General Guide

■ Turning on or off

To turn the calculator on, press [ON] ; To turn the calculator off, press [2nd] [OFF].

■ Battery replacement

SRP-300 is powered by two lithium batteries (GP76A). If the display becomes dim and difficult to read, the batteries should be replaced as soon as possible.

To replace batteries :

1) Remove the screws and the back cover.
2) Replace the old batteries and install new ones with polarity in correct directions, then secure the screws in place and press [ON] to turn the power on.

■ Auto power-off function

This calculator automatically turns it off when not operated for approximately 9~15 minutes. It can be reactivated by pressing [ON] key and the display, memory, settings are retained.

■ Reset operation

If the calculator is on but you get unexpected results, press [2nd] [RESET] in sequence. A message appears on the display to confirm whether you want to reset the calculator and clear memory contents.

RESET : N Y

Move the cursor to " **Y** " by [▸], then press [ENTER] to clear all variables, programs, pending operations, statistical data, answers, all previous entries, and memory; To abort the reset operation without clearing the calculator, please choose " **N** " .

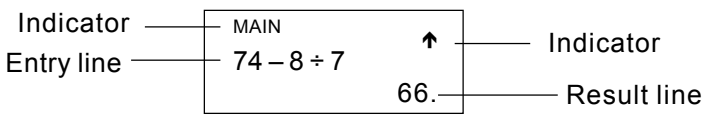
If the calculator is lock and further key operations becomes impossible, please press [0] [DMS] at the same time to release the condition. It will return all settings to default settings.

■ Contrast adjustment

Pressing the [▲] or [▼] following [MODE] key can make the contrast of the screen lighter or darker. Holding either key down will make the display become respectively lighter or darker.

■ Display readout

The display comprises the entry line, the result line, and indicators.



Entry line SRP-300 displays an entry of up to 76 digits. Entries begin on the left ; those with more than 11 digits scroll to the left. Press [▸] or [◂] to move the cursor through an entry. Press [2nd] [◂] or [2nd] [▸] to move the cursor immediately to the beginning or end of the entry.

Result line It displays a result of up to 10 digits, as well as a decimal, a negative sign, a " **x10** " indicator, and a 2-digits positive or negative exponent. Results that exceed the digit limit are displayed in scientific notation.

Indicators The following indicators appear on the display to indicate you the current status of the calculator.

Indicator	Meaning
M	Independent memory
–	Result is negative, or the entry line is full
2nd	2nd set of function keys is active.
MODE	Mode selection is active
MAIN	Main mode is active
STAT	Statistics mode is active
Base-n	Base-n mode is active
VLE	Variable linear equation mode is active
QE	Quadratic equation mode is active
CPLX	Complex number mode is active
DEGRAD	Angle mode : **DEG**rees, **GRAD**s, or **RAD**s
ENGSCI	**ENG**ineering or **SCI**entific notation.
TAB	Number of decimal places displayed is fixed
HYP	Hyperbolic-trig function will be calculated
BUSY	While an operation is executing
← →	There are digits to the left or right of the display
↑ ↓	There are earlier or later results that can be displayed

Before starting calculation

■ Changing a mode

Pressing [MODE] can enter mode menus. You can choose one of six operating modes, including " **0)MAIN** ", " **1)STAT** ", " **2)Base-n** ", " **3)CPLX** ", " **4)VLE** ", " **5)QE** ".

Give **"** 2)Base-n **"** as an example :

Method 1 : Scroll through the menus using [◂] or [▸] until " **2)Base-n** " is shown, then enter the desired mode by pressing [ENTER].

Method 2 : Key in directly the number of the mode, [2] , to enter the desired mode immediately.

■ Selecting an item from display menus

Many functions and settings are available on menus. A menu is a list of

options displayed across the entry line.

Give **"** Pressing [DRG] key displays the menu for choosing the angle setting under MAIN mode **"** as an example :

Method : Press [DRG] to display the menu, and then move the cursor [◂] or [▸] to an item you want. Press [ENTER] while the item is underlined.

For menu items followed by an argument value, enter the argument value while the item is underlined. The item and the argument value are displayed in the previous screen.

■ Using " 2nd " keys

To execute the functions marked in yellow, please press [2nd] and then the corresponding key. When you press [2nd], the " **2nd** " indicator shown in the display is to tell you that you will be selecting the second function of the next key you press. If you press [2nd] by mistake, simply press [2nd] again to remove the " **2nd** " indicator.

■ Cursor

Pressing [◂] or [▸] key can move the cursor to the left or the right. Hold down any of those keys to move the cursor at high speed.

Pressing [▲] or [▼] can scroll the display up or down while there are previous entries hidden the display. You can reuse or edit a previous entry when it is on the entry line.

■ Making corrections during input

To delete a character at the cursor, make the character underlined by using [◂] or [▸] to move the cursor, and then press [DEL] to delete the character. Delete 1 character to the left of the cursor each time you press [DEL].

