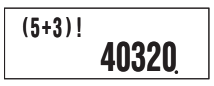
The x!, nPr, and nCr functions can be used in the CMPLX Mode, but complex number arguments are not supported.

Factorial (!)

Syntax: {n}! ({n} must be a natural number or 0.)

Example: (5 + 3)!

[(] [5] [+] [3] [)]
[SHIFT] [x^3] (x!) [EXE]



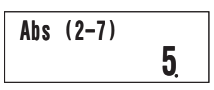
Absolute Value (Abs)

When you are performing a real number calculation, Abs(simply obtains the absolute value. This function can be used in the CMPLX Mode to determine the absolute value (size) of a complex number. See “Complex Number Calculations” on page 34 for more information.

Syntax: Abs({n})

Example: Abs (2 – 7) = 5

[SHIFT] [)] (Abs) [2] [−] [7] [)] [EXE]



Random Number (Ran#)

This function generates a three-decimal place (0.000 to 0.999) pseudo random number. It does not require an argument, and can be used the same way as a variable.

Syntax: Ran#

Example: To use 1000Ran# to obtain three 3-digit random numbers.

[1] [0] [0] [0] [SHIFT] [·] (Ran#) [EXE]

[EXE]

[EXE]

- The above values are provided for example only. The actual values produced by your calculator for this function will be different.

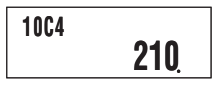
Permutation (nPr)/Combination (nCr)

Syntax: {n}P{m}, {n}C{m}

Example: How many four-person permutations and combinations are possible for a group of 10 people?

[1] [0] [SHIFT] [×] (nPr) [4] [EXE]

[1] [0] [SHIFT] [÷] (nCr) [4] [EXE]



Rounding Function (Rnd)

You can use the rounding function (Rnd) to round the value, expression, or calculation result specified by the argument. Rounding is performed to the number of significant digits in accordance with the number of display digits setting.

Rounding for Norm1 or Norm2

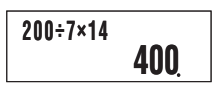
The mantissa is rounded off to 10 digits.

Rounding for Fix or Sci

The value is rounded to the specified number of digits.

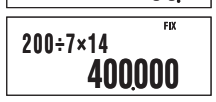
Example: 200 ÷ 7 × 14 = 400

[2] [0] [0] [÷] [7] [×] [1] [4] [EXE]



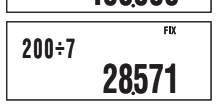
(3 decimal places)

[SHIFT] [MODE] [▶] [1] (Fix) [3]

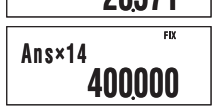


(Internal calculation uses 15 digits.)

[2] [0] [0] [÷] [7] [EXE]

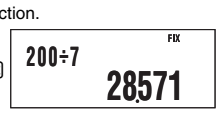


[×] [1] [4] [EXE]



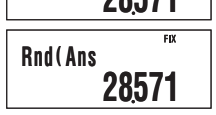
Now perform the same calculation using the rounding (Rnd) function.

[2] [0] [0] [÷] [7] [EXE]



(Calculation uses rounded value.)

[SHIFT] [0] (Rnd) [EXE]



(Rounded result) [×] [1] [4] [EXE]

Using 10^3 Engineering Notation (ENG)

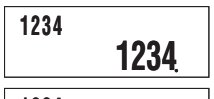
Engineering notation (ENG) expresses quantities as a product of a positive number between 1 and 10 and a power of 10 that is always a multiple of three. There are two types of engineering notation, ENG→ and ENG←.

Function	Key Operation
ENG→	[ENG]
ENG←	[SHIFT] [ENG] (←)

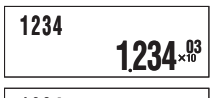
■ ENG Calculation Examples

Example 1: To convert 1234 to engineering notation using ENG→

[1] [2] [3] [4] [EXE]



[ENG]

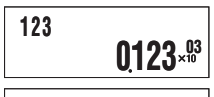


[ENG]

Example 2: To convert 123 to engineering notation using ENG←

[1] [2] [3] [EXE]

[SHIFT] [ENG] (←)



[SHIFT] [ENG] (←)

Complex Number Calculations (CMPLX)

To perform the example operations in this section, first select CMPLX (MODE 2) as the calculation mode.

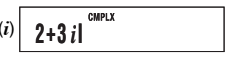
■ Inputting Complex Numbers

◘ Inputting Imaginary Numbers (*i*)

In the CMPLX Mode, the ENG key is used to input the imaginary number *i*. Use ENG (*i*) when inputting complex numbers using rectangular coordinate format (*a*+*bi*).

Example: To input 2 + 3*i*

2 + 3 ENG (*i*)

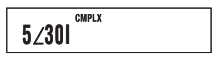


◘ Inputting Complex Number Values Using Polar Coordinate Format

Complex numbers can also be input using polar coordinate format (*r* ∠ *θ*).

Example: To input 5 ∠ 30

5 SHIFT (↦) (∠) 3 0



Important!

When inputting argument *θ*, enter a value that indicates an angle in accordance with the calculator's current default angle unit setting.

■ Complex Number Calculation Result Display

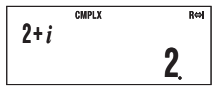
When a calculation produces a complex number result, R⇔I symbol turns on in the upper right corner of the display and the only the real part appears at first. To toggle the display between the real part and the imaginary part, press SHIFT EXE (Re⇔Im).

Example: To input 2 + 1*i* and display its calculation result

Before starting the calculation, you need to perform the following operation to change the complex number display setting to "*a*+*bi*" as shown below.

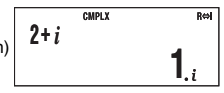
To select rectangular coordinate format: SHIFT MODE (SETUP) ▶ ▶ ▶ 1 (*a*+*bi*)

2 + ENG (*i*) EXE



Displays real part.

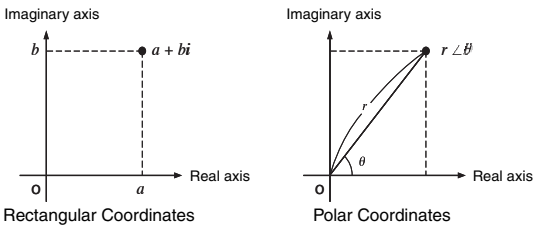
SHIFT EXE (Re⇔Im)



Displays imaginary part.
(*i* symbol turns on during imaginary part display.)

◘ Default Complex Number Calculation Result Display Format

You can select either rectangular coordinate format or polar coordinate format for complex number calculation results.



Rectangular Coordinates　　Polar Coordinates

Use the setup screens to specify the default display format you want. For details, see "Specifying the Complex Number Display Format" (page 9).

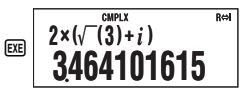
■ Calculation Result Display Examples

◘ Rectangular Coordinate Format (*a*+*bi*)

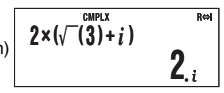
SHIFT MODE (SETUP) ▶ ▶ ▶ 1 (*a*+*bi*)

Example 1: 2 × (√3 + *i*) = 2√3 + 2*i* = 3.464101615 + 2*i*

2 × (√ 3 + ENG (*i*)) EXE

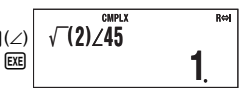


SHIFT EXE (Re⇔Im)

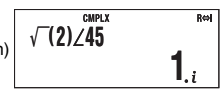


Example 2: √2 ∠ 45 = 1 + 1*i* (Angle Unit: Deg)

√ 2) SHIFT (↦) (∠) 4 5 EXE



SHIFT EXE (Re⇔Im)

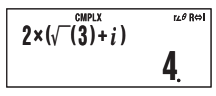


◘ Polar Coordinate Format (*r*∠*θ*)

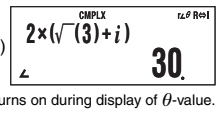
SHIFT MODE (SETUP) ▶ ▶ ▶ 2 (*r*∠*θ*)

Example 1: 2 × (√3 + *i*) = 2√3 + 2*i* = 4 ∠ 30

2 × (√ 3 + ENG (*i*)) EXE



SHIFT EXE (Re⇔Im)



∠ symbol turns on during display of *θ*-value.

Example 2: 1 + 1*i* = 1.414213562 ∠ 45 (Angle Unit: Deg)

1 + 1 ENG (*i*) EXE

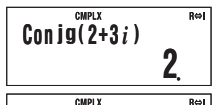
SHIFT EXE (Re⇔Im)

■ Conjugate Complex Number (Conjg)

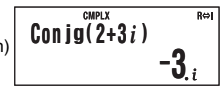
You can perform the operation below to obtain conjugate complex number $\bar{z} = a + bi$ for the complex number $z = a + bi$.

Example: Obtain the conjugate complex number of 2 + 3*i*

SHIFT • (Conjg) 2 + 3 ENG (*i*)) EXE



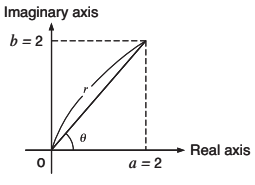
SHIFT EXE (Re⇔Im)



■ Absolute Value and Argument (Abs, arg)

You can use the procedure shown below to obtain the absolute value (|z|) and argument (arg) on the Gaussian plane for a complex number in the format $z = a + bi$.

Example:
To obtain the absolute value and argument of 2 + 2*i*
(Angle Unit: Deg)

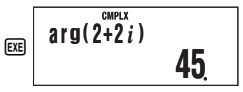


Absolute Value:

SHIFT) (Abs) 2 + 2 ENG (*i*)) EXE

Argument:

SHIFT ((arg) 2 + 2 ENG (*i*)) EXE



■ Overriding the Default Complex Number Display Format

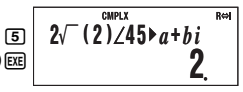
You can use the procedures described below to override the default complex number display format and specify a particular display format for the calculation you are currently inputting.

◘ Specifying Rectangular Coordinate Format for a Calculation

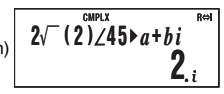
Input SHIFT − (▶*a*+*bi*) at the end of the calculation.

