

INTRODUCTION

About the calculation examples (including some formulas and tables), refer to the reverse side of this English manual. Refer to the number on the right of each title on the manual for use. After reading this manual, store it in a convenient location for future reference. Note: Some of the models described in this manual may not be available in some countries.

Operational Notes

- Do not carry the calculator around in your back pocket, as it may break when you sit down. The display is made of glass and is particularly fragile.
- Keep the calculator away from extreme heat such as on a car dashboard or near a heater, and avoid exposing it to excessively humid or dusty environments.
- Since this product is not waterproof, do not use it or store it where fluids, for example water, can splash onto it. Raindrops, water spray, juice, coffee, steam, perspiration, etc. will also cause malfunction.
- Clean with a soft, dry cloth. Do not use solvents or a wet cloth. Avoid using a rough cloth or anything else that may cause scratches.
- Do not drop it or apply excessive force.
- Never dispose of batteries in a fire.
- Keep batteries out of the reach of children.
- This product, including accessories, may change due to upgrading without prior notice.

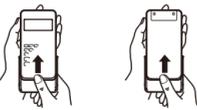
NOTICE

- SHARP strongly recommends that separate permanent written records be kept of all important data. Data may be lost or altered in virtually any electronic memory product under certain circumstances. Therefore, SHARP assumes no responsibility for data lost or otherwise rendered unusable whether as a result of improper use, repairs, defects, battery replacement, use after the specified battery life has expired, or any other cause.
- SHARP will not be liable nor responsible for any incidental or consequential economic or property damage caused by misuse and/or malfunctions of this product and its peripherals, unless such liability is acknowledged by law.

- Press the RESET switch (on the front), with the tip of a ball-point pen or similar object, only in the following cases. Do not use an object with a breakable or sharp tip. Note that pressing the RESET switch erases all data stored in memory.
  - When using for the first time
  - After replacing the battery
  - To clear all memory contents
  - When an abnormal condition occurs and all keys are inoperative.

If service should be required on this calculator, use only a SHARP servicing dealer, SHARP approved service facility, or SHARP repair service where available.

Hard Case



DISPLAY



- During actual use, not all symbols are displayed at the same time.
- Certain inactive symbols may appear visible when viewed from a far off angle.
- Only the symbols required for the usage under instruction are shown in the display and calculation examples.
- ←/→ : Appears when the entire equation cannot be displayed. Press ←/→ to see the remaining (hidden) section.

- The previous calculation result will not be recalled after entering multiple instructions.
  - In the case of utilizing postfix functions (√, sin, etc.), you can perform a chain calculation even when the previous calculation result is cleared by the use of the ON/C key.
- Fracton Calculations [8]**
- This calculator performs arithmetic operations and memory calculations using fractions, and conversion between a decimal number and a fraction.
- If the number of digits to be displayed is greater than 10, the number is converted to and displayed as a decimal number.

- Binary, Pental, Octal, Decimal, and Hexadecimal Operations (N-Base) [9]**
- This calculator can perform conversions between numbers expressed in binary, pental, octal, decimal and hexadecimal systems. It can also perform the four basic arithmetic operations, calculations with parentheses and memory calculations using binary, pental, octal, decimal, and hexadecimal numbers. In addition, the calculator can carry out the logical operations AND, OR, NOT, NEG, XOR and XNOR on binary, pental, octal and hexadecimal numbers.
- Conversion to each system is performed by the following keys:

- [2ndF] [↔BIN]: Converts to the binary system. "b" appears.
- [2ndF] [↔PEN]: Converts to the pental system. "P" appears.
- [2ndF] [↔OCT]: Converts to the octal system. "o" appears.
- [2ndF] [↔HEX]: Converts to the hexadecimal system. "H" appears.
- [2ndF] [↔DEC]: Converts to the decimal system. "d", "P", "o", and "H" disappear from the display.

Conversion is performed on the displayed value when these keys are pressed.

Note: In this calculator, the hexadecimal numbers A - F are entered by pressing  $\frac{A}{16}$ ,  $\frac{B}{17}$ ,  $\frac{C}{18}$ ,  $\frac{D}{19}$ ,  $\frac{E}{20}$ ,  $\frac{F}{21}$ , and  $\frac{16}{16}$ , and displayed as follows:

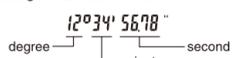
$$A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow E, E \rightarrow F, F \rightarrow 16$$

In the binary, pental, octal, and hexadecimal systems, fractional parts cannot be entered. When a decimal number having a fractional part is converted into a binary, pental, octal, or hexadecimal number, the fractional part will be truncated. Likewise, when the result of a binary, pental, octal, or hexadecimal calculation includes a fractional part, the fractional part will be truncated. In the binary, pental, octal, and hexadecimal systems, negative numbers are displayed as a complement.