To replace a character, make the character underlined by using [◂] or [▸] to move the cursor, and then enter a new entry to replace the character.

To insert a character, move the cursor to the position of the character where you want to insert, it will be inserted in the front of the character after pressing [2nd] [INS] and entering a new character.

(Note) : The blinking cursor " ◂ " means the calculator is in insert mode On the contrary, the blinking cursor is displayed as "_" and it means the calculator is in overwrite mode.

To clear all characters, clear all input character by [CL] key.

■ Replay function

- This function stores the latest operation executed. After execution is completed, pressing [▲] or [▼] key will display the operation from the beginning or the end. You can continue moving the cursor by [▸] or [◂] to edit it. To delete a digit, press [DEL]. (or, in overwrite mode, just type over

the digit). See Example 1.

- The replay function can keep input digits up to 254 characters for SRP-300. After execution is completed or during entering, you can press either [◂] [▸] to display previous input steps and edit values or commands for sub sequent execution. See Example 2.

  (Note) : The replay function isn't cleared even when [CL] is pressed or power is turned off, so contents can be recalled even after [CL] is pressed. However, replay function is cleared when mode is switched.

■ Error position display function

- When a mathematically illegal calculation is performed, error position display function will tell you with the cursor where the error is. Press [▸] or [◂] to move the cursor and then give it a correct entry. You can also clear an error by pressing [CL] and then re-entered the values and expression from the beginning. See Example 3.

■ Memory calculation

- Press [M+] to add a result to running memory. Press [M–] to subtract the value from running memory. To recall the value in running memory, press [MRC]. To clear running memory, press [MRC] twice. See Example 4.

- The calculator has ten memory variables for repeated use : **A**, **B**, **C**, **X**, **Y**, **M**, **X1**, **X2**, **PROG1** and **PROG2**. You can store a real number in variables **A**, **B**, **C**, **X**, **Y**, **M**, **X1**, **X2** and two expressions in **PROG1** and **PROG2**. See Example 5.

  * [P/V RCL] recalls all variables.
  * [SAVE] lets you store values to variables.
  * [2nd] [RECALL] recalls the value of variable.
  * [2nd] [CL-VAR] clears all variables except **PROG1, PROG2**.
  * [2nd] [CL-PROG] clears the contents of **PROG1, PROG2**.

  (Note) : **M** and **X** are actually special memory variables. Besides pressing [SAVE] key to store a value, you can also assign values to memory variable **M** by [M+] or [M–]. However, anything currently stored in variable **M** will be deleted and replaced it with the newly assigned value.
  A value in Memory variable **X** is also replaced after integrations or differentiation are executed, where the value for derivative **a** or the point **a** for integration interval is assigned to variable **X**.

■ Order of operations

Each calculation is performed in the following order of precedence :

1) Expression inside parentheses.

2) Coordinates transformation, and Type B functions which are required pressing the function key before entering, for example, sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, log, ln, 10^x, e^x, $\sqrt{\ }$, d/dx, $\int dx$, NEG, NOT, X '( ), Y '( ).
3) Type A functions which are required entering values before pressing the function key, for example, x^2, °''', !, x^{-1}, %, r, g.
4) Exponentiation (^), $\sqrt[x]{\ }$
5) Fractions
6) Abbreviated multiplication format in front of variables, π, RAND, RANDI.
7) (–)
8) Abbreviated multiplication format in front of Type B functions $2\sqrt{3}$, Alog2, etc.
9) nPr, nCr
10) x , ÷
11) +, –
12) AND, NAND
13) OR, XOR, XNOR
14) Conversion ($A^b/_c$ ◀▶ $^d/_e$, F◀▶D, ▶DMS)

- When functions with the same priority are used in series, execution is performed from right to left.

  $e^x \ln 120 \rightarrow e^x\{\ln(120)\}$

  otherwise, execution is from left to right.
- Compound functions are executed from right to left.
- Anything contained within parentheses receives the highest priority.

■ Accuracy and Capacity

Output digits : Up to 10 digits.

Calculating digits : Up to 24 digits

In general, every reasonable calculation is displayed up to 10 digits mantissa, or 10-digits mantissa plus 2-digits exponent up to $10^{\pm 99}$.