Example: 2√2 ∠ 45 = 2 + 2*i* (Angle Unit: Deg)

2 √ 2) SHIFT (↦) (∠) 4 5
SHIFT − (▶*a*+*bi*) EXE



SHIFT EXE (Re⇔Im)



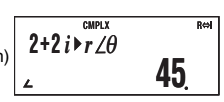
◘ Specifying Polar Coordinate Format for a Calculation

Input SHIFT + (▶*r*∠*θ*) at the end of the calculation.

Example: 2 + 2*i* = 2√2 ∠ 45 = 2.828427125 ∠ 45 (Angle Unit: Deg)

2 + 2 ENG (*i*)
SHIFT + (▶*r*∠*θ*) EXE

SHIFT EXE (Re⇔Im)



Statistical Calculations (SD/REG)

■ Statistical Calculation Sample Data

◘ Inputting Sample Data

You can input sample data either with statistical frequency turned on (FreqOn) or off (FreqOff). The calculator's initial default setting is FreqOn. You can select the input method you want to use with the setup screen statistical frequency setting (page 9).

◘ Maximum Number of Input Data Items

The maximum number of data items you can input depends on whether frequency is on (FreqOn) or off (FreqOff).

Calculation Mode \ Frequency Setting	FreqOn	FreqOff
SD Mode	40 items	80 items
REG Mode	26 items	40 items

◘ Sample Data Clear

All sample data currently in memory is cleared whenever you change to another calculation mode and when you change the statistical frequency setting.

■ Performing Single-variable Statistical Calculations

To perform the example operations in this section, first select SD (MODE 4) as the calculation mode.

◘ Inputting Sample Data

Frequency On (FreqOn)

The following shows the key operations required when inputting class values $x1$, $x2$, ...xn, and frequencies Freq1, Freq2, ... Freq$n$.

{$x1$} SHIFT ▸ (;) {Freq1} M+ (DT)
{$x2$} SHIFT ▸ (;) {Freq2} M+ (DT)
⋮
{xn} SHIFT ▸ (;) {Freq$n$} M+ (DT)

Note

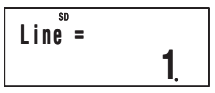
If the frequency of a class value is only one, you can input it by pressing {xn} M+ (DT) only (without specifying the frequency).

Example: To input the following data

Class Value (x)	Frequency (Freq)
24.5	4
25.5	6
26.5	2

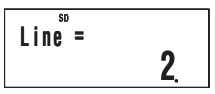
2 4 • 5 SHIFT ▸ (;) 4

M+ (DT)

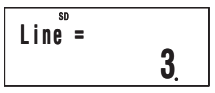


M+ (DT) tells the calculator this is the end of the first data item.

2 5 • 5 SHIFT ▸ (;) 6 M+ (DT)



2 6 • 5 SHIFT ▸ (;) 2 M+ (DT)



Frequency Off (FreqOff)

In this case, input each individual data item as shown below.

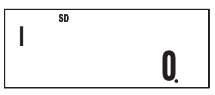
{$x1$} M+ (DT) {$x2$} M+ (DT) ... {xn} M+ (DT)

◘ Viewing Current Sample Data

After inputting sample data, you can press ▼ to scroll through the data in the sequence you input it. The ▼ symbol indicates there is data below the sample that is currently on the display. The ▲ symbol indicates there is data above.

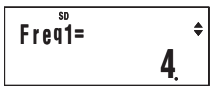
Example: To view the data you input in the example under "Inputting Sample Data" on page 38 (Frequency Setting: FreqOn)

AC



▼

▼



▼

▼

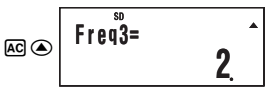
When the statistical frequency setting is FreqOn, data is displayed in the sequence: $x1$, Freq1, $x2$, Freq2, and so on. In the case of FreqOff, it is displayed in the sequence: $x1$, $x2$, $x3$, and so on. You can also use ▲ to scroll in the reverse direction.

◘ Editing a Data Sample

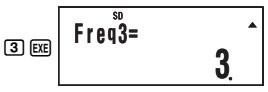
To edit a data sample, recall it, input the new value(s), and then press EXE.

Example: To edit the "Freq3" data sample input under "Inputting Sample Data" on page 38

AC ▲



3 EXE



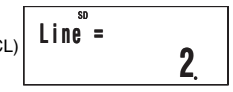
◘ Deleting a Data Sample

To delete a data sample, recall it and then press SHIFT M+ (CL).

Example: To delete the "$x2$" data sample input under "Inputting Sample Data" on page 38

AC ▼ ▼ ▼

SHIFT M+ (CL)



Note

- The following shows images of how the data appears before and after the delete operation.

Before	
$x1$: 24.5	Freq1: 4
$x2$: 25.5	Freq2: 6
$x3$: 26.5	Freq3: 2

Shifted upwards.

After	
$x1$: 24.5	Freq1: 4
$x2$: 26.5	Freq2: 2

- When the statistical frequency setting is turned on (FreqOn), the applicable x-data and Freq data pair is deleted.

◘ Deleting All Sample Data

Perform the following key operation to delete all sample data.

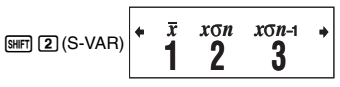
SHIFT 9 (CLR) 1 (Stat) EXE

If you do not want to delete all sample data, press AC in place of EXE in the above operation.

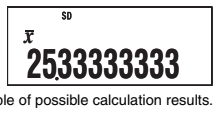
◘ Statistical Calculations Using Input Sample Data

To perform a statistical calculation, input the applicable command and then press EXE. To determine the mean ($\bar{x}$) value of the current input sample data, for example, perform the operation shown below.

SHIFT 2 (S-VAR)



1 EXE



* This is one example of possible calculation results.

◘ SD Mode Statistical Command Reference

Σx^2 SHIFT 1 (S-SUM) 1

Obtains the sum of squares of the sample data.

$$\Sigma x^2 = \Sigma x_i^2$$

Σx SHIFT 1 (S-SUM) 2

Obtains the sum of the sample data.

$$\Sigma x = \Sigma x_i$$

n SHIFT 1 (S-SUM) 3

Obtains the number of samples.

$\bar{x}$ SHIFT 2 (S-VAR) 1

Obtains the mean.

$$\bar{x} = \frac{\Sigma x_i}{n}$$

$x\sigma_n$ SHIFT 2 (S-VAR) 2

Obtains the population standard deviation.

$$x\sigma n = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n}}$$

$x\sigma_{n-1}$ SHIFT 2 (S-VAR) 3

Obtains the sample standard deviation.

$$x\sigma n{-}1 = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}}$$

minX SHIFT 2 (S-VAR) ▶ 1

Determines the minimum value of the samples.

maxX SHIFT 2 (S-VAR) ▶ 2

Determines the maximum value of the samples.

■ Performing Paired-variable Statistical Calculations

To perform the example operations in this section, first select REG (MODE 5) as the calculation mode.

◘ Regression Calculation Types

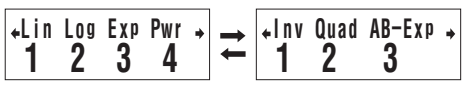
The REG Mode lets you perform the seven types of regression listed below. The figures in the parentheses show the theoretical formulas.

- Linear ($y = a + bx$)
- Quadratic ($y = a + bx + cx^2$)
- Logarithmic ($y = a + b \ln x$)
- e Exponential ($y = ae^{bx}$)
- ab Exponential ($y = ab^x$)
- Power ($y = ax^b$)
- Inverse ($y = a + b/x$)

Each time you enter the REG Mode, you must select the type of regression calculation you plan to perform.

Selecting the Regression Calculation Type

1. Press MODE 5 (REG) to enter the REG Mode.
   - This displays the initial regression calculation selection menu. The menu has two screens, and you can use ◀ and ▶ to navigate between them.



2. Perform one of the following operations to select the regression calculation you want.

To select this regression type:	And press this key:
Linear	1 (Lin)
Logarithmic	2 (Log)
e Exponential	3 (Exp)
Power	4 (Pwr)
Inverse	▶ 1 (Inv)
Quadratic	▶ 2 (Quad)
ab Exponential	▶ 3 (AB-Exp)

Note

You can switch to another regression calculation type from within the REG Mode, if you want. Pressing SHIFT 2 (S-VAR) 3 (TYPE) will display a menu screen like the one shown in step 1 above. Perform the same operation as the above procedure to select the regression calculation type you want.

◘ Inputting Sample Data

Frequency On (FreqOn)

The following shows the key operations required when inputting class values ($x1$, $y1$), ($x2$, $y2$), ...(xn, yn), and frequencies Freq1, Freq2, ... Freq$n$.

{$x1$} ▼ {$y1$} SHIFT ▼ (;) {Freq1} M+ (DT)
{$x2$} ▼ {$y2$} SHIFT ▼ (;) {Freq2} M+ (DT)
⋮
{xn} ▼ {yn} SHIFT ▼ (;) {Freq$n$} M+ (DT)

Note

If the frequency of a class value is only one, you can input it by pressing {xn} ▼ {yn} M+ (DT) only (without specifying the frequency).

Frequency Off (FreqOff)

In this case, input each individual data item as shown below.

{$x1$} ▼ {$y1$} M+ (DT)
{$x2$} ▼ {$y2$} M+ (DT)
⋮
{xn} ▼ {yn} M+ (DT)

◘ Viewing Current Sample Data

After inputting sample data, you can press ▼ to scroll through the data in the sequence you input it. The ▼ symbol indicates there is data below the sample that is currently on the display. The ▲ symbol indicates there is data above.

When the statistical frequency setting is FreqOn, data is displayed in the sequence: $x1$, $y1$, Freq1, $x2$, $y2$, Freq2, and so on. In the case of FreqOff, it is displayed in the sequence: $x1$, $y1$, $x2$, $y2$, $x3$, $y3$, and so on. You can also use ▲ to scroll in the reverse direction.

◘ Editing a Data Sample

To edit a data sample, recall it, input the new value(s), and then press EXE.

◘ Deleting a Data Sample

To delete a data sample, recall it and then press SHIFT M+ (CL).

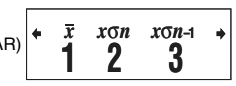
◘ Deleting All Sample Data

See “Deleting All Sample Data” (page 41).

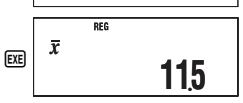
◘ Statistical Calculations Using Input Sample Data

To perform a statistical calculation, input the applicable command and then press EXE. To determine the mean ($\bar{x}$ or $\bar{y}$) value of the current sample data, for example, perform the operation shown below.

