Scientific Calculator

User's guide

Scientific Calculator	1
About this manual	3
Initializing the Calculator	4
Safety Precautions	4
Battery	4
Disposing of the Calculator	4
Handling Precautions	5
Before Using the Calculator	6
Display Indicators	7
Calculation Modes and Calculator Setup	8
Modes	8

About this manual

The "Math" mark indicated an example that uses Match format, while the "Line" mark indicated linear format. For details about input/output formats, see "Specifying the Input/Output Format".

Keycap marking indicate what key input or what function it performs. Examples: "1", "2", "+", "-", "AC" etc.

Pressing the "Shift" or "Alpha" key followed by a second key performs the alternate function of the second key. The alternate function is indicated by the text printed above the key.

The following shows what the different colours of the alternate function key text mean.

If key marking text is this colour	It means this
Yellow	Press "Shift" and then the key to access
	the applicable function.
Red	Press "Alpha" and then the key to input
	the applicable variable, constant or
	symbol.

The following shows an example of how an alternate function operation is represented in this User's Guide.

Example: "Shift" "sin" (sin⁻¹) "1" "=" ... indicates the function that is accessed by the key operation ("Shift" "sin") before it. Note that this is not part of the actual key operation you perform.

The following shows an example of how a key operation to select an on-screen menu item is represented in this User's Guide.

Example: "1" (Setup) ... indicated the menu item that is selected by the number key operation ("1") before it. Note that this is not part of the actual key operation you perform.

The cursor key is marked with four arrows indicating direction. In this User's Guide, cursor key operation is indicated as "UP", "DOWN", "LEFT" and "RIGHT".

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.

"Deg" specify degree for the angle unit. "Rad" specify radian for the angle unit.

Initializing the Calculator

Perform the following procedure when you want to initialize the calculator and return the calculation mode and setup to their initial default settings. Note that this operation also clears all data currently in calculator memory.

SHIFT 9 (CLR) 3 (All) = (Yes)

For information about calculation modes and setup settings, see "Calculation Modes and Calculator Setup".

For information about memory, see "Using Calculator Memory".

Safety Precautions

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

Exclamation symbol marks 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 will not get accidentally swallowed. If swallowed, consult with a physician immediately.

Never charge the battery, try to take the battery apart or allow the battery to direct hear 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 batteries positive and negative ends are facing correctly when you load it into the calculator.

Remove the battery if you do not plan to use the calculator for a long time.

Use only thy 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.

Handling Precautions

Be sure to press "ON" key before unit the calculator for the first time.

Even if the calculator is operating normally, replace the battery at least once every two years.

A dead battery can leak, causing damage to the calculator resulting in malfunction. 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.

Avoid use and storage the calculator in areas subjected to large amounts of humidity and dust.

Never drop the calculator or otherwise subject it to a strong impact.

Never twist or bend the calculator.

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.

Before Using the Calculator

Remove the Hard Case. Before using the calculator, slide its hard case downwards to remove it, and then affix the hard case to the back of the calculator as shown in the illustration below.



Turn Power On and Off. Press "ON" to turn on the calculator. Press "Shift" "AC" (Off) to turn off the calculator.

Adjusting Display Contrast. SHIFT MODE (SETUP) (≤ (CONT) This displays the contrast adjustment screen. Use "LEFT" and "RIGHT" to adjust display contrast. After the setting is the way you want, press "AC". You can also adjust contrast using "LEFT" and "RIGHT" while in the mode menu (which appears when you press "MODE").

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

About the Display. Your calculator has a 31-dot × 96-dot LCD screen.

Display Indicators

This indicator	Means this
c	The keypad has been shifted by pressing the "Shift" key. The keypad
3	will unshift and this indicator will disappear when you press a key.
	The alpha input mode has been entered by pressing the "Alpha" key.
A	The alpha input mode will be exited and this indicator will disappear
	when you press a key.
М	There is a value stored in the independent memory.
	The calculator is standing by for input of a variable name to assign a
STO	value to the variable. This indicator appears after you press "Shift"
	"RCL" (STO).
RCI	The calculator is standing by for input of a variable name to recall the
	variable's value. This indicator appears after you press "RCL".
STAT	The calculator is in the STAT mode.
D	The default angle unit is degrees.
R	The default angle unit is radians.
G	The default angle unit is grads.
FIX	A fixed number of decimal places is in effect.
SCI	A fixed number of significant digits is in effect.
Math	Math style is selected as the input/output format.
T A	Calculation history memory data is available and can be replayed, or
•	there is more data above/below the current screen.
Disp	The display currently shows an intermediate result of a multi-
lish	statement calculation.