Numbers used as input must be within the range of the given function as follow :

Functions	Input range
sin x, cos x, tan x	Deg : $\lvert x \rvert < 4.5 \times 10^{10}$ deg Rad : $\lvert x \rvert < 2.5 \times 10^{8} \pi$ rad Grad : $\lvert x \rvert < 5 \times 10^{10}$ grad however, for tan x Deg : $\lvert x \rvert \neq 90\ (2n+1)$ Rad : $\lvert x \rvert \neq \frac{\pi}{2}\ (2n+1)$ Grad : $\lvert x \rvert \neq 100\ (2n+1)$ (n is an integer)
$\sin^{-1} x$, $\cos^{-1} x$	$\lvert x \rvert \leqq 1$

$\tan^{-1} x$	$\lvert x \rvert < 1 \times 10^{100}$
$\sinh x, \cosh x$	$\lvert x \rvert \leqq 230.2585092$
$\tanh x$	$\lvert x \rvert < 1 \times 10^{100}$
$\sinh^{-1} x$	$\lvert x \rvert < 5 \times 10^{99}$
$\cosh^{-1} x$	$1 \leqq x < 5 \times 10^{99}$
$\tanh^{-1} x$	$\lvert x \rvert < 1$
$\log x, \ln x$	$1 \times 10^{-99} \leqq x < 1 \times 10^{100}$
10^x	$-1 \times 10^{100} < x < 100$
e^x	$-1 \times 10^{100} < x \leqq 230.2585092$
$\sqrt{x}$	$0 \leqq x < 1 \times 10^{100}$
x^2	$\lvert x \rvert < 1 \times 10^{50}$
x^{-1}	$\lvert x \rvert < 1 \times 10^{100}$, $X \neq 0$
$\sqrt[3]{x}$	$\lvert x \rvert < 1 \times 10^{100}$
$x!$	$0 \leqq x \leqq 69$, x is an integer.
$P(x, y)$	$\sqrt{x^2 + y^2} < 1 \times 10^{100}$
$R(r, \theta)$	$0 \leqq r < 1 \times 10^{100}$ Deg : $\lvert \theta \rvert < 4.5 \times 10^{10}$ deg Rad : $\lvert \theta \rvert < 2.5 \times 10^{8} \pi$ rad Grad : $\lvert \theta \rvert < 5 \times 10^{10}$ grad however, for tan x Deg : $\lvert \theta \rvert \neq 90 (2n+1)$ Rad : $\lvert \theta \rvert \neq \frac{\pi}{2} (2n+1)$ Grad : $\lvert \theta \rvert \neq 100 (2n+1)$ (n is an integer)
▸ DMS	$\lvert DD \rvert$, MM, SS.SS $< 1 \times 10^{100}$, $0 \leqq$ MM, SS.SS , $\lvert x \rvert < 10^{100}$
x^y	$x > 0 : -1 \times 10^{100} < y \log x < 100$ $x = 0 : y > 0$ $x < 0 : y = n, 1/(2n+1)$, n is an integer. but $-1 \times 10^{100} < y \log \lvert x \rvert < 100$
$\sqrt[x]{y}$	$y > 0 : x \neq 0, -1 \times 10^{100} < \frac{1}{x} \log y < 100$ $y = 0 : x > 0$ $y < 0 : x = 2n+1, 1/n$, n is an integer.$(n \neq 0)$ but $-1 \times 10^{100} < \frac{1}{x} \log \lvert y \rvert < 100$
nPr, nCr	$0 \leqq r \leqq n$, $n < 10^{100}$, n, r are integers.

STAT	$\|x\| < 1x10^{100}$, $\|y\| < 1x10^{100}$ 1 -VAR : $n \leqq 40$, 2 -VAR : $n \leqq 40$ FREQ. = n, $0 \leqq n < 10^{100}$: n is an integer in 1-VAR mode. σx, σy, $\bar{x}$, $\bar{y}$, a, b, r : $n \neq 0$ Sx, Sy : $n \neq 0,1$
Base-n	**DEC :** $-2147483648 \leqq x \leqq 2147483647$ **BIN :** $10000000000000000000000000000000 \leqq x \leqq$ 11111111111111111111111111111111 (for negative) $0 \leqq x \leqq$ 01111111111111111111111111111111 (for zero, positive) **OCT :** $20000000000 \leqq x \leqq 37777777777$ (for negative) $0 \leqq x \leqq 17777777777$ (for zero or positive) **HEX** : $80000000 \leqq x \leqq$ FFFFFFFF(for negative) $0 \leqq x \leqq$ 7FFFFFFF (for zero or positive)

■ Error conditions

Error message will appear on the display and further calculation becomes impossible when any of the following conditions occur.

DOMAIN Er (1) When specifying an argument to a function outside the valid range.
(2) **FREQ** value (in 1-VAR stats) < 0 or non-integer.
(3) When USL value < LSL value

DIVIDE BY 0 (1) You attempted to divide by 0.
(2) Integration interval [a, b] is unavailable or interrupted for the integrated function.

OVERFLOW Er When result of function calculations exceeds the range specified.

STAT Er When in MAIN,CPLX,VLE,or QE mode, press [DATA] or [STATVAR].

SYNTAX Er (1) Input errors are made.
(2) When improper arguments are used in commands or functions that require arguments.

NO SOL
MULTI SOLS There is no solution or infinite to the simultaneous equation under VLE mode.