SHIFT 2 (S-VAR) 1 (VAR)



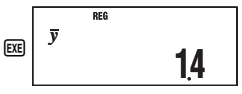
1 EXE



* This is one example of possible calculation results.

SHIFT 2 (S-VAR) 1 (VAR) ▶

1 EXE



* This is one example of possible calculation results.

◘ REG Mode Statistical Command Reference

Sum and Number of Sample Command (S-SUM Menu)

Σx^2 SHIFT 1 (S-SUM) 1

Obtains the sum of squares of the sample x-data.

$$\Sigma x^2 = \Sigma x_i^2$$

Σx SHIFT 1 (S-SUM) 2

Obtains the sum of the sample x-data.

$$\Sigma x = \Sigma x_i$$

n SHIFT 1 (S-SUM) 3

Obtains the number of samples.

Σy^2 SHIFT 1 (S-SUM) ▶ 1

Obtains the sum of squares of the sample y-data.

$$\Sigma y^2 = \Sigma y_i^2$$

Σy SHIFT 1 (S-SUM) ▶ 2

Obtains the sum of the sample y-data.

$$\Sigma y = \Sigma y_i$$

Σxy SHIFT 1 (S-SUM) ▶ 3

Obtains the sum of products of the sample x-data and y-data.

$$\Sigma xy = \Sigma x_i y_i$$

$\Sigma x^2 y$ SHIFT 1 (S-SUM) ◀ 1

Obtains the sum of squares of the sample x-data multiplied by the sample y-data.

$$\Sigma x^2 y = \Sigma x_i^2 y_i$$

Σx^3 SHIFT 1 (S-SUM) ◀ 2

Obtains the sum of cubes of the sample x-data.

$$\Sigma x^3 = \Sigma x_i^3$$

Σx^4 SHIFT 1 (S-SUM) ◀ 3

Obtains the sum of the fourth power of the sample x-data.

$$\Sigma x^4 = \Sigma x_i^4$$

Mean and Standard Deviation Commands (VAR Menu)

$\bar{x}$ SHIFT 2 (S-VAR) 1 (VAR) 1

Obtains the mean of the sample x-data.

$$\bar{x} = \frac{\Sigma x_i}{n}$$

$x\sigma n$ SHIFT 2 (S-VAR) 1 (VAR) 2

Obtains the population standard deviation of the sample x-data.

$$x\sigma n = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n}}$$

$x\sigma_{n-1}$ SHIFT 2 (S-VAR) 1 (VAR) 3

Obtains the sample standard deviation of the sample x-data.

$$x\sigma n{-}1 = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}}$$

$\bar{y}$ SHIFT 2 (S-VAR) 1 (VAR) ▶ 1

Obtains the mean of the sample y-data.

$$\bar{y} = \frac{\Sigma y_i}{n}$$

$y\sigma n$ SHIFT 2 (S-VAR) 1 (VAR) ▶ 2

Obtains the population standard deviation of the sample y-data.

$$y\sigma n = \sqrt{\frac{\Sigma(y_i - \bar{y})^2}{n}}$$

$y\sigma_{n-1}$ SHIFT 2 (S-VAR) 1 (VAR) ▶ 3

Obtains the sample standard deviation of the sample y-data.

$$y\sigma n{-}1 = \sqrt{\frac{\Sigma(y_i - \bar{y})^2}{n-1}}$$

Regression Coefficient and Estimated Value Commands for Non-quadratic Regression (VAR Menu)

The calculation that is performed when one of these commands is performed depends on the regression type that is currently selected. For details about each regression calculation formula, see “Regression Coefficient and Estimated Value Calculation Formula Table” (page 47).

a SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 1

Obtains constant term a of the regression formula.

b SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 2

Obtains coefficient b of the regression formula.

r SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 3

Obtains correlation coefficient r.

$\hat{x}$ SHIFT 2 (S-VAR) 1 (VAR) ◀ 1

Taking the value input immediately before this command as the y-value, obtains the estimated value of x based on the regression formula for the currently selected regression calculation.

$\hat{y}$ SHIFT 2 (S-VAR) 1 (VAR) ◀ 2

Taking the value input immediately before this command as the x-value, obtains the estimated value of y based on the regression formula for the currently selected regression calculation.

Regression Coefficient and Estimated Value Commands for Quadratic Regression (VAR Menu)

For details about the formula that is executed by each of these commands, see "Regression Coefficient and Estimated Value Calculation Formula Table" (page 47).

a SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 1

Obtains constant term a of the regression formula.

b SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 2

Obtains coefficient b of the regression formula.

c SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 3

Obtains coefficient c of the regression formula.

$\hat{x}_1$ SHIFT 2 (S-VAR) 1 (VAR) ◀ 1

Taking the value input immediately before this command as the y-value, uses the formula on page 47 to determine one estimated value of x.

$\hat{x}_2$ SHIFT 2 (S-VAR) 1 (VAR) ◀ 2

Taking the value input immediately before this command as the y-value, uses the formula on page 47 to determine one more estimated value of x.

$\hat{y}$ SHIFT 2 (S-VAR) 1 (VAR) ◀ 3

Taking the value input immediately before this command as the x-value, uses the formula on page 47 to determine the estimated value of y.

Minimum and Maximum Value Commands (MINMAX Menu)

minX SHIFT 2 (S-VAR) 2 (MINMAX) 1

Obtains the minimum value of the sample x-data.

maxX SHIFT 2 (S-VAR) 2 (MINMAX) 2

Obtains the maximum value of the sample x-data.

minY SHIFT 2 (S-VAR) 2 (MINMAX) ▶ 1

Obtains the minimum value of the sample y-data.

maxY SHIFT 2 (S-VAR) 2 (MINMAX) ▶ 2

Obtains the maximum value of the sample y-data.

Regression Coefficient and Estimated Value Calculation Formula Table

The following table shows the calculation formulas used by the regression coefficient and estimated value commands for each regression calculation type.

Linear Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \frac{\Sigma y_i - b\cdot\Sigma x_i}{n}$
Regression Coefficient b	$b = \frac{n\cdot\Sigma x_i y_i - \Sigma x_i\cdot\Sigma y_i}{n\cdot\Sigma x_i^2 - (\Sigma x_i)^2}$
Correlation Coefficient r	$r = \frac{n\cdot\Sigma x_i y_i - \Sigma x_i\cdot\Sigma y_i}{\sqrt{\{n\cdot\Sigma x_i^2 - (\Sigma x_i)^2\}\{n\cdot\Sigma y_i^2 - (\Sigma y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = \frac{y - a}{b}$
Estimated Value $\hat{y}$	$\hat{y} = a + bx$

Quadratic Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \frac{\Sigma y_i}{n} - b\left(\frac{\Sigma x_i}{n}\right) - c\left(\frac{\Sigma x_i^2}{n}\right)$
Regression Coefficient b	$b = \frac{Sxy\cdot Sx^2x^2 - Sx^2y\cdot Sxx^2}{Sxx\cdot Sx^2x^2 - (Sxx^2)^2}$
Regression Coefficient c	$c = \frac{Sx^2y\cdot Sxx - Sxy\cdot Sxx^2}{Sxx\cdot Sx^2x^2 - (Sxx^2)^2}$

However,

$$Sxx = \Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n} \qquad Sxx^2 = \Sigma x_i^3 - \frac{(\Sigma x_i\cdot\Sigma x_i^2)}{n}$$

$$Sxy = \Sigma x_i y_i - \frac{(\Sigma x_i\cdot\Sigma y_i)}{n} \qquad Sx^2x^2 = \Sigma x_i^4 - \frac{(\Sigma x_i^2)^2}{n}$$

$$Sx^2y = \Sigma x_i^2 y_i - \frac{(\Sigma x_i^2\cdot\Sigma y_i)}{n}$$

Command	Calculation Formula
Estimated Value $\hat{x}_1$	$\hat{x}_1 = \frac{-b + \sqrt{b^2 - 4c(a - y)}}{2c}$
Estimated Value $\hat{x}_2$	$\hat{x}_2 = \frac{-b - \sqrt{b^2 - 4c(a - y)}}{2c}$
Estimated Value $\hat{y}$	$\hat{y} = a + bx + cx^2$

Logarithmic Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \frac{\Sigma y_i - b\cdot\Sigma\ln x_i}{n}$
Regression Coefficient b	$b = \frac{n\cdot\Sigma(\ln x_i)y_i - \Sigma\ln x_i\cdot\Sigma y_i}{n\cdot\Sigma(\ln x_i)^2 - (\Sigma\ln x_i)^2}$
Correlation Coefficient r	$r = \frac{n\cdot\Sigma(\ln x_i)y_i - \Sigma\ln x_i\cdot\Sigma y_i}{\sqrt{\{n\cdot\Sigma(\ln x_i)^2 - (\Sigma\ln x_i)^2\}\{n\cdot\Sigma y_i^2 - (\Sigma y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = e^{\frac{y - a}{b}}$
Estimated Value $\hat{y}$	$\hat{y} = a + b\ln x$

e Exponential Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \exp\left(\frac{\Sigma\ln y_i - b\cdot\Sigma x_i}{n}\right)$
Regression Coefficient b	$b = \frac{n\cdot\Sigma x_i\ln y_i - \Sigma x_i\cdot\Sigma\ln y_i}{n\cdot\Sigma x_i^2 - (\Sigma x_i)^2}$
Correlation Coefficient r	$r = \frac{n\cdot\Sigma x_i\ln y_i - \Sigma x_i\cdot\Sigma\ln y_i}{\sqrt{\{n\cdot\Sigma x_i^2 - (\Sigma x_i)^2\}\{n\cdot\Sigma(\ln y_i)^2 - (\Sigma\ln y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = \frac{\ln y - \ln a}{b}$
Estimated Value $\hat{y}$	$\hat{y} = ae^{bx}$

ab Exponential Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \exp\left(\frac{\Sigma\ln y_i - \ln b\cdot\Sigma x_i}{n}\right)$
Regression Coefficient b	$b = \exp\left(\frac{n\cdot\Sigma x_i\ln y_i - \Sigma x_i\cdot\Sigma\ln y_i}{n\cdot\Sigma x_i^2 - (\Sigma x_i)^2}\right)$
Correlation Coefficient r	$r = \frac{n\cdot\Sigma x_i\ln y_i - \Sigma x_i\cdot\Sigma\ln y_i}{\sqrt{\{n\cdot\Sigma x_i^2 - (\Sigma x_i)^2\}\{n\cdot\Sigma(\ln y_i)^2 - (\Sigma\ln y_i)^2\}}}$