Important! For a very complex calculation or some other type of calculation that takes a long time to execute, the display may show only the above indicators (without any value) while it performs the calculation internally.

Calculation Modes and Calculator Setup

Modes

When you want to perform this type of operation	Select this mode
General calculations	СОМР
Statistical and regression calculations	STAT
Generation of a number table based on an expression	TABLE

Specifying the Calculation Mode

- 1. Press "Mode" to display the mode menu.
- 2. Press the number key that corresponds to the mode you want to select.

Configuring the Calculator Setup

Pressing "Shift" "Mode" (Setup) displays the setup menu, which you can use to control how the calculations are executed and displayed. The setup menu has two screens, which you can jump between using "DOWN" and "UP".



See "Adjusting Display Contrast" for information about how to use "< CONT >".

Specifying the Input/Output Format

For this input/output format	Perform this key operation
Math	"Shift" "Mode" "1" (MthIO)
Linear	"Shift" "Mode" "2" (LinelO)

Math format causes fractions, irrational numbers and other expressions to be displayed as they are written on the paper.

Linear format causes fractions and other expressions to be displayed in a single line.



Specifying the Default Angle Unit

To specify this	Perform this key operation
Degrees	"Shift" "Mode" "3" (Deg)
Radians	"Shift" "Mode" "4" (Rad)
Grads	"Shift" "Mode" "5" (Gra)

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

Specifying the Number of Display Digits

To specify this	Perform this key operation
Number of Decimal Places	"Shift" "Mode" "6" (Fix) "0" – "9"
Number of Significant Digits	"Shift" "Mode" "7" (Sci) "0" – "9"
Exponential Display Range	"Shift" "Mode" "8" (Norm) "1" (Norm1) or "2" (Norm2)

Calculation Display Result Examples

Fix: The value you specify (from 0 to 9) controls the number of decimal places for displayed calculation results. Calculation results are rounded off to the specified digit before being displayed.

Example: 100 ÷ 7 = 14.286 (Fix3) = 14.29 (Fix2)

Sci: The value you specify (from 0 to 10) controls the number of significant digits for displayed calculation results. Calculation results are rounded off to the specified digit before being displayed.

Example: $1 \div 7 = 1.4286 \times 10^{-1}$ (Sci5) = 1.429×10^{-1} (Sci4)

Norm: Selecting one of the two available settings (Norm1, Norm2) determines the range in which results will be displayed in non-exponential format. Outside the specified range, results are displayed using exponential format.

```
Norm1: 10^{-2} |x|, |x| \ge 10^{10}
```

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

Example: $1 \div 200 = 5 \times 10^{-3}$ (Norm1) = 0.005 (Norm2)

To specify this fraction format	Perform this key operation
Mixed	"Shift" "Mode" "DOWN" "1" (ablc)
Improper	"Shift" "Mode" "DOWN" "2" (dlc)

Specifying the Fraction Format

Specifying the Statistical Display Format

Use the following procedure to turn display of the frequency (FREQ) column of the STAT Mode STAT editor screen on or off.

To specify this	Perform this key operation
Show FREQ Column	"Shift" "Mode" "DOWN" "3" (STAT) "1" (ON)
Hide FREQ Column	"Shift" "Mode" "DOWN" "3" (STAT) "2" (OFF)

Specifying the Decimal Point Display Format

To specify this decimal point display	Perform this key operation
format	
Dot (.)	"Shift" "Mode" "DOWN" "4" (Disp) "1" (Dot)
Comma (,)	"Shift" "Mode" "DOWN" "4" (Disp) "2" (Comma)

This setting you configure here is applied for calculation results only. The decimal point for input values is always a dot (.).

Initialising the Calculation Mode and Other Settings

Performing the following procedure initializes the calculation mode and other setup settings as shown below.

SHIFT 9(CLR) 1(Setup) =(Yes)

This setting	Is initialized to this
Calculation Mode	Comp
Input/Output Format	MthIO
Angle Unit	Deg
Display Digits	Norm1
Fraction Format	d/c
Statistical Display	OFF
Decimal Point	Dot

To cancel initialization without doing anything, press "AC" (Cancel) instead of "=".