NO REAL SOL There is no real solution to quadratic equation under QE mode.

LENGTH Er An entry exceeds 84 digits after implied multiplication with auto-correction.

OUT OF SPEC You input a negative C_{PU} or C_{PL} value , where

$$C_{PU} = \frac{USL - \bar{x}}{3\sigma} \quad , \quad C_{PL} = \frac{\bar{x} - LSL}{3\sigma}$$

To release the above errors, please press [CL] key.

Mode 0 - MAIN

■ Arithmetic calculation

- Arithmetic operations are performed by pressing the keys in the same sequence as in the expression. See Example 6.
- For negative values, press [(–)] before entering the value. See Example 7.
- For mixed arithmetic operations, multiplication and division are given priority over addition and subtraction. See Example 8.
- Results greater than 10^{10} or less than 10^{-9} are displayed in exponential form. See Example 9.

■ Display formats

- Decimal places formats are selected by pressing [2nd] [FIX] to display the menu. To set decimal places to **n** (**F0123456789**), enter a **n** value directly or press [ENTER] key while the item is underlined. (The default setting is floating point notation **F** and the **n** value is •). See Example 10.
- Even if the number of decimal places is specified, internal calculation for a mantissa is performed up to 24 digits, and the display value is stored in 10 digits. To round off those values to the specified number of decimal places, press [2nd] [RND]. See Example 11~12.
- Number display formats are selected by pressing [2nd] [SCI/ENG] to display the menu. The items on the menu are **FLO** (for floating point), **SCI** (for scientific), and **ENG** (for engineering). Press [◂] or [▸] until the desired formats is underlined, and then press [ENTER]. See Example 13.

  (Note) : The engineering format is similar to the scientific format, except the mantissa can have up to three digits left of the decimal, instead of only one, and the exponent is always a multiple of three. It is useful for engineers to convert units based on multiples of 10^{3}.

- You can enter a number in mantissa and exponent form by [EXP] key. See Example 14.

■ Parentheses calculations

- Operation inside parentheses are always executed first. SRP-300 can use up to 13 levels of consecutive parentheses in a single calculation. See Example15.

- Closed parentheses occurring immediately before operation of the [ENTER] key may be omitted, no matter how many are required. See Example16.

- A multiplication sign " x " occurring immediately before an open parenthesis can omitted. See Example 17.

  (Note) : The calculator can auto-correct abbreviated multiplication in front of all functions, except memory variables, left parenthesis, type B functions.

- Henceforth, abbreviated type will not be used in this manual. See Example 18.

- The correct result cannot be derived by entering [( ] 2 [+] 3 [ )] [EXP] 2. Be sure to enter [x] 1 between the [ )] and [EXP] in the below example. See Example 19.

■ Percentage calculation

- [2nd] [%] divides the number in the display by 100. You can use this key sequence to calculate percentages, add-ons, discounts, and percentages ratios. See Example 20~21.

■ Continuous calculation function

- The calculator enables you to repeat the last operation executed by pressing [=] key for further calculation. See Example 22.

- Even if calculations are concluded with the [=] key, the result obtained can be used for further calculation. See Example 23.

■ Answer function

- Answer function stores the most recently calculated result. It is retained even after the power is turned off. Once a numeric value or numeric expression is entered and [ENTER] is pressed, the result is stored by this function. See Example 24.

  (Note) : Even if execution of a calculation results in an error, however, Answer memory retains its current value.

■ Logarithms and Antilogarithms

- The calculator can calculate common and natural logarithms and anti-

logarithms using [LOG], [LN], [2nd] [10^x], and [2nd] [e^x]. See Example 25~27.

■ Fraction calculation

Fraction value display is as follow :

5 /12	Display of $\frac{5}{12}$
56 ∪ 5 / 12	Display of $56\ \frac{5}{12}$

- To enter a mixed number, enter the integer part, press [$A^b/_c$], enter the numerator, press [$A^b/_c$], and enter the denominator ; To enter an improper fraction, enter the numerator, press [$A^b/_c$], and enter the denominator. See Example 28.
- During a fraction calculation, if the figure is reducible, a figure is reduced to the lowest terms after pressing a function command key ([+], [–], [x] or [÷]) or the [=] key. By pressing [2nd] [$A^b/_c \blacklozenge\blacklozenge {}^d/_e$], the displayed value will be converted to the improper fraction and vice versa. See Example 29.
- To convert between a decimal and fractional result, press [2nd] [F ◆◆ D] and [ENTER]. See Example 30.
- Calculations containing both fractions and decimals are calculated in decimal format. See Example 31.