Command	Calculation Formula
Estimated Value $\hat{x}$	$\hat{x} = \frac{\ln y - \ln a}{\ln b}$
Estimated Value $\hat{y}$	$\hat{y} = ab^x$

Power Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \exp\left(\frac{\Sigma\ln y_i - b\cdot\Sigma\ln x_i}{n}\right)$
Regression Coefficient b	$b = \frac{n\cdot\Sigma\ln x_i\ln y_i - \Sigma\ln x_i\cdot\Sigma\ln y_i}{n\cdot\Sigma(\ln x_i)^2 - (\Sigma\ln x_i)^2}$
Correlation Coefficient r	$r = \frac{n\cdot\Sigma\ln x_i\ln y_i - \Sigma\ln x_i\cdot\Sigma\ln y_i}{\sqrt{\{n\cdot\Sigma(\ln x_i)^2 - (\Sigma\ln x_i)^2\}\{n\cdot\Sigma(\ln y_i)^2 - (\Sigma\ln y_i)^2\}}}$
Estimated Value $\hat{x}$	$\hat{x} = e^{\frac{\ln y - \ln a}{b}}$
Estimated Value $\hat{y}$	$\hat{y} = ax^b$

Inverse Regression

Command	Calculation Formula
Regression Formula Constant Term a	$a = \frac{\Sigma y_i - b\cdot\Sigma x_i^{-1}}{n}$
Regression Coefficient b	$b = \frac{Sxy}{Sxx}$
Correlation Coefficient r	$r = \frac{Sxy}{\sqrt{Sxx\cdot Syy}}$

However,

$$Sxx = \Sigma(x_i^{-1})^2 - \frac{(\Sigma x_i^{-1})^2}{n}$$

$$Syy = \Sigma y_i^2 - \frac{(\Sigma y_i)^2}{n}$$

$$Sxy = \Sigma(x_i^{-1})y_i - \frac{\Sigma x_i^{-1}\cdot\Sigma y_i}{n}$$

Command	Calculation Formula
Estimated Value $\hat{x}$	$\hat{x} = \dfrac{b}{y - a}$
Estimated Value $\hat{y}$	$\hat{y} = a + \dfrac{b}{x}$

■ Statistical Calculation Examples

This section provides some actual examples of statistical calculation examples as they are performed on your calculator.

Example 1: The nearby table shows the pulse rates of 50 students who attend a high school for boys that has a total enrollment of 1,000 students. Determine the mean and standard deviation of the sample data.

Pulse Rate	Students
54 – 56	1
56 – 58	2
58 – 60	2
60 – 62	5
62 – 64	8
64 – 66	9
66 – 68	8
68 – 70	6
70 – 72	4
72 – 74	3
74 – 76	2

Operation Procedure

Select the SD Mode: MODE 4 (SD)
Select FreqOn for the statistical frequency setting:
SHIFT MODE (SETUP) ◀ ◀ 1 (FreqOn)
Input the sample data:

55 M+ (DT) 57 SHIFT , (;) 2 M+ (DT) 59 SHIFT , (;) 2 M+ (DT)
61 SHIFT , (;) 5 M+ (DT) 63 SHIFT , (;) 8 M+ (DT)
65 SHIFT , (;) 9 M+ (DT) 67 SHIFT , (;) 8 M+ (DT)
69 SHIFT , (;) 6 M+ (DT) 71 SHIFT , (;) 4 M+ (DT)
73 SHIFT , (;) 3 M+ (DT) 75 SHIFT , (;) 2 M+ (DT)

Obtain the mean:

SHIFT 2 (S-VAR) 1 ($\bar{x}$) EXE

Obtain the sample standard deviation:

SHIFT 2 (S-VAR) 3 ($x\sigma_{n-1}$) EXE

Example 2: The nearby data shows how the weight of a newborn at various numbers of days after birth.

① Obtain the regression formula and correlation coefficient produced by linear regression of the data.
② Obtain the regression formula and correlation coefficient produced by logarithmic regression of the data.
③ Predict the weight 350 days after birth based on the regression formula that best fits the trend of the data in accordance with the regression results.

Number of Days	Weight (g)
20	3150
50	4800
80	6420
110	7310
140	7940
170	8690
200	8800
230	9130
260	9270
290	9310
320	9390

Operation Procedure

Enter the REG Mode and select linear regression:
MODE 5 (REG) 1 (Lin)
Select FreqOff for the statistical frequency setting:
SHIFT MODE (SETUP) ◀ ◀ 2 (FreqOff)
Input the sample data:

20 , 3150 M+ (DT) 50 , 4800 M+ (DT)
80 , 6420 M+ (DT) 110 , 7310 M+ (DT)
140 , 7940 M+ (DT) 170 , 8690 M+ (DT)
200 , 8800 M+ (DT) 230 , 9130 M+ (DT)
260 , 9270 M+ (DT) 290 , 9310 M+ (DT)
320 , 9390 M+ (DT)

① Linear Regression

Regression Formula Contant Term a:

SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 1 (a) EXE

Regression Coefficient b:

SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 2 (b) EXE

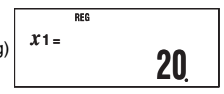
Correlation Coefficient:

SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 3 (r) EXE

② Logarithmic Regression

Select logarithmic regression:

SHIFT 2 (S-VAR) 3 (TYPE) 2 (Log)



Regression Formula Contant Term a:

AC SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 1 (a) EXE

Regression Coefficient b:

SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 2 (b) EXE

Correlation Coefficient:

SHIFT 2 (S-VAR) 1 (VAR) ▶ ▶ 3 (r) EXE

③ Weight Prediction

The absolute value of the correlation coefficient for logarithmic regression is closer to 1, so perform the weight prediction calculation using logarithmic regression.

Obtain $\hat{y}$ when x = 350:

3 5 0
SHIFT 2 (S-VAR) 1 (VAR) ◀ 2 ($\hat{y}$) EXE

Base-*n* Calculations (BASE)

To perform the example operations in this section, first select BASE (MODE 3) as the calculation mode.

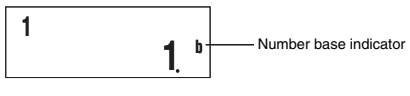
■ Performing Base-*n* Calculations

◘ Specifying the Default Number Base

Use the following keys to select a default number base.

DEC x^2 HEX $\sqrt[x]{\ }$ BIN 10^x OCT e^x

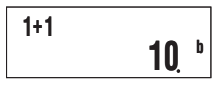
To select this number base:	Press this key:	Screen Indicator
Decimal	x^2 (DEC)	d
Hexadecimal	$\sqrt[x]{\ }$ (HEX)	H
Binary	log (BIN)	b
Octal	ln (OCT)	o



◘ Example Base-*n* Calculations

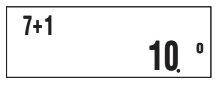
Example 1: To select binary as the number base and calculate $1_2 + 1_2$

AC log (BIN) 1 + 1 EXE



Example 2: To select octal as the number base and calculate $7_8 + 1_8$

AC ln (OCT) 7 + 1 EXE



- Inputting an invalid value causes a Syntax ERROR.
- In the BASE Mode, input of fractional (decimal) values and exponential values is not supported. Anything to the right of the decimal point of calculation results is cut off.

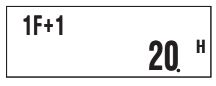
◘ Hexadecimal Value Input and Calculation Example

Use the following keys to input the letters required for hexadecimal values (A, B, C, D, E, F).

(–) A ← B hyp C sin D cos E tan F

Example: To select hexadecimal as the number base and calculate $1F_{16} + 1_{16}$

AC (HEX) 1 tan (F) + 1 EXE



◘ Effective Calculation Ranges

Number Base	Effective Range
Binary	Positive: $0 \leqq x \leqq 111111111$ Negative: $1000000000 \leqq x \leqq 1111111111$
Octal	Positive: $0 \leqq x \leqq 3777777777$ Negative: $4000000000 \leqq x \leqq 7777777777$
Decimal	$-2147483648 \leqq x \leqq 2147483647$
Hexadecimal	Positive: $0 \leqq x \leqq 7FFFFFFF$ Negative: $80000000 \leqq x \leqq FFFFFFFF$

A Math ERROR occurs when a calculation result is outside of the applicable range for the current default number base.

■ Converting a Displayed Result to another Number Base

Pressing [x²](DEC), [△](HEX), [log](BIN), or [ln](OCT) while a calculation result is displayed will convert the result to the corresponding number base.

Example: To convert the decimal value 30_{10} to binary, octal, and hexadecimal format

[AC] [x²](DEC) [3] [0] [EXE]

30
30. d

[log](BIN)

30
11110. b

[ln](OCT)

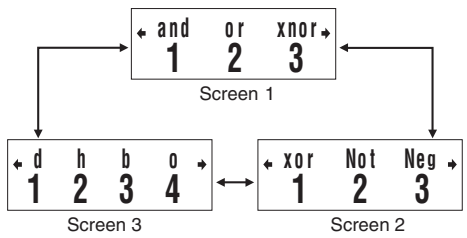
30
36. o

[△](HEX)

30
1E. H

■ Using the LOGIC Menu

In the BASE Mode, the [x] key changes function to become a LOGIC menu display key. The LOGIC menu has three screens, and you can use [◀] and [▶] to navigate between them.



Screen 1

Screen 3 Screen 2

■ Specifying a Number Base for a Particular Value

You can specify a number base that is different from the current default number base while inputting a value.

✪ Specifying the Number Base during Input

Inputting a decimal value of 3, for example, can be performed using the following key operation.

[x](LOGIC) [◀] [1](d) [3]

d3

✪ Example Calculation Using Base-*n* Specification

Example: To perform the calculation $5_{10} + 5_{16}$, and display the result in binary

[AC] [log](BIN) [x](LOGIC) [◀] [1](d)
[5] [+] [x](LOGIC) [◀] [2](h) [5] [EXE]

d5+h5
1010. b

■ Performing Calculations Using Logical Operations and Negative Binary Values

Your calculator can perform 10-digit (10-bit) binary logical operations and negative value calculations. All of the examples shown below are performed with BIN (binary) set as the default number base.

✪ Logical Product (and)

Returns the result of a bitwise product.

Example: 1010_2 and $1100_2 = 1000_2$

[1] [0] [1] [0] [x](LOGIC) [1](and)
[1] [1] [0] [0] [EXE]

1010and1100
1000. b

✪ Logical Sum (or)

Returns the result of a bitwise sum.