Input Expressions and Values

Inputting a Calculation Expression Using Standard Format

Your calculator lets you input calculation expressions just as they are written. Then simply press the "=" key to execute it. The calculator automatically judges the calculation priority sequence for addition, subtraction, multiplication and division, functions and parentheses.



Inputting a General Function

When you input any of the general functions shown below, it is automatically input with the open Parenthesis (() character. Next you need to input the argument and then closing parenthesis ()).

Example: sin 30 =

[LINE]			D	*
	sin 30)=	Sin(30)		0.5

Note that the input procedure is different if you want to use Math format. For more information, see "Inputting with Math Format".

Omitting the Multiplication Sign

You can omit the multiplication sign (×) in any of the following cases.

- Before an open parenthesis: 2(5 + 4) instead of $2 \times (5 + 4)$.
- Before a general function.
- Before a variable name, constant or random number.

Final Closed Parenthesis

You can omit one or more closed parentheses that come at the end of a calculation, immediately before the "=" key is pressed. For details, see "Omitting a Final Closed Parenthesis".

Displaying a Long Expression

The display can show up to 14 characters at a time. Inputting the 15th character causes the expression to shift to the left. At this time, the "LEFT" indicator appears to the left of the expression, indicating that is runs off the left side of the screen.

When the "LEFT" indicator is displayed, you can scroll left using the "LEFT" key.

Number of Input Characters (Bytes)

You can input up to 99 bytes of data for a single expression. Basically, each key operation uses up one byte. A function that requires two key operation to input (like "Shift" "sin") also uses only one byte. Note, however, that when you are inputting functions with Math format, each item you input uses up more than one byte. For more information, see "Inputting with Math Format".

Normally, the input cursor appears as a straight vertical or horizontal flashing line on the display screen. When there are 10 or fewer bytes of input remaining in the current expression, the cursor changes shape to rectangle to let you know. If the rectangular cursor appears, terminate the expression at a convenient point and calculate the result.

Correcting an Expression

This section explains how to correct an expression as you are inputting it. The procedure you should use depends on whatever you have insert of overwrite selected as the input mode.

About the Insert and Overwrite Input Modes

The cursor is a vertical flashing line when the insert mode is selected. The cursor is a horizontal flashing line when the overwrite mode is selected.

The initial default for Linear format input is the insert mode. You can switch to overwrite mode by pressing "Shift" "Del" (INS).

With Math format, you can only use the insert move.

The calculator automatically changes to the insert move whenever you change the input/output format from Linear to Math.

Displaying the Location of an Error

If an error message appears when you press "=", press "LEFT" or "RIGHT". This will display the part of the calculation where the error occurred.

Inputting with Math Format

When inputting with Math format, you can input and display fractions and some functions using the same format as they appear in your textbook.

Displaying Calculation Results in a Form that Includes Irrational Number Form

When "MthIO" is selected for the input/output format, you can specify whether calculation results should be displayed in a form that include expressions like square roots and so on.

Pressing "=" after inputting a calculation displays the result using irrational number form.

Pressing "Shift" "=" after inputting a calculation displays the result using decimal values.

Basic Calculations

This section explains how to perform arithmetic, fraction, percent and sexagesimal calculations. All calculations in this section are performed in the COMP Mode.

Arithmetic Calculations

Use the "+", "-", "×" and "÷" keys to perform arithmetic calculations.

Fraction Calculations

How you should input fractions depends on the input/output format that is currently selected.

	Improper Fraction	Mixed Fraction
Math	7	21
	3	$^{2}\overline{3}$
Linear	7 (Numerator) / 2	2 (Integer Part) / 1
	(Denominator)	(Numerator) / 3
		(Denominator)

Switching Between Fraction and Decimal Format

The format of the fraction depends on the currently selected fraction format setting (improper fraction or mixed fraction). You cannot switch from decimal format to mixed fraction format if the total number of digits used in the mixed fraction is greater than 10.

For details about the "S-D" key, see "Using S-D Transformation".

Degree, Minute, Second (Sexagesimal) Calculations

You can perform calculations using sexagesimal values and covert values between sexagesimal and decimal.