■ Angle units conversion

- The angle units (**DEG**, **RAD**, **GRAD**) is set by pressing [DRG] to display the angle menu. The relation among the three angle units is :

  $180\ ^\circ = \pi$ rad = 200 grad

  Angle conversions (See Example 32.) :

  1. Change the default angle settings to the units you want to convert to.
  2. Enter the value of the unit to convert.
  3. Press [DMS] to display the menu. The units you can select are **°** (degrees), **‘** (minutes), **“** (seconds), **ʳ** (radians), **ᵍ** (gradians) or **▶ DMS** (Degree-Minutes-Seconds).
  4. Choose the units you are converting from.
  5. Press [ENTER] twice.
- To convert an angle to DMS notation, select **“ ▶ DMS** ”, which converts an entry to DMS notations, i.e., where **1ᴼ 30ᴵ 0ᴵᴵ** represents 1 degrees, 30 minutes, 0 seconds. See Example 33.

- To convert a DMS notation to decimal, select **°** (degrees), **‘** (minutes), **“** (seconds). See Example 34.

■ Trigonometric / Inverse-Tri. functions

- SRP-300 provides standard trigonometric functions and inverse trigonometric functions - sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$ and $\tan^{-1}$. See Example 35~37.

  (Note) : When using those keys, make sure the calculator is set for the angle unit you want.

■ Hyperbolic / Inverse-Hyp. functions

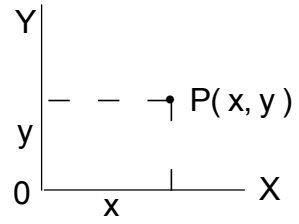
- SRP-300 uses [2nd] [HYP] to calculate the hyperbolic functions and inverse- hyperbolic functions - sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$ and $\tanh^{-1}$. See Example 38~39.

  (Note) : When using those keys, make sure the calculator is set for the angle unit you want.

■ Coordinates transformation

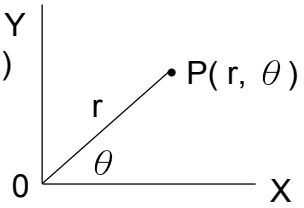
- Pressing [2nd] [R◂ ▸P] displays a menu to convert rectangular coordinates to polar coordinates or vice versa. See Example 40~41.

Rectangular Coordinates



$x + y\,i = r(\cos\theta + i\sin\theta)$

Polar Coordinates



(Note) : When using those key, make sure the calculator is set for the angle unit you want.

■ Probability

- Pressing [PRB] displays the probability menu. See Example 42~46. With the following functions :

  nPr Calculates the number of possible permutations of n item taken r at a time.

  nCr Calculates the number of possible combinations of n items taken r at a time.

  ! Calculates the factorial of a specified positive integer n , where $n \leqq 69$.

  RANDM Generates a random number between 0 and 1.

  RANDMI Generates a random integer value between two specified integers, A and B, where $A \leqq$ random value $\leqq B$.

■ Other functions (x^{-1}, $\sqrt{\ }$, $\sqrt[x]{\ }$,x^2, ^)

- The calculator also provides reciprocal ([x^{-1}]), square root ([$\sqrt{\ }$]), universal root [$\sqrt[x]{\ }$], square ([x^2]) and exponentiation ([^]) functions. See Example 47~50.

■ Unit Conversion

- The calculators has a built-in unit conversion feature that enables you to convert numbers from metric to English units and vice versa. See Example 51.

1. Enter the number you want to convert.
2. Press [2nd] [CONV] to display the menu. There are 7 menus, covering distance, area, temperature, capacity, weight, energy, and pressure.
3. Use the [▼] [▲] to scroll through the list of units until a appropriate units menu is shown, then [ENTER].
4. Pressing [▶] or [◀] can convert the number to another unit.

■ Physics constants

- You can use a number physics constants in your calculations. With the following constants :

Symbol	Meaning	Value
c	Speed of light	299792458 m / s
g	Acceleration of gravity	9.80665 $m.s^{-2}$
G	Gravitational constant	6.6725985 x 10^{-11} $N.m^2$ kg^{-2}
Vm	molar volume of ideal gas	0.0224141 m^3 mol^{-1}
N_A	Avagadro's number	6.022136736 x 10^{23} mol^{-1}
e	Elementary charge	1.6021773349 x 10^{-19} C
me	Electron mass	9.109389754 x 10^{-31} kg
mp	Proton mass	1.672623110 x 10^{-27} kg
h	Plank's constant	6.626075540 x 10^{-34} J.s
k	Boltzmann's constant	1.38065812 x 10^{-23} $J.K^{-1}$
R	Gas constant	8.31451070 J / mol • k
F	Faraday constant	96485.30929 C / mol
mn	Neutron constant	1.674928610x 10^{-27} kg
μ	Atomic mass constant	1.660540210 x 10^{-27} kg
ε_0	Dielectric permittivity	8.854187818 x 10^{-12} F / m
μ_0	Magnetic permittivity	1.256637061 x 10^{-06} H / m
φ_0	Flux quantum	2.0678346161 x 10^{-15} Vs
a_0	Bohr radius	5.2917724924 x 10^{-11} m
μB	Bohr magneton	9.274015431 x 10^{-24} A • m^2
μN	Neutron magnetic moment	5.050786617 x 10^{-27} J / T

To insert a constant at the cursor position (See Example 52.) :

1. Press [CONST] to display the physics constants menu.
2. Press [▸] until the constant you want is underlined.
3. Press [ENTER].