Example: 1011_2 or $11010_2 = 11011_2$

[1] [0] [1] [1] [x](LOGIC) [2](or)
[1] [1] [0] [1] [0] [EXE]

1011or11010
11011. b

✪ Exclusive Logical Sum (xor)

Returns the result of a bitwise exclusive logical sum.

Example: 1010_2 xor $1100_2 = 110_2$

[1] [0] [1] [0] [x](LOGIC) [▶] [1](xor)
[1] [1] [0] [0] [EXE]

1010xor1100
110. b

✪ Exclusive Logical Sum Negation (xnor)

Returns the result of the negation of a bitwise exclusive logical sum.

Example: 1111_2 xnor $101_2 = 1111110101_2$

[1] [1] [1] [1] [x](LOGIC) [3](xnor)
[1] [0] [1] [EXE]

1111xnor101
1111110101. b

✪ Complement/Inversion (Not)

Returns the complement (bitwise inversion) of a value.

Example: Not(1010_2) = 1111110101_2

[x](LOGIC) [▶] [2](Not) [1] [0] [1] [0] [)]
[EXE]

Not(1010)
1111110101. b

✪ Negation (Neg)

Returns the twos complement of a value.

Example: Neg(101101_2) = 1111010011_2

[x](LOGIC) [▶] [3](Neg)
[1] [0] [1] [1] [0] [1] [)] [EXE]

Neg(101101)
1111010011. b

Built-in Formulas

Your calculator has 23 built-in formulas for mathematics and physics, which can be used in the COMP Mode.

■ Using Built-in Formulas

✪ Selecting a Built-in Formula by Its Formula Number

1. Press [FMLA].
   • This will display the message “Formula No.?”.
2. Input the two-digit formula number (01 to 23) of the formula you want to recall.
   • For a list of formulas and their numbers, see the “Built-in Formula List” (page 58).

Formula No.?
–06–

➡

Q?
0.

✪ Selecting a Built-in Formula by Scrolling

1. Press [FMLA].
2. Use [▼] and [▲] to scroll through the built-in formulas until the one you want to recall is on the display.

✪ Performing Calculation with a Built-in Formula

The following example shows how to use Heron’s formula to determine the area of a triangle when the lengths of its three sides (8, 5, 5) are known.

Operation Procedure

Recall Heron’s formula:

[FMLA] [▼] [▼] [▼]

03:HeronFormula

[EXE]
(Prompt for input for variable a)

a?
0.

Input 8 for variable a:

[8] [EXE]

b?
0.

Input 5 for variable b:

[5] [EXE]

c?
0.

Input 5 for variable c:

[5] [EXE]

03:HeronFormula
s= 12.

- As shown above, the calculation result appears after you assign values to all of the required variables.
- Pressing [EXE] while a calculation result is on the display will re-execute the formula from the beginning.

✪ Special Built-in Formula Variables (Formula Variables)

When you perform a calculation using a built-in formula, you assign values to the variables of the formula and calculate the result. In addition to the a, b, and c variables we saw in Heron's formula above, there are also variables named r, t, v, ρ, and θ. Since these variables are used only in built-in formulas, they are called formula variables.

Values you assign to formula variables when you perform a calculation with a built-in formula are retained until you change to another calculation mode, perform a memory clear operation ([SHIFT] [9](CLR) [1](Mem)), or reset the calculator ([SHIFT] [9](CLR) [3](All)). This means that you can execute a built-in calculation multiple times leaving one or more of the variables assigned with the same values as a previous execution, if you want.

Pressing [EXE] after performing the operation under “Performing Calculation with a Built-in Formula” will display the variable assignment screen again, with the previously assigned values as the initial defaults.

Prompt for input for variable a → a? 8.

Value previously assigned to variable a

If you want to leave the displayed value assigned to the variable, press [EXE]. In this case, pressing [EXE] will leave 8 assigned to variable a.

Note

Even if you select a different built-in formula, all variables that have the same names as the previously used formula will retain their current values.

■ Built-in Formula List

No. 01 Quadratic Equation Solution

Solves a quadratic equation using values you specify for a, b, and c.

$$ax^2 + bx + c = 0 \qquad (a \neq 0,\ b^2 - 4ac \geqq 0)$$

No. 02 Cosine Theorem

For a triangle for which the lengths of two sides (b and c) and the angle (θ) formed by them are known, determines the length of remaining side.

$$a = \sqrt{b^2 + c^2 - 2bc\cos\theta} \qquad (b,\ c > 0,\ 0^\circ < \theta \leqq 180^\circ)$$

No. 03 Heron's Formula

Determines the area (S) of a triangle when the lengths of its three sides (a, b, c) are known.

$$S = \sqrt{s(s-a)(s-b)(s-c)}\ ,\ s = \frac{(a+b+c)}{2}$$

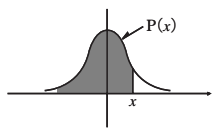
$$(a + b > c > 0,\ b + c > a > 0,\ c + a > b > 0)$$

No. 04 Normal Probability Function P(x)

Uses Hastings' estimate formula to determine the probability of a standard normal distribution P(x) illustrated below when the standardized variate (x) is known.

$$P(x) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{x} e^{-\frac{t^2}{2}}dt$$

$$(0 \leqq x < 1 \times 10^{50})$$



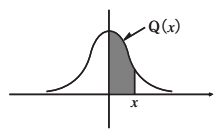
Important!
Since this is an estimate formula, proper precision may not be obtainable.

No. 05 Normal Probability Function Q(x)

Uses Hastings' estimate formula to determine the probability of a standard normal distribution Q(x) illustrated below when the standardized variate (x) is known.

$$Q(x) = \frac{1}{\sqrt{2\pi}}\int_{0}^{|x|} e^{-\frac{t^2}{2}}dt$$

$$(0 \leqq x < 1 \times 10^{50})$$



Important!
Since this is an estimate formula, proper precision may not be obtainable.

No. 06 Coulomb's Law

Determines the force (F) between two charges of quantities Q and q, over a separation of r.

$$F = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2} \qquad (r > 0) \qquad (\varepsilon_0\text{: permittivity})$$

Units: Q, q: C, r: m

No. 07 Resistance of a Conductor

Determines resistance R of a conductor when its length (ℓ) and cross sectional area (S), and the resistance of its component material (ρ) are known.

$$R = \rho\frac{\ell}{S} \qquad (S, \ell, \rho > 0)$$

Units: ℓ: m, S: m^2, ρ: Ω·m, R: Ω

No. 08 Magnetic Force

Determines the motive force (F) in a conductor with electric current (I) flowing through it and placed in a magnetic field of uniform magnetic force density (B), when the length of the conductor is ℓ and the angle formed by the conductor and magnetic field is θ.

$$F = IB\ell\sin\theta \qquad (\ell > 0,\ 0^\circ \leqq |\theta| \leqq 90^\circ)$$

Units: B: T, I: A, ℓ: m, θ: ° (degrees), F: N

No. 09 Change in Terminal Voltage of R in an RC Series Circuit

Determines the terminal voltage (V_R) of terminal R at time t in an RC series circuit when voltage V is applied to a circuit with a resistance of R and capacitance of C.

$$V_R = V \cdot e^{-t/CR} \qquad (C, R, t > 0)$$

Units: R: Ω, C: F, t: seconds, V and V_R: V

No. 10 Voltage Gain

Determines the voltage gain (G) of an amplifier circuit when input voltage (E) and output voltage (E′) are known.

$$G[dB] = 20\log_{10}\left(\frac{E'}{E}\right)\ [dB] \qquad (E'/E > 0)$$

Units: E and E′: V, G: dB

No. 11 Impedance in an LRC Series Circuit

Determines the impedance (Z) of an LRC series circuit of frequency f, when resistance (R), coil inductance (L), and capacitance (C) are known.

$$Z = \sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC}\right)^2} \qquad \left(= \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)}\right)$$

$$(R, f, L, C > 0)$$

Units: f: Hz, L: H, C: F, R and Z: Ω

No. 12 Impedance in an LRC Parallel Circuit

Determines the impedance (Z) of an LRC parallel circuit of frequency f, when resistance (R), coil inductance (L), and capacitance (C) are known.

$$Z = \frac{1}{\sqrt{\left(\frac{1}{R}\right)^2 + \left(2\pi fC - \frac{1}{2\pi fL}\right)^2}} \qquad (R, f, L, C > 0)$$

Units: f: Hz, C: F, L: H, R and Z: Ω

No. 13 Frequency of Electric Oscillation

Determines the harmonic oscillation frequency (f_1) of a series resonance circuit when the coil self-inductance (L) and capacitance (C) are known.

$$f_1 = \frac{1}{2\pi\sqrt{LC}} \qquad (L,\ C > 0)$$

Units: L: H, C: F, f_1: Hz

No. 14 Distance of Drop

Determines the distance of drop (S) after t seconds of an object dropped straight down (gravitational direction) at an initial velocity of v_1 (air friction disregarded).

$$S = v_1 t + \frac{1}{2}gt^2 \qquad (g\text{: gravitational acceleration},\ t \geqq 0)$$

Units: v_1: m/s, t: seconds, S: m

No. 15 Cycle of Simple Pendulum

Determines the cycle (T) of a simple pendulum with a string of length ℓ.

$$T = 2\pi\sqrt{\frac{\ell}{g}} \qquad (g\text{: gravitational acceleration},\ \ell > 0)$$

Units: ℓ: m, T: seconds

No. 16 Cycle of Spring Pendulum

Determines the cycle of simple oscillation (T) of a spring pendulum when the mass of the weight (m) and the spring constant of the spring (k) are known.

$$T = 2\pi\sqrt{\frac{m}{k}} \qquad (m, k > 0)$$

Units: m: kg, k: N/m, T: seconds

No. 17 Doppler Effect

Determines the oscillation frequency (f) heard by an observer when both the sound source and observer are moving, when the sound source oscillation frequency (f_1), acoustic velocity (v), sound source movement speed (v_1) and observer movement speed (u) are known.

$$f = f_1\frac{v-u}{v-v_1} \qquad \left(v \neq v_1,\ f_1 > 0,\ (v-u)/(v-v_1) > 0\right)$$

Units: v, v_1 and u: m/s, f_1 and f: Hz

No. 18 Equation of State of Ideal Gas

Determines the pressure (P) of a gas when the number of mols (n), absolute temperature (T), and volume (V) are known.