Example: To input 2°0'30", write

Using Multi-statements in Calculations

You can use the colon character (:) to connect two or more expressions and execute them in sequence from left to right when you press "=".

Example: To create a multi-statement that performs the following two calculations: 3+3 and 3×3.

LINE



"Disp" indicated this is an intermediate result of a multi-statement.



Using Calculation History Memory and Replay

Calculation history memory maintains a record of each calculation expression you input and execute, and its result. You can use calculation history memory in the COMP Mode only.

Recalling Calculation History Memory Contents

Press "UP" to back-step through calculation history memory contents. Calculation history memory shows both calculation expressions and results.

Using Calculator Memory

Memory Name	Description
Answer Memory	Stores the last calculation result obtained.
Independent Memory	Calculation results can be added to or
	subtracted from independent memory.
	The "M" display indicator indicated data in
	independent memory.
Variables	Six variables named A, B, C, D, X and Y can
	be used for storage of individual values.

Answer Memory (Ans)

Answer Memory can hold up to 15 digits. The content isn't changed if the last calculation ended with an error message.

Variables (A, B, C, D, X, Y)

You can assign a specific value or a calculation result to a variable. To assign the result of 3+5 to variable A, execute following sequence: 3+5 SHIFTED (STO) (-) (A)

Function Calculations

This section explains how to use the calculator's built-in functions. The functions available to you depends on the calculation mode you are in. The explanations in this section are mainly about the functions that are available in all calculation modes. All of the examples in this section show operation in the COMP Mode.

Pi and Natural Logarithm Base

You can input pi or natural logarithm base into a calculation. The following shows the required key operations and the values this calculator uses for pi and natural logarithm base.

 $\pi = 3.14159265358980(\text{SHFT} \times 10^{\circ}(\pi))$ $e = 2.71828182845904(\text{ALPHA} \times 10^{\circ}(e))$

Trigonometric and Inverse Trigonometric Functions

The angle unit required by trigonometric and inverse trigonometric functions is one specified as the calculator's default angle unit. Before performing a calculation, be sure to specify the default angle unit you want to use. See "Specifying the Default Angle Unit" for more information.

Hyperbolic and Inverse Hyperbolic Functions

Pressing the "hyp" key displays a menu of functions. Press the number key that corresponds to the function you want to input.

Converting an Input Value to the Calculator's Default Angle Unit

After inputting a value, press "Shift" "Ans" to display the angle unit specification menu shown below. Press the number key that corresponds to the angle unit of the input value. The calculator will automatically convert it to the calculator's default angle unit.

Exponential Functions and Logarithmic Functions

For the logarithmic function "log" you can specify base "m" using the syntax "log (m, n)". If you input only a single value, a base of 10 is used to the calculation.

"In(" is a natural logarithm function with base e.

You can also use the well key when inputting an expression with the form of "logmn" while using Math format.

Rectangular-Polar Coordinate Conversion

Coordinate conversion can be performed in the COMP and STAT calculation modes. converting to Polar Coordinates (Pol).

Pol(X,Y). X specifies the rectangular coordinate X value. Y specified the rectangular coordinate Y value.

Calculation result is displayed in the range od -180°< θ <= 180°

Round Function (Rnd)

This function rounds the value or the result of the expression in the function's argument to the number of significant digits specified by the number of display digits setting.

Transforming Displayed Values

you can use procedures in this section to transform a displayed value to engineering notation, or to transform between standard form and decimal form.

Using Engineering Notation

A simple key operation transforms a displayed value to engineering notation. Transform the value 1,234 to engineering notation, shifting the decimal point to the right.

LINE



Using S-D Transformation

You can use S-D Transformation to transform a value between its decimal (D) form and its standard (S) form (fraction, pi).

Formats Supported for the S-D Transformation

S-D transformation can be used to transform a displayed decimal calculation result to one of the other forms. Performing S-D transformation again converts back to the original decimal value.

Statistical Calculation

All calculations in this section are performed in the STAT Mode.

Key	Menu Item	Statistical Calculation
1	1 – VAR	Single variable
2	A + BX	Linear regression
3	_ + CX ²	Quadratic regression
4	Ln X	Logarithmic regression
5	e^ X	e exponential repression
6	A . B^X	ab exponential regression
7	A . X^B	Power regression
8	f/X	Inverse regression

Statistical Calculation Types

Inputting Sample Data

The STAT editor screen appears after you enter the STAT Mode from another mode. Use the STAT menu to select a statistical calculation type. To display the STAT editor screen from another STAT Mode screen, press "Shift" "1" (STAT) "2" (Data).