■ Integration and Differentiation

SRP-300 can perform numerical integration and differentiation by [2nd] [∫dx] and [2nd] [d/dx].

Integration

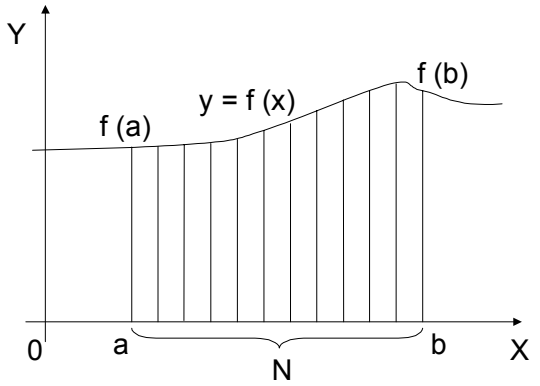
The calculator uses Simpson's rule to perform integration calculations as shown in the below :

where [a, b] is integration interval and N is the number of division. (n is an integer from 1 to 9)

Simpson's Rule

$$\text{Area} = \frac{h}{3}\{f(a)+4\{f(a+h)+f(a+3h)+...+f(a+(N-1)h\}+2\{f(a+2h)+f(a+4h)+...+f(a+(N-2)h)\}+f(b)\},$$

$$\text{Where } h=\frac{b-a}{N},$$



In general, the larger n is, the more calculation time is required and the higher precision for the result is. In some case, the results of your integration may be erroneous even if the larger n is used. In particular, when significant digits are less than 1, an error message sometimes will be shown.

Step : (See Example 53)

1. Select integration mode by pressing [2nd] [∫dx].
2. Enter the function you want to integrate. You can use [2nd] [x] key to enter the variable **x** into the function.
3. Press [▾]. Enter the lower and upper limits of integration (**a** and **b**).
4. Press [▾]. Give the number of division to specify 2^n = N, where the value of **n** is an integer from 1 to 9 and the default value is **5**.
5. Press [ENTER].

(Note) : The calculator always perform trigonometric integration using radians as the unit of angular measurement.

(Note) : Integration involving certain types of functions or ranges can result in relatively large errors being generated in the values produced.

Differentiation

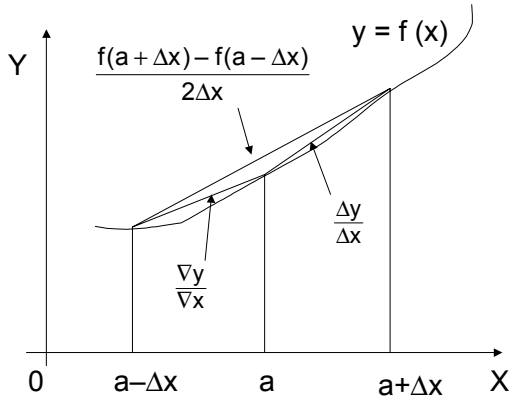
The calculator uses Central difference to perform differential calculations as shown in the below :

$$f'(a)=\lim_{\Delta \to 0}\frac{f(a+\Delta x)-f(a)}{\Delta x}$$

where a is the point you want to determine the derivative and Δx is increase/ decrease of x.

Central difference

$$f'(a)=\frac{1}{2}\left(\frac{\Delta Y}{\Delta X}+\frac{\nabla Y}{\nabla X}\right)$$
$$=\frac{1}{2}\left(\frac{f(a+\Delta x)-f(a)}{\Delta x}+\frac{f(a)-f(a-\Delta x)}{\Delta x}\right)$$
$$=\frac{f(a+\Delta x)-f(a-\Delta x)}{2\Delta x}$$



The smaller Δx is, the more calculation time is required and the higher precision for the derivative is. In general, the precision is ± 1 at the least significant digit of the result. However, you needn't input a value of Δx and just press [ENTER] to skip it. The calculator automatically assigns the default value of 10^{-8}.

Step : (See Example 54)

1. Select differentiation mode by pressing [2nd] [d/dx].
2. Enter the differential function. You can use [2nd] [χ] key to enter the variable **x** into the function.
3. Press [▼]. Input point x = a to determinate the derivative.
4. Press [▼]. Enter the increase / decrease of x (Δx)
5. Press [ENTER].

Application of integration and differentiation

- Integrals and differentials can be added, subtracted, multiplied and divided with each other. For example, $\int_a^b f(x)\,dx+\int_c^d g(x)\,dx$, $\int_a^b f(x)\,dx\times\int_c^d g(x)\,dx$, $f'(a)\div\int_a^b g(x)\,dx$ .... See Example 55.