$$P = \frac{nRT}{V} \qquad (R\text{: gas constant},\ n, T, V > 0)$$

Units: n: mol, T: K, V: m^3, P: N/m^3

No. 19 Centrifugal Force

Determines the centrifugal force (F) for an object of mass m moving at velocity v in a circular pattern of radius r.

$$F = m\frac{v^2}{r} \qquad (m, v, r > 0)$$

Units: m: kg, v: m/s, r: m, F: N

No. 20 Elastic Energy

Determines the elastic energy (U) of an object when its elastic constant (K) and elongated length (x) are known.

$$U = \frac{1}{2}Kx^2 \qquad (K, x > 0)$$

Units: K: N/m, x: m, U: J

No. 21 Bernoulli's Theorem

Determines the fixed value (C) of an inviscid fluid (steady flow, incompressible fluid) when the flow velocity (v), location (height) (z), specific weight (ρ), and pressure (P) are known.

$$C = \frac{1}{2}v^2 + \frac{P}{\rho} + gz \qquad (g\text{: gravitational acceleration},\ v, z, \rho, P > 0)$$

Units: v: m/s, z: m, ρ: kgf/m^3, P: kgf/m^2, C: m^2/s^2

No. 22 **Calculations Using a Stadia (Height)**

Determines the difference in elevation (h) from the transit to the leveling rod after a transit is used to read the length on the leveling rod (ℓ) between the upper and lower stadia lines, and the angle of elevation (θ).

$$h = \frac{1}{2}K\ell\sin 2\theta + C\sin\theta \quad \text{(K and C: stadia constants, } 0° < \theta \leqq 90°,\ \ell > 0\text{)}$$

Units: ℓ: m, θ: ° (degrees), h: m

No. 23 **Calculations Using a Stadia (Distance)**

Determines the horizontal distance (S) from the transit to the leveling rod after a transit is used to read the length on the leveling rod (ℓ) between the upper and lower stadia lines, and the angle of elevation (θ).

$$S = K\ell\cos^2\theta + C\cos\theta \quad \text{(K and C: stadia constants, } 0° < \theta \leqq 90°,\ \ell > 0\text{)}$$

Units: ℓ: m, θ: ° (degrees), S: m

Program Mode (PRGM)

You can use the PRGM Mode (MODE 6) to create and store programs for calculations you need to perform on a regular basis. You can include any calculation that can be performed in the COMP, CMPLX, BASE, SD, or REG Mode in a program.

■ Program Mode Overview

◘ Specifying a Program Run Mode

Though you create and run programs in the PRGM Mode, each program has a "run mode" that it runs in. You can specify COMP, CMPLX, BASE, SD, or REG as a program's run mode. This means you need to think about what you want your program to do and select the appropriate run mode.

◘ Program Memory

Program memory has a total capacity of 680 bytes, which can be shared by up to four programs. Further program storage is not possible after program memory becomes full.

■ Creating a Program

◘ Creating a New Program

Example: To create a program that converts inches to centimeters (1 inch = 2.54 cm)

? → A : A × 2.54

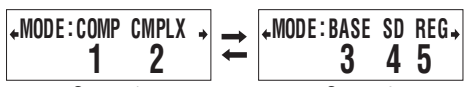
1. Press MODE 6 (PRGM) to enter the PRGM Mode.

2. Press 1 (EDIT).

Program areas that already contain program data (P1 through P4)

Remaining program memory capacity

3. Press the number key that corresponds to an unused program area number.
   • This displays the run mode selection menu. Use ▶ and ◀ to switch between menu screen 1 and screen 2.

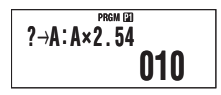


Screen 1 Screen 2

4. Press the number key that corresponds to the mode you want to assign as the program's run mode.
   • Here, select 1 (COMP) on screen 1. This selects COMP as the run mode, and displays the program editing screen.

Important!
You cannot change the run mode of a program once it has been assigned. A run mode can be assigned only when you are creating a new program.

5. Input the program.



   • Here we will input the program shown below.

Program	? → A : A × 2.54
Key Operation	SHIFT 3 (P-CMD) 1 (?) SHIFT RCL (→) (↔) (A) EXE ALPHA (↔) (A) × 2 • 5 4

   • SHIFT 3 (P-CMD) displays a special program command input screen. See "Inputting Commands" on page 65 for more information.

6. After inputting the program, press AC or SHIFT Prog (EXIT).
   • To run the program you just created, press EXE here to display the RUN Program screen. For more information, see "Running a Program" below.
   • To return to the normal calculation screen, press MODE 1 to enter the COMP Mode.

◘ Editing an Existing Program

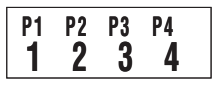
1. Press MODE 6 (PRGM) 1 (EDIT) to display the EDIT Program screen.
2. Use number keys 1 through 4 to select the program area that contains the program you want to edit.
3. Use ▶ and ◀ to move the cursor around the program, and perform the required operations to edit the contents of the program or to add new contents.
   • Pressing ▲ jumps to the beginning of the program, while ▼ jumps to the end.
4. After you finish editing the program, press AC or SHIFT Prog (EXIT).

■ Running a Program

You can run a program in the PRGM Mode or from another mode.

◘ Running a Program from Outside the PRGM Mode

1. Press Prog.



2. Use number keys 1 through 4 to select a program area and execute its program.

◘ Running a Program in the PRGM Mode

1. Press MODE 6 (PRGM) to display the PRGM Mode initial screen.
2. Press 2 (RUN).
   • This will display the RUN Program screen.

Program areas that already contain program data (P1 through P4)

Remaining program memory capacity

3. Use number keys 1 through 4 to select the program area that contains the program you want to run.
   • This will execute the program in the program area you select.

◘ What to do if an error message appears

Press ◀ or ▶. This will display the editing screen for the program, with the cursor located at the location where the error was generated so you can correct the problem.

■ Deleting a Program

You can delete an existing program by specifying its program area number.

◘ Deleting the Program in a Specific Program Area

1. Press MODE 6 (PRGM) to display the PRGM Mode initial screen.

2. Press 3 (DEL).

Program areas that already contain program data (P1 through P4)

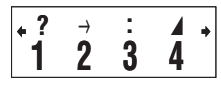
Remaining program memory capacity

3. Use number keys 1 through 4 to select the program area whose program you want to delete.
   • The symbol next to the number of the program area that contained the program you just deleted will turn off, and the remaining program memory capacity value will increase.

■ Inputting Commands

◘ Inputting Special Program Commands

1. While the program editing screen is on the display, press SHIFT 3 (P-CMD).
   • This displays page 1 of the command menu.



2. Use ▶ and ◀ to scroll through the pages and display the one that contains the command you want.
3. Use number keys 1 through 4 to select and input the command you want.

Note
To input a separator symbol (:), press EXE.

◘ Functions that Can be Input as Program Commands

You can input the settings and other operations that you perform during normal calculations as program commands. For more information, see the "Command Reference" below.

■ Command Reference

This section provides details on each of the commands that you can use in programs. Commands that have **P-CMD** in the title can be input on the screen that appears when you press SHIFT 3 (P-CMD) or Prog.

◘ Basic Operation Commands **P-CMD**

? (Input Prompt)

Syntax	? → {variable}
Function	Displays the input prompt "{variable}?" and assigns the input value to a variable.
Example	? → A

→ (Variable Assignment)

Syntax {expression ; ?} → {variable}
Function Assigns the value obtained by the element on the left to the variable on the right.
Example A+5 → A

: (Separator Code)

Syntax {statement} : {statement} : ... : {statement}
Function Separates statements. Does not stop program execution.
Example ? → A : A^2 : Ans^2

◢ (Output Command)

Syntax {statement} ◢ {statement}
Function Pauses program execution and displays the result of the current execution. The **Disp** symbol is turned on while program execution is paused by this command.
Example ? → A : A^2 ◢ Ans^2

Unconditional Jump Command P-CMD

Goto ~ Lbl

Syntax Goto n : .... : Lbl n or Lbl n : .... : Goto n (n = integer from 0 to 9)
Function Execution of Goto n jumps to corresponding Lbl n.
Example ? → A : Lbl 1 : ? → B : A × B ÷ 2 ◢ Goto 1

Important!
A Syntax ERROR occurs if there is no corresponding Lbl n in the same program where Goto n is located.

Conditional Jump Commands and Conditional Expressions P-CMD

⇒

Syntax ① {expression} {relational operator} {expression} ⇒ {statement1} : {statement2} : ....
② {expression} ⇒ {statement1} : {statement2} : ....
Function Conditional branching command used in combination with relational operators (=, ≠, >, ≧, <, ≦).
Syntax ①: {statement1} is executed if the condition to the left of the ⇒ command is true, and then {statement2} and everything after it is executed in sequence. {statement1} is skipped if the condition to the left of the ⇒ command is false, and then {statement2} and everything after it is executed.
Syntax ②: A non-zero evaluation result of the condition to the left of the ⇒ command is interpreted as "true", so {statement1} is executed, followed by {statement2} and everything after it in succession. A zero evaluation result of the condition to the left of the ⇒ command is interpreted as "false", so {statement1} is skipped, and {statement2} and everything after it is executed.

Example Lbl 1 : ? → A : A ≧ 0 ⇒ √(A) ◢ Goto 1

=, ≠, >, ≧, <, ≦ (Relational Operators)

Syntax {expression} {relational operator} {expression}
Function These commands evaluate the expressions on either side, and return a value of true (1) or false (0). These commands are used in combination with the branching command ⇒, and when structuring the {conditional expression} of If statements and While statements.
Example See the entries for ⇒ (page 66), If statement (page 67), and While statement (page 68).

Note
These commands evaluate the expressions on either side, and return 1 if true and 0 if false, and store the result in Ans.

Control Structure Commands/If Statement P-CMD

The If statement is used to control program execution branching according to whether the expression following If (which is the branching condition) is true or false.

If Statement Precautions
- An If must always be accompanied by a Then. Using an If without a corresponding Then will result in a Syntax ERROR.
- An expression, Goto command, or Break command can be used for the {expression*} following Then and Else.
- You cannot include an If statement inside of another If statement.

If~Then (~Else) ~IfEnd

Syntax If {conditional expression} : Then {expression*} : Else {expression*} : IfEnd : {statement} : ...
Function
- The statements following Then are executed up to Else, and then the statements following IfEnd are executed when the conditional statement following If is true. The statements following Else and then the statements following IfEnd are executed when the conditional statement following If is false.
- Else {expression} may be omitted.
- Always include the IfEnd:{statement}. Omitting it will not cause an error, but certain program contents can cause unexpected execution results by everything after the If statement.