**Time, Decimal and Sexagesimal Calculations [10]**

Conversion between decimal and sexagesimal numbers can be performed. In addition, the four basic arithmetic operations and memory calculations can be carried out using the sexagesimal system.

Notation for sexagesimal is as follows:



Coordinate Conversions [11]

- Before performing a calculation, select the angular unit.
- 

- The calculation result is automatically stored in memories X and Y.
- Value of r or x: X memory
- Value of theta or y: Y memory

Modify Function [12]

In this calculator, calculation results are internally obtained in scientific notation with up to 14 digits for the mantissa. However, since calculation results are displayed in the form designated by the display notation and the number of decimal places indicated, the internal calculation result may differ from that shown in the display. By using the modify function, the internal value is converted to match that of the display, so that the displayed value can be used without change in subsequent operations.

STATISTICAL CALCULATIONS [13]

Statistical calculations are performed in the statistics mode. Press [MODE] [1] to select the statistics mode. This calculator performs the seven statistical calculations indicated below. After selecting the statistics mode, select the desired sub-mode by pressing the number key corresponding to your choice. When changing to the statistical sub-mode, press the corresponding number key after performing the operation to select the statistics mode (press [MODE] [1]).

- ▲/▼ : Indicates that data can be visible above/below the screen. These indications may appear when menu, multi-line playback, and statistics data are displayed. Press [▲] [▼] to scroll up/down the view.
- 2ndF : Appears when [2ndF] is pressed, indicating that the functions shown in orange are enabled.
- HYP : Indicates that [HYP] has been pressed and the hyperbolic functions are enabled. If [2ndF] [HYP] are pressed, the symbols "2ndF HYP" appear, indicating that inverse hyperbolic functions are enabled.
- ALPHA : Indicates that [ALPHA] (STAT VAR), [STO] or [RCL] has been pressed, and entry (recall) of memory contents and recall of statistics can be performed.
- FIX/SCI/ENG : Indicates the notation used to display a value and changes by SET UP menu.
- DEG/RAD/GRAD : Indicates angular units and changes each time [DRG] is pressed.
- STAT : Appears when statistics mode is selected.
- M : Indicates that a numerical value is stored in the independent memory.

BEFORE USING THE CALCULATOR

In this manual, key operations are described as follows:

ex	To specify $x^y$ :	[2ndF] [C <sup>x</sup> ]
In	To specify In :	[ln]
	To specify F :	[ALPHA] [F]

Functions that are printed in orange above the key require [2ndF] to be pressed first before the key. When you specify the memory, press [ALPHA] first. Numbers for input value are not shown as keys, but as ordinary numbers.

**Power On and Off**

Press [ON/C] to turn the calculator on, and [2ndF] [OFF] to turn it off.

**Clearing the Entry and Memories**

Clearing methods are described in the table as follows:

Clearing operation	Entry (Display)	M <sup>+</sup>	A-F, X, Y <sup>+</sup>	STAT <sup>+</sup>
[ON/C]	0	x	x	x
[2ndF] [CA]	0	x	0	0
[2ndF] [M-CL] [0] [0]	0	0	0	0
[2ndF] [M-CL] [1] [0]	0	0	0	0
RESET switch	0	0	0	0

- 0 : Clear
- x : Retain
- \*1 : Independent memory M.
- \*2 : Temporary memory A-F, X and Y.
- \*3 : Last answer memory.
- \*4 : Statistical data (entered data).
- \*5 :  $\Sigma x, \Sigma x^2, \Sigma y, \Sigma y^2, \Sigma xy, \Sigma x^2, \Sigma y^2, \Sigma xy, r, a, b, c$ .
- \*6 : All variables are cleared. See 'About the Memory clear key' for details.
- \*7 : This key combination functions the same as the RESET switch. See 'About the Memory clear key' for details.

[About the Memory clear key]

Press [2ndF] [M-CL] to display the menu.



- To clear all variables (M, A-F, X, Y, ANS, STATVAR), press [0] [0] or [0] [ENT].
- To RESET the calculator, press [1] [0] or [1] [ENT]. The RESET operation will erase all data stored in memory, and restore the calculator's default setting.