- Integrated or differential results can be used in addition, multiplication, and division, and in function. For example, $5\times\int_a^b f(x)\,dx$, $\ln(\int_a^b f(x)\,dx)$ ... See Example 56.

- After you perform an integration, you can integrate the same f(x) again, with different limits of integration , **a** and **b**, or a different number of divisions, **n**. Differentiation also provides the feature. See Example 57.

- When integration interval [a, b] is unavailable or interrupted for the integrated function, an error message will appear on the display. It means you need to change the lower and upper limits of integration (a, b) for the integrated function. See Example 58.

(Note) : If the result for integration or differentiation takes a long time to calculate and you want to interrupt (while it is executing and the word **BUSY** appears on the display), please press [CL]. A message appears on the display to confirm whether you want to interrupt.

STOP : N Y

Move the cursor to " **Y** " to interrupt or " **N** " to return.

Mode 1 - STAT

There are three menu operation in statistics menu : **1-VAR** (for analyzing data in a single dataset), **2-VAR** (for analyzing paired data from two datasets) and **D-CL** (for clearing all datasets).

■ Single-Variable / Two-variable statistics

Step :

1. From the statistics menu, choose **1-VAR** or **2-VAR** and press [ENTER].
2. Press [DATA] and there are three menu : **DATA-INPUT**, **LIMIT-SET**, **DISTR**. Please choose **DATA-INPUT** and press [ENTER].
3. Enter an x - value and press [▼].
4. Enter the frequency (**FREQ**) of the x - value (in **1-VAR** mode) or the corresponding y - value (in **2-VAR** mode) and press [▼].
5. To enter more data, repeat from step 3.
6. Press [STATVAR] and scroll through the statistical results menu by [▶] or [◀] to find out statistical variables you want. (See table below)

Variable	Meaning
n	Number of the x values or x-y pairs entered.
$\bar{x}$ or $\bar{y}$	Mean of the x values or y values
Xmax or **Ymax**	Maximum of the x values or y values
Xmin or **Ymin**	Minimum of the x values or y values
Sx or **Sy**	Sample standard deviation of x values or y values.

$$S_x = \sqrt{\frac{\Sigma(x-\bar{x})^2}{n-1}}, \quad S_y = \sqrt{\frac{\Sigma(y-\bar{y})^2}{n-1}}$$

σ **x** or σ **y** Population standard deviation of x values or y values

$$\sigma x = \sqrt{\frac{\sum(x-\bar{x})^2}{n}} \quad , \quad \sigma y = \sqrt{\frac{\sum(y-\bar{y})^2}{n}}$$

$\sum$ **x** or $\sum$ **y** Sum of all x values or y values
$\sum$ **x** ^{2} or $\sum$ **y** ^{2} Sum of all x^2 values or y^2 values
$\sum$ **x y** Sum of (x x y) for all x-y pairs

■ Process capability

Step : (See Example 59~60)

1. Press [DATA] and there are three menu : **DATA-INPUT**, **LIMIT-SET**, **DISTR**. Please choose **LIMIT-SET** and press [ENTER].
2. Enter a upper spec. limit value (**X USL** or **X LSL**), then press [▼].
3. Enter a lower spec. limit value (**X LSL** or **Y LSL**).
4. Enter the datasets you want under **DATA-INPUT** mode.
5. Press [STATVAR] and scroll through the statistical results menu by [▶] or [◀] to find out process capability variables you want. (See table below)

Variable	Meaning
Cax or **Cay**	Capability accuracy of the x values or y values

$$Cax = \frac{\left|\left(\frac{XUSL + XLSL}{2}\right) - \bar{x}\right|}{\frac{XUSL - XLSL}{2}} \quad , \quad Cay = \frac{\left|\left(\frac{yUSL + yLSL}{2} - \bar{y}\right)\right|}{\frac{yUSL - yLSL}{2}}$$

Cpx or **Cpy** Potential capability precision of the x values or y values

$$Cpx = \frac{XUSL - XLSL}{6\sigma} \quad , \quad Cpy = \frac{yUSL - yLSL}{6\sigma}$$

Cpkx or **Cpky** Minimum (C_{PU}, C_{PL}) of the x values or y values , where C_{PU} is upper spec. limit of capability precision and C_{PL} is lower spec. limit of capability precision

$$Cpkx = Min(C_{PUX}, C_{PLX}) = Cpx(1 - Cax)$$

$$C_{pky} = Min(C_{PUY}, C_{PLY}) = Cpy(1 - Cay)$$

(Note) : When calculating process capability in **2-VAR** mode, the x_n and y_n are independent with each other.