STAT Editor Screen

There are two STAT editor screen formats, depending on the type of statistical calculation you selected.





Single-variable Statistics

Paired-variable Statistics

The first line of the STAT editor screen shows the value for the first sample or the values for their first pair of samples.

FREQ Column

If you turn on the Statistical Display item on the calculator's setup screen, a column labelled "FREQ" will also be included on the STAT editor screen. You can use FREQ column to specify the frequency (the number of times the same sample appears in the group of data) of each sample value.

STAT Editor Screen Input Precautions

The number of lines in STAT editor screen (the number of sample data values you can input) depends on the type of statistical data you select and on the Statistical Display setting of the calculator's setup screen.

STAT Calculation Screen

The SAT calculation screen is for performing statistical calculations with the data you input with the STAT editor screen. Pressing the "AC" key while the STAT editor screen is displayed switches to the STAT calculation screen.

The STAT calculation screen also uses linear format, regardless of the current input/output format setting on the calculator's setup screen.

Using the STAT Menu

While the STAT editor screen or STAT calculation screen is on the display, press "Shift" "1" (STAT) to display the STAT menu.

The content to the STAT menu depends on whether the currently selected statistical operation type uses a single variable or paired variables.

Generating a Number Table from a Function

Configurating a Number Table Generation Function

The procedure below configures the number table generation function with the following settings.

Function: $f(x) = x^2 + \frac{1}{2}$

Start Value: 1, End Value: 5, Step Value: 1

- 1. Press "Mode" "3" (Table)
- 2. Input the function
- 3. After making sure the function is the way you want, press "="
- 4. After specifying the start value, press "="
- 5. After specifying the end value, press "="
- 6. After specifying the step value, press "="

Pressing the "AC" key returns to the function editor screen.

Supported Function Types

Except for the X variable, other variables and independent memory are all treated as values (the current variable assigned to the variable of stored in independent memory).

Only variable X can be used as the variable of a function.

The coordinate conversion (Pol, Rec) functions cannot be used for a number table generation function. Note that the number table generation operation causes the contents of variable X to be changed.

Start, End and Step Value Rules

Linear format is always used for value input. You can specify either values or calculation expressions (which must produce a numeric result) for Start, End and Step.

Specifying an End value that is less than the Start value causes an error so the number table is not generated.

Technical Information

Calculation Priority Sequence

The calculator performs calculations according to a Calculation priority sequence. Basically, calculations are performed from left to right. Expressions with in parentheses have the highest priority. The following shows the priority sequence for each individual command:

- 1. Function with parentheses
- 2. Functions preceded by values, powers, power roots
- 3. Fractions
- 4. Prefix symbol
- 5. Statistical estimated value calculation
- 6. Permutations, combinations
- 7. Multiplication and division
- 8. Addition and subtraction

Stack Limitations

This calculator uses memory areas called stacks to temporarily store 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.

$$2 \times ((3 + 4 \times (5 + 4) \div 3) \div 5) + 8 =$$

Numeric Stack

0	2
2	3
3	4
4	5
6	4
:	

Command Stack

[1]	×
	- ,
2	(
3	(
4	+
5	×
6	(
7	+
:	

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

Reference

Power Requirements and Battery Replacement

This calculator is powered by a single AAA-size battery.

Replacing the battery

Dim figures on the display of the calculator indicate that battery power is low. Continues use of the calculator when the battery is low can result in improper operation. Replace the battery as soon as possible when display figures become dim. Even if the calculator is operating normally, replace the battery at least once every two years.

- 1. Press "Shift" "AC" (Off) to turn off the calculator.
- 2. On the back of the calculator, remove the screws and the back cover.
- 3. Remove the old battery.
- 4. Load a new battery into the calculator with its positive and negative ends facing correctly.
- 5. Replace the back cover and secure it in place with its screws.
- 6. Perform the following key operation: "On" "Shift" "9" (CLR) "3" (All) "=" (Yes)

Specifications

Power Requirements:	Battery LR44
Battery Life:	Approximately 2 years
Power Consumption:	0.0002 W
Operating Temperature:	0°C to 40°C
Bundled Items:	Hard Case

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