Entering and Correcting the Equation

- [Cursor keys]
  - Press [←] or [→] to move the cursor. You can also return to the equation after getting an answer by pressing [↵] [←]. See the next section for using the [▲] and [▼] keys.
  - In the SET UP menu and other locations, use the [←] or [→] key to move the flashing cursor, then press [ENT] (= key). If you need to scroll up/down the view, use the [▲] or [▼] key.

[Insert mode and Overwrite mode in the Equation display]

- This calculator has two editing modes: insert mode (default), and overwrite mode. Pressing [2ndF] [INS] switches between the two modes. A triangular cursor indicates that an entry will be inserted at the cursor, while the rectangular cursor indicates to overwrite preexisting data as you make entries.
- To insert a number in the insert mode, move the cursor to the place immediately after where you wish to insert, then make a desired entry. In the overwrite mode, data under the cursor will be overwritten by the number you enter.
- This mode setting will be retained until the next RESET operation is executed.

[Deletion key]

- To delete a number/function, move the cursor to the number/function you wish to delete, then press [DEL]. If the cursor is located at the right end of an equation, the [DEL] key will function as a back space key.

- [0] (SD) : Single-variable statistics
- [1] (LINE) : Linear regression calculation
- [2] (QUAD) : Quadratic regression calculation
- [3] (EXP) : Exponential regression calculation
- [4] (LOG) : Logarithmic regression calculation
- [5] (PWR) : Power regression calculation
- [6] (INV) : Inverse regression calculation

The following statistics can be obtained for each statistical calculation (refer to the table below):

Single-variable statistical calculation

Statistics of ①

**Linear regression calculation**

Statistics of ① and ②, and, in addition, estimate of y for a given x (estimate y') and estimate of x for a given y (estimate x')

Exponential regression, Logarithmic regression, Power regression, and Inverse regression calculation

Statistics of ① and ②. In addition, estimate of y for a given x and estimate of x for a given y. (Since the calculator converts each formula into a linear regression formula before actual calculation takes place, it obtains all statistics, except coefficients a and b, from converted data rather than entered data.)

Quadratic regression calculation

Statistics of ① and ② and coefficients a, b, c in the quadratic regression formula ( $y = a + bx + cx^2$ ). (For quadratic regression calculations, no correlation coefficient (r) can be obtained.) When there are two x' values, press [2ndF] [↔].

When performing calculations using a, b and c, only one numeric value can be held.

	$\bar{x}$	Mean of samples (x data)
	st	Sample standard deviation (x data)
	$\sigma x$	Population standard deviation (x data)
①	n	Number of samples
	$\Sigma x$	Sum of samples (x data)
	$\Sigma x^2$	Sum of squares of samples (x data)
	$\bar{y}$	Mean of samples (y data)
	sy	Sample standard deviation (y data)
	$\sigma y$	Population standard deviation (y data)
	$\Sigma y$	Sum of samples (y data)
	$\Sigma y^2$	Sum of squares of samples (y data)
②	$\Sigma xy$	Sum of products of samples (x, y)
	r	Correlation coefficient
	a	Coefficient of regression equation
	b	Coefficient of regression equation
	c	Coefficient of quadratic regression equation

- Use [ALPHA] and [RCL] to perform a STAT variable calculation.

Data Entry and Correction [14]

Entered data are kept in memory until [2ndF] [CA] are pressed or mode selection. Before entering new data, clear the memory contents.

[Data Entry]

Single-variable data  
Data [DATA] frequency [DATA] (To enter multiples of the same data)

Two-variable data  
Data x [DATA] Data y [DATA]  
Data x [DATA] Data y [DATA] frequency [DATA] (To enter multiples of the same data x and y.)

- Up to 100 data items can be entered. With the single-variable data, a data item without frequency assignment is counted as one data item, while an item assigned with frequency is stored as a set of two data items. With the two-variable data, a set of data items without frequency assignment is counted as two data items, while a set of items assigned with frequency is stored as a set of three data items.

[Data Correction]

Correction prior to pressing [DATA] immediately after a data entry: Delete incorrect data with [ON/C], then enter the correct data. Correction after pressing [DATA]:

- Use [▲] [▼] to display the data previously entered. Press [↵] to display data items in ascending (oldest first) order. To reverse the display order to descending (latest first), press the [▲] key. Each item is displayed with 'N1=', 'Y1=', or 'Nn=' (n is the sequential number of the data set). Display the data item to modify, input the correct value, then press [DATA]. Using [↵], you can correct the values of the data set all at once.