Example 1 ? → A : If A < 10 : Then 10A ◢ Else 9A ◢ IfEnd : Ans×1.05
Example 2 ? → A : If A > 0 : Then A × 10 → A : IfEnd : Ans×1.05

Control Structure Commands/For Statement P-CMD

The For statement repeats execution of the statements between For and Next as long as the value assigned to the control variable is within the specified range.

For Statement Precautions
- A For statement must always be accompanied by a Next statement. Using a For without a corresponding Next will result in a Syntax ERROR.
- You cannot include a While statement inside of a For statement.

For~To~Next

Syntax For {expression (starting value)} → {variable (control variable)} To {expression (ending value)} : {statement} : ... {statement} : Next : ....
Function Execution of the statements from For to Next repeats as the control variable is incremented by 1 with each execution, starting from the starting value. When the value of the control value reaches the ending value, execution jumps to the statement following Next. Program execution stops if there is no statement following Next.
Example For 1 → A To 10 : A^2 → B : B ◢ Next

For~To~Step~Next

Syntax For {expression (starting value)} → {variable (control variable)} To {expression (ending value)} Step {expression (step)} : {statement} : ... {statement} : Next : ....
Function Execution of the statements from For to Next repeats as the control variable is incremented by the step amount with each execution, starting from the starting value. Except for that, this command is the same as For~To~Next.
Example For 1 → A To 10 Step 0.5 : A^2 → B : B ◢ Next

Control Structure Commands/While Statement P-CMD

While Statement Precautions
- You cannot include a For statement inside of a While statement.

While~WhileEnd

Syntax While {conditional expression} : {statement} : ... {statement} : WhileEnd : ....
Function The statements from While to WhileEnd are repeated while the conditional expression following While is true (non-zero). When the conditional expression following While becomes false (0), the statement following WhileEnd is executed.
Example ? → A : While A < 10 : A^2 ◢ A+1 → A : WhileEnd : A÷2

Note
If the condition of the While statement is false the first time this command is executed, execution jumps directly to the statement following WhileEnd without executing the statements from While to WhileEnd even once.

Program Control Commands P-CMD

Break

Syntax .. : {Then ; Else ; ⇒ } Break : ..
Function This command forces a break in a For or While loop, and jumps to the next command. Normally, this command is used inside of a Then statement in order to apply a Break condition.
Example ? → A : While A > 0 : If A > 2 : Then Break : IfEnd : WhileEnd : A ◢

Setup Commands

These commands function the same way as the calculator's various setup settings. For more information, see "Calculator Setup" on page 8.

Important!
With some setup commands, the settings you configure remain in effect even after you finish running the program.

Angle Unit Commands

Deg, Rad, Gra (COMP, CMPLX, SD, REG)

Syntax .. : Deg : ..
.. : Rad : ..
.. : Gra : ..
Operation [SHIFT] [MODE] (SETUP) [1] (Deg)
[SHIFT] [MODE] (SETUP) [2] (Rad)
[SHIFT] [MODE] (SETUP) [3] (Gra)
Function These commands specify the angle unit setting.

Display Format Command

Fix (COMP, CMPLX, SD, REG)

Syntax .. : Fix {n} : .. (n = an integer from 0 to 9)
Operation [SHIFT] [MODE] (SETUP) ▶ [1] (Fix) [0] to [9]
Function This command fixes the number of decimal places (from 0 to 9) for output of calculation results.

Sci (COMP, CMPLX, SD, REG)

Syntax .. : Sci {n} : .. (n = an integer from 0 to 9)
Operation [SHIFT] [MODE] (SETUP) ▶ [2] (Sci) [0] to [9]
Function This command fixes the number of significant digits (from 1 to 10) for output of calculation results.
Pressing [SHIFT] [MODE] (SETUP) ▶ [2] (Sci) and then [0] specifies 10 significant digits.

Norm (COMP, CMPLX, SD, REG)

Syntax .. : Norm {1 ; 2} : ..
Operation [SHIFT] [MODE] (SETUP) ▶ [3] (Norm) [1] or [2]
Function This command specifies either Norm1 or Norm2 for output of calculation results.

Statistical Frequency Command

FreqOn, FreqOff (SD, REG)

Syntax .. : FreqOn : ..
.. : FreqOff : ..
Operation [SHIFT] [MODE] (SETUP) ◀ [1] (FreqOn)
[SHIFT] [MODE] (SETUP) ◀ [2] (FreqOff)
Function This command turns statistical frequency on (FreqOn) or off (FreqOff).

Clear Commands

ClrMemory (COMP, CMPLX, BASE)

Syntax .. : ClrMemory : ..
Operation [SHIFT] [9] (CLR) [1] (Mem)
Function This command clears all variables (A, B, C, D, X, Y, M) to zero.

Note
To clear a specific variable, use 0 → {variable}.

ClrStat (SD, REG)

Syntax .. : ClrStat : ..
Operation [SHIFT] [9] (CLR) [1] (Stat)
Function This command clears all statistical sample data currently in memory.

Independent Memory Commands

M+, M– (COMP, CMPLX, BASE)

Syntax .. : {expression} M+ : .. / .. : {expression} M– : ..
Operation [M+] / [SHIFT] [M+] (M–)
Function M+ adds the value of the expression to independent memory, while M– subtracts it.

Rounding (Rnd) Command

Rnd((COMP, CMPLX, SD, REG)

Syntax .. : {expression} : Rnd(Ans : ..
Operation [SHIFT] [0] (Rnd)
Function This command rounds a calculation result in accordance with the number of digits specified by the display format.

Number Base Commands

Dec, Hex, Bin, Oct (BASE)

Syntax .. : Dec : .. / .. : Hex : .. / .. : Bin : .. / .. : Oct : ..
Operation [x^2] (DEC) / [^] (HEX) / [log] (BIN) / [ln] (OCT)
Function These commands specify the number base for base-n calculations.

Statistical Data Input Command

DT (SD, REG)

Syntax .. : {expression (x-value)} ; {expression (Freq-value)} DT : .. .. SD Mode, FreqOn
.. : {expression (x-value)} DT : .. .. SD Mode, FreqOff
.. : {expression (x-value)} , {expression (y-value)} ; {expression (Freq-value)} DT : .. ..REG Mode, FreqOn
.. : {expression (x-value)} , {expression (y-value)} DT : .. ..REG Mode, FreqOff

Important!
To input a semicolon (;) in the above syntax, press [SHIFT] [,] (;). To input a comma (,), press [,].

Operation [M+] (Inputs DT.)
Function Use this command to input one set of sample data. The DT command functions the same way as the [M+] key (DT key) in the SD Mode and REG Mode.

Functions Not Supported in Programs

The following functions are not supported inside of functions.
- Calculation result conversion functions (ENG→, ENG←, Sexagesimal ↔ Decimal Conversion, Fraction ↔ Decimal Conversion)
- Display switching ([SHIFT] [EXE] (Re⇔Im)) while a complex number calculation result is displayed
- Reset ([SHIFT] [9] (CLR) [3] (All) [EXE])
- Setup information clear ([SHIFT] [9] (CLR) [2] (Setup) [EXE])

Appendix

■ Calculation Priority Sequence

The calculator performs calculations you input in accordance with the priority sequence shown below.
- Basically, calculations are performed from left to right.
- Calculations enclosed in parentheses are given priority.

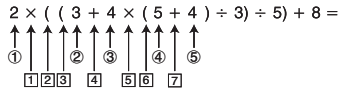
Sequence	Operation Type	Description
1	Parenthetical Functions	Pol(, Rec(sin(, cos(, tan(, $\sin^{-1}$(, $\cos^{-1}$(, $\tan^{-1}$(, sinh(, cosh(, tanh(, $\sinh^{-1}$(, $\cosh^{-1}$(, $\tanh^{-1}$(log(, ln(, e^(, 10^(, $\sqrt{}$(, $\sqrt[3]{}$(arg(, Abs(, Conjg(Not(, Neg(, Rnd(
2	Functions Preceded by Values Power, Power Root Percent	x^2, x^3, x^{-1}, $x!$, °, ′, ″, °, r, g ^(, $\sqrt[x]{}$(%
3	Fractions	$a\,b/c$
4	Prefix Symbols	(–) (minus sign) d, h, b, o (number base symbol)
5	Statistical Estimated Value Calculations	$\hat{x}$, $\hat{y}$, $\hat{x}1$, $\hat{x}2$
6	Permutation, Combination Complex Number Symbol	nPr, nCr ∠

Sequence	Operation Type	Description
7	Multiplication, Division Omitted Multiplication Sign	×, ÷ Multiplication sign can be omitted immediately before π, e, variables, scientific constants (2π, 5A, πA, 3mp, 2i, etc.), and parenthetical functions (2$\sqrt{}$(3), Asin(30), etc.)
8	Addition, Subtraction	+, –
9	Relational Operators	=, ≠, >, <, ≧, ≦
10	Logical Product	and
11	Logical Sum, Exclusive Logical Sum, Exclusive Negative Logical Sum	or, xor, xnor

Note
- If a calculation contains a negative value, you may need to enclose the negative value in parentheses. If you want to square the value –2, for example, you need to input: $(-2)^2$. This is because x^2 is a function preceded by a value (Priority 2, above), whose priority is greater than the negative sign, which is a prefix symbol (Priority 4).
  [(–)] [2] [x^2] [EXE] $-2^2 = -4$
  [(] [(–)] [2] [)] [x^2] [EXE] $(-2)^2 = 4$
- Multiplication and division, and multiplication where the sign is omitted are the same priority (Priority 7), so these operations are performed from left to right when both types are mixed in the same calculation. Enclosing an operation in parentheses causes it to be performed first, so the use of parentheses can result in different calculation results.
  [1] [$a\frac{b}{c}$] [2] [ENG] (i) [EXE] $1 \lrcorner 2i = \frac{1}{2}i$
  [1] [$a\frac{b}{c}$] [(] [2] [ENG] (i) [)] [EXE] $1 \lrcorner (2i) = -\frac{1}{2}i$

■ Stack Limitations

This calculator uses memory areas called “stacks” for temporary storage of lower calculation priority sequence values, commands, and functions. The “numeric stack” has 10 levels and the “command stack” has 24 levels as shown in the illustration below.