- When ▲ or ▼ appears, more data items can be browsed by pressing [▲] or [▼].
- To delete a data set, display an item of the data set to delete, then press [2ndF] [CD]. The data set will be deleted.
- To add a new data set, press [ON/C] and input the values, then press [DATA].

Multi-line Playback function [15]

This calculator is equipped with a function to recall previous equations in the normal mode. Equations also include calculation ending instructions such as "←" and a maximum of 142 characters can be stored in memory. When the memory is full, stored equations are deleted in the order of the oldest first. Pressing [▲] will display the previous equation and the answer. Further pressing [▲] will display preceding equations (after returning to the previous equation, press [▼] to view equations in order). In addition, [2ndF] [▲] can be used to jump to the oldest equation.

- To edit an equation after recalling it, press [↵] [←].
- To edit the displayed equation, press [↵] [←] immediately after obtaining a calculation answer.
- The multi-line memory is cleared by the following operations: [2ndF] [CA], [2ndF] [OFF] (including the Automatic Power Off feature), mode change, memory clear ([2ndF] [M-CL]), RESET, [2ndF] [M-CL] ([RCL]) ([RCL]), constant calculation, chain calculation, angle unit conversion, coordinate conversion, N-base conversion, numerical value storage to the temporary memories and independent memory, and input/deletion of statistical data.

Priority Levels in Calculation

This calculator performs operations according to the following priority:

- 1 Fractions (1/4, etc.)
- 2 Functions preceded by their argument (x<sup>2</sup>, x<sup>3</sup>, n!, etc.)
- 3 Y<sup>n</sup>, x<sup>y</sup>
- 4 Implied multiplication of a memory value (2Y, etc.)
- 5 Functions followed by their argument (sin, cos, etc.)
- 6 Implied multiplication of a function (2sin30, etc.)
- 7 +, -, ×, ÷
- 8 ×, ÷, +, -
- 9 OR, XOR, XNOR
- 10 =, M+, M-, →M, ►DEG, ►RAD, ►GRAD, DATA, CD, →R0, →xy and other calculation ending instructions

- If parentheses are used, parenthesized calculations have precedence over any other calculations.

INITIAL SET UP

Mode Selection

Normal mode (NORMAL): [MODE] [0]  
Used to perform arithmetic operations and function calculations.

Statistics mode (STAT): [MODE] [1]  
Used to perform statistical calculations.

When executing mode selection, temporary memories, statistical variables, statistical data and last answer memory will be cleared even when reselecting the same mode.

HOME Key

Press [HOME] to return to NORMAL mode from other modes. Note: Equations and values currently being entered will disappear, in the same way as when the mode is changed.

SET UP menu

Press [SETUP] to display the SET UP menu.



- A menu item can be selected by:
  - moving the flashing cursor by using [↵] [←], then press [ENT] (= key), or
  - pressing the number key corresponding to the menu item number.
- If ▲ or ▼ is displayed on the screen, press [▲] or [▼] to view the previous/next menu screen.
- Press [ON/C] to exit the SET UP menu.

[Selecting the Display Notation and Decimal Places]

The calculator has four display notation systems (Floating point, Fixed decimal point, Scientific notation and Engineering notation) for displaying calculation results.

- When the FIX, SCI, or ENG symbol is displayed, the number of decimal places (TAB) can be set to any value between 0 and 9. Displayed values will be reduced to the corresponding number of digits.
- If a floating point number does not fit in the specified range, the calculator will display the result using the scientific notation (exponential notation) system. See 'Setting the Floating Point Numbers System in Scientific Notation' for details.
- Press [SETUP], followed by [0], to display the following sub-menu:



[Setting the Floating Point Numbers System in Scientific Notation]

The calculator has two settings for displaying a floating point number: NORM1 (default setting) and NORM2. In each display setting, a number is automatically displayed in scientific notation outside a preset range:

- NORM1: 0.000000001 ≤ |x| ≤ 9999999999
- NORM2: 0.01 ≤ |x| ≤ 9999999999

100000÷3=	[ON/C] 100000 [÷] [3] [ENT]	33'333.33333
[Floating point (NORM1)]	[SETUP] [0] [0]	33'333.33333
[Fixed decimal point]	[SETUP] [1] [2]	33'333.33
[TAB set to 2]	[SETUP] [0] [1]	3.33×10 <sup>04</sup>
[Scientific notation]	[SETUP] [0] [2]	33.33×10 <sup>09</sup>
[Engineering notation]	[SETUP] [0] [3]	33'333.33333
[Floating point (NORM1)]	[SETUP] [0] [3]	
3÷1000=	[ON/C] 3 [÷] 1000 [ENT]	0.003
[Floating point (NORM1)]	[SETUP] [0] [4]	3.×10 <sup>-03</sup>
[Floating point (NORM2)]	[SETUP] [0] [3]	0.003
[Floating point (NORM1)]	[SETUP] [0] [3]	

Statistical Calculation Formulas [15]

Type	Regression formula
Linear	$y = a + bx$
Exponential	$y = a \cdot e^{bx}$
Logarithmic	$y = a + b \cdot \ln x$
Power	$y = a \cdot x^b$
Inverse	$y = a + b \cdot \frac{1}{x}$
Quadratic	$y = a + bx + cx^2$

In the statistical calculation formulas, an error will occur when:

- The absolute value of the intermediate result or calculation result is equal to or greater than  $1 \times 10^{10}$ .
- The denominator is zero.
- An attempt is made to take the square root of a negative number.
- No solution exists in the quadratic regression calculation.

ERROR AND CALCULATION RANGES

Errors

An error will occur if an operation exceeds the calculation ranges, or if a mathematically illegal operation is attempted. When an error occurs, pressing [↵] (or [↵] [→]) automatically moves the cursor back to the place in the equation where the error occurred. Edit the equation or press [ON/C] to clear the equation.

Error Codes and Error Types

Syntax error (Error 1):  
An attempt was made to perform an invalid operation.  
Ex. 2 [2ndF] [↔]

Calculation error (Error 2):

- The absolute value of an intermediate or final calculation result equals or exceeds  $10^{10}$ .
- An attempt was made to divide by 0 (or an intermediate calculation resulted in zero).
- The calculation ranges were exceeded while performing calculations.

Depth error (Error 3):

- The available number of buffers was exceeded. (There are 10 buffers for numeric values and 24 buffers for calculation instructions).
- 5 buffers in STAT mode.
- Data items exceeded 100 in the statistics mode.

Equation too long (Error 4):

- The equation exceeded its maximum input buffer (142 characters). An equation must be shorter than 142 characters.

Calculation Ranges [16]

- Within the ranges specified, this calculator is accurate to ±1 of the least significant digit of the mantissa. However, a calculation error increases in continuous calculations due to accumulation of each calculation error. (This is the same for  $y^x$ ,  $\sqrt{x}$ ,  $n!$ ,  $e^x$ ,  $\ln$ , etc., where continuous calculations are performed internally.) Additionally, a calculation error will accumulate and become larger in the vicinity of inflection points and singular points of functions.
- Calculation ranges
  - ±10<sup>10</sup> ~ ±9.999999999×10<sup>99</sup> and 0.

If the absolute value of an entry or a final or intermediate result of a calculation is less than 10<sup>-99</sup>, the value is considered to be 0 in calculations and in the display.

BATTERY REPLACEMENT

Notes on Battery Replacement  
Improper handling of batteries can cause electrolyte leakage or explosion. Be sure to observe the following handling rules:

- Make sure the new battery is the correct type.
- When installing, orient the battery properly as indicated in the calculator.
- The battery is factory-installed before shipment, and may be exhausted before it reaches the service life stated in the specifications.

Notes on erasure of memory contents

When the battery is replaced, the memory contents are erased. Erasure can also occur if the calculator is defective or when it is repaired. Make a note of all important memory contents in case accidental erasure occurs.

When to Replace the Battery

[EL-509TS/531TH/531TS] If the display has poor contrast, the battery require replacement.  
[EL-531TG] If the display has poor contrast or nothing appears on the display even when [ON/C] is pressed in dim lighting, it is time to replace the battery.

Cautions

- Fluid from a leaking battery accidentally entering an eye could result in serious injury. Should this occur, wash with clean water and immediately consult a doctor.
- Should fluid from a leaking battery come in contact with your skin or clothes, immediately wash with clean water.
- If the product is not to be used for some time, to avoid damage to the unit from leaking batteries, remove them and store in a safe place.
- Do not leave exhausted batteries inside the product.

Determination of the Angular Unit

In this calculator, the following three angular units (degrees, radians, and grads) can be specified.



SC