Numeric Stack

①	2
②	3
③	4
④	5
⑤	4
⋮	

Command Stack

1	×
2	(
3	(
4	+
5	×
6	(
7	+
⋮	

A Stack ERROR occurs when the calculation you are performing causes the capacity of a stack to be exceeded.

Note
When inputting a value in the CMPLX Mode, each value takes up two stack levels: one for the real part and one for the imaginary part. This means that the numeric stack has only five levels in the CMPLX Mode.

■ Calculation Ranges, Number of Digits, and Precision

The following table shows the general calculation range (value input and output range), number of digits used for internal calculations, and calculation precision.

Calculation Range	$\pm 1\times10^{-99}$ to $\pm 9.999999999\times10^{99}$ or 0
Internal Calculation	15 digits
Precision	In general, ±1 at the 10th digit for a single calculation. Error in the case of a calculation result in exponential format is ±1 at the least significant digits of the mantissa. Errors are cumulative in the case of consecutive calculations.

Function Calculation Input Ranges and Precision

Functions		Input Range
sin$x$	DEG	$0 \leqq \lvert x \rvert < 9\times10^{9}$
	RAD	$0 \leqq \lvert x \rvert < 157079632.7$
	GRA	$0 \leqq \lvert x \rvert < 1\times10^{10}$
cos$x$	DEG	$0 \leqq \lvert x \rvert < 9\times10^{9}$
	RAD	$0 \leqq \lvert x \rvert < 157079632.7$
	GRA	$0 \leqq \lvert x \rvert < 1\times10^{10}$
tan$x$	DEG	Same as sin$x$, except when $\lvert x \rvert = (2n-1)\times90$.
	RAD	Same as sin$x$, except when $\lvert x \rvert = (2n-1)\times\pi/2$.
	GRA	Same as sin$x$, except when $\lvert x \rvert = (2n-1)\times100$.
$\sin^{-1}x$		$0 \leqq \lvert x \rvert \leqq 1$
$\cos^{-1}x$		
$\tan^{-1}x$		$0 \leqq \lvert x \rvert \leqq 9.999999999\times10^{99}$
sinh$x$		$0 \leqq \lvert x \rvert \leqq 230.2585092$
cosh$x$		
$\sinh^{-1}x$		$0 \leqq \lvert x \rvert \leqq 4.999999999\times10^{99}$
$\cosh^{-1}x$		$1 \leqq x \leqq 4.999999999\times10^{99}$
tanh$x$		$0 \leqq \lvert x \rvert \leqq 9.999999999\times10^{99}$
$\tanh^{-1}x$		$0 \leqq \lvert x \rvert \leqq 9.999999999\times10^{-1}$
log$x$/ln$x$		$0 < x \leqq 9.999999999\times10^{99}$
10^x		$-9.999999999\times10^{99} \leqq x \leqq 99.99999999$

Functions	Input Range
e^x	$-9.999999999\times10^{99} \leqq x \leqq 230.2585092$
$\sqrt{x}$	$0 \leqq x < 1\times10^{100}$
x^2	$\lvert x \rvert < 1\times10^{50}$
$1/x$	$\lvert x \rvert < 1\times10^{100}$; $x \neq 0$
$\sqrt[3]{x}$	$\lvert x \rvert < 1\times10^{100}$
$x!$	$0 \leqq x \leqq 69$ (x is an integer)
$n\mathrm{P}r$	$0 \leqq n < 1\times10^{10}$, $0 \leqq r \leqq n$ (n, r are integers) $1 \leqq \{n!/(n-r)!\} < 1\times10^{100}$
$n\mathrm{C}r$	$0 \leqq n < 1\times10^{10}$, $0 \leqq r \leqq n$ (n, r are integers) $1 \leqq n!/r! < 1\times10^{100}$ or $1 \leqq n!/(n-r)! < 1\times10^{100}$
Pol(x, y)	$\lvert x \rvert, \lvert y \rvert \leqq 9.999999999\times10^{99}$ $\sqrt{x^2+y^2} \leqq 9.999999999\times10^{99}$
Rec(r, θ)	$0 \leqq r \leqq 9.999999999\times10^{99}$ θ: Same as sin$x$
°’”	$\lvert a \rvert, b, c < 1\times10^{100}$ $0 \leqq b, c$
°’” ↔	$\lvert x \rvert < 1\times10^{100}$ Decimal ↔ Sexagesimal Conversions $0°0'0'' \leqq \lvert x \rvert \leqq 9999999°59'59''$
$\wedge(x^y)$	$x > 0$: $-1\times10^{100} < y\log x < 100$ $x = 0$: $y > 0$ $x < 0$: $y = n, \frac{m}{2n+1}$ (m, n are integers) However: $-1\times10^{100} < y\log \lvert x \rvert < 100$
$\sqrt[x]{y}$	$y > 0$: $x \neq 0$, $-1\times10^{100} < 1/x\log y < 100$ $y = 0$: $x > 0$ $y < 0$: $x = 2n+1, \frac{2n+1}{m}$ ($m \neq 0$; m, n are integers) However: $-1\times10^{100} < 1/x\log \lvert y \rvert < 100$
$a\ b/c$	Total of integer, numerator, and denominator must be 10 digits or less (including separtor symbols).

- $\wedge(x^y)$, $\sqrt[x]{y}$, $\sqrt[3]{}$, $x!$, $n\mathrm{P}r$, $n\mathrm{C}r$ type functions require consecutive internal calculation, which can result in accumulation of errors that occur within each individual calculation.
- Errors are cumulative and tend to be large in the vicinity of a function's singular point and inflection point.

■ Error Messages

An error message will appear on the screen if you perform a calculation that causes a calculator's limit to be exceeded, or if you try to perform some operation that is not allowed.

Math ERROR

Sample Error Message

Recovering from an Error Message

You can recover from an error message by performing the key operations described below, regardless of the error type.

- Press ◀ or ▶ to display the editing screen for the calculation expression you input immediately before the error occurred, with the cursor positioned at the location that caused the error. For more information, see "Finding the Location of an Error" on page 13.
- Pressing AC will clear the calculation expression you input immediately before the error occurred. Note that a calculation expression that causes an error will not be included in calculation history.

Error Message Reference

This section lists all of the error messages that the calculator displays, as well as their causes and what you need to do to avoid them.

Math ERROR

Cause	• An intermediate or the final result of the calculation falls outside of the allowable calculation range. • An input value is outside the allowable input range. • You are trying to perform an illegal mathematical operation (such as division by zero).
Action	• Check your input values and reduce the number of digits, if required. • When using independent memory or a variable as the argument of a function, make sure that the memory or variable value is within the allowable range for the function.

For information about the allowable value input range, see "Calculation Ranges, Number of Digits, and Precision" on page 73.

Stack ERROR

Cause	The calculation has causes the capacity of the numeric stack or the command stack to be exceeded.
Action	• Simplify the calculation expression so it does not exceed the capacity of the stacks. • Try splitting the calculation into two or more parts.

For information about the capacities of the stacks, see "Stack Limitations" on page 72.

Syntax ERROR

Cause	The calculation has a format problem.
Action	Check the syntax and make the required corrections.

Arg ERROR

Cause	The calculation has a problem with how an argument being used.
Action	Check how arguments are being used and make the required corrections.

Data Full

Cause	You are attempting to store sample data in the SD Mode or REG Mode when the allowable number of data samples are already stored in memory.
Action	Keep the number of data samples within the allowable limit. For more information, see "Maximum Number of Input Data Items" on page 38.

Go ERROR

Cause	A program (that you created in the PRGM Mode) has a "Goto n" command without a corresponding "Lbl n" label.
Action	Either add a "Lbl n" for the "Goto n" command, or delete the applicable "Goto n" command.

■ Before assuming malfunction of the calculator...

Perform the following steps whenever an error occurs during a calculation or when calculation results are not what you expected. If one step does not correct the problem, move on to the next step. Note that you should make copies of important copies of important data before performing these steps.

① Check the calculation expression to make sure it does not include any errors.
② Make sure that you are using the correct mode for the type of calculation you are trying to perform.
③ If the above steps do not restore normal operation, press the ON key. The calculator will perform a self-check of its status as it starts up. If the calculator discovers a problem, it will return its calculation mode and setup to their initial defaults, and clear all data currently in memory.
④ If step ③ does not restore normal operation, initialize all modes and settings by pressing SHIFT 9 (CLR) 2 (Setup) EXE.

Power Requirements

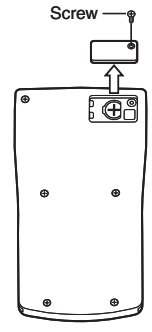
Your calculator has a TWO WAY POWER system that combines a solar cell with a button battery (LR44). Unlike solar cell-only calculators that operate only when light is present, a TWO WAY POWER system calculator keeps on operating even in the dark. (Of course, you will need enough light to be able to read the display contents.)

Replacing the Battery

Dim display characters, especially when using the calculator where lighting is dim, or slow display response when you turn on the calculator indicates that button battery power is low. Replace the battery whenever you notice these symptoms. You should also regularly replace the battery at least once every three years, even if the calculator is operating normally.

Important!
Removing the button battery from the calculator causes independent memory contents and values assigned to variables to be cleared.

1. Press SHIFT AC (OFF) to turn off the calculator.
   To ensure that you do not accidentally turn on the calculator while replacing the battery, slide the hard case into the front of the calculator.
2. On the back of the calculator, remove the screw and the battery cover.
3. Remove the old battery.
4. After wiping a new battery with a dry cloth, load it into the battery compartment with its plus ⊕ side facing upwards (so you can see it).
5. Replace the battery cover and secure it in place with the screw.
6. Initialize the calculator by pressing SHIFT 9 (CLR) 3 (All) EXE.
   Be sure to perform this step! Do not skip it!



Auto Power Off

Your calculator will turn off automatically if you do not perform any operation for about 10 minutes. If this happens, press the ON key to turn the calculator back on.

Specifications

Power Requirements:
Solar Cell: Built into front of calculator (fixed)
Button Battery: G13 type (LR44) × 1

Approximate Battery Life:
3 years (based on 1 hour of operation per day)

Operating Temperature: 0˚C to 40˚C (32˚F to 104˚F)

Dimensions: 12.2 (H) × 80 (W) × 161 (D) mm
$^1/_2$" (H) × 3$^1/_8$" (W) × 6$^5/_{16}$" (D)

Approximate Weight: 105 g (3.7 oz) including the battery

Bundled Accessories: Hard Case