■ Probability distribution

Step : (See Example 61)

1. Based on the datasets in 1-VAR mode, press [DATA] and there are three menu : **DATA-INPUT**, **LIMIT-SET**, **DISTR**. Please choose **DISTR** and press [ENTER].
2. Enter a $\mathbf{a}_x$ value.
3. Press [STATVAR] and scroll through the statistical results menu by [▸] or [◂] to find out probability distribution variables you want. (See table below)

Variable	Meaning
t	Test value $t = \frac{a_x - \bar{x}}{\sigma}$
P(t)	Represent the cumulative fraction of the standard normal distribution that is less than the value t
R(t)	Represent the cumulative fraction of the standard normal distribution that lies between the value t and 0. R(t)=1–P(t)
Q(t)	Represent the cumulative fraction of the standard normal distribution that is greater than the value t Q(t)=0.5–R(t)

■ Linear regression

Step : (See Example 62)

1. Based on the datasets in **2-VAR** mode, press [STATVAR] and scroll through the statistical results menu by [▸] or [◂] to find out **a**, **b**, or **r**.
2. To predict a value for x (or y) given a value for y (or x), select the **x'** (or **y'**) variable, press [ENTER], enter the given value, and press [ENTER] again. (See table below)

Variable	Meaning
a	Linear regression y-intercept $a = \frac{\sum y - b\sum x}{n}$
b	Linear regression slope $b = \frac{(n\sum xy - \sum x\sum y)}{(n\sum x^2 - (\sum x)^2)}$
r	Correlation coefficient $r = \frac{(n\sum xy - \sum x\sum y)}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2)}}$
x'	Predicted x values given a, b, and y vales $x' = \frac{y-a}{b}$

y' Predicted y value given a, b, and x value.

$$y' = a + bx$$

■ Correcting data

Step : (See Example 63)

1. Press [DATA].
2. To change x - values or the frequency of the x - value in **1 - VAR** mode (or the corresponding y - value in **2 - VAR** mode), please choose **DATA-INPUT**. To change upper spec. limit value, or lower spec. limit value, please choose **LIMIT-SET**. To change a_x, please choose **DISTR**.
3. Press [▼] to scroll through the data you have entered.
4. To change an entry, display it and enter the new data. The new data you enter overwrites the old entry. Press [▼] or [ENTER] to save the change.

(Note) : Even you exit STAT mode, all data in **1 - VAR** and **2 - VAR** mode are still retained unless you clear all data by selecting **D-CL** mode.

Mode 2 - Base-n

■ Bases conversions

- The number system (10, 16, 2 , 8) is set by pressing [2nd] [dhbo] to display the menu, making one of the items underlined followed [ENTER]. A corresponding symbol - "**d** ", "**h**", "**b**", "**o**" appears on the display. (The default setting is **d** : decimal base). See Example 64.

(Note) : The total range of numbers handled in this mode is 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F. If values not valid for the particular number system are used, attach the corresponding designator (**d**, **h**, **b**, **o**), or an error message will appear.

Binary base (**b**) : 0, 1
Octal base (**o**) : 0, 1, 2, 3, 4, 5, 6, 7
Decimal base (**d**) : 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
Hexadecimal base (**h**) : 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

- Pressing [↻] can use block function to display a result in octal or binary base which exceeds 8 digits. The system is designed to display up to 4 blocks. See Example 65.

■ Negative expressions

- In binary, octal, and hexadecimal bases, the calculator represents negative numbers using complement notation. The complement is the result of subtracting that number from 10000000000 in that number's base by pressing

[NEG] key in non-decimal bases. See Example 66.

■ Basic arithmetic operations for bases

- The unit enables you to calculate in number base other than decimal. The calculator can add, subtract, multiply, and divide binary, octal, and hexadecimal numbers. See Example 67.

■ Logical operation

- Logical operations are performed through logical products (AND), negative logical (NAND), logical sums (OR), exclusive logical sums (XOR), negation (NOT), and negation of exclusive logical sums (XNOR). See Example68.

Mode 3 - CPLX

- Complex mode enables you to add, subtract, multiply, and divide complex numbers. See Example 69. The results of a complex operation are displayed as follow :

Re	Real value	**Im**	Imaginary value
ab	Absolute value	**ar**	Argument value

Mode 4 - VLE

Variable linear equations (**VLE**) mode can solve a set of simultaneous equations with two unknowns as follows :

$a\,x + b\,y = c$

$d\,x + e\,y = f$, where x and y are unknown.

- In VLE mode, you just enter each coefficient (**a**, **b**, **c**, **d**, **e**, **f**) in the correct order, and the calculator automatically solves for **x**, **y**. See Example 70.

Mode 5 - QE

Quadratic equations (**QE**) mode can solve a equations as follows :

$a\,x^2 + b\,x + c = 0$, where x is unknown.

- In QE mode, you just enter each coefficient (**a**, **b**, **c**) in the correct order, and the calculator automatically solves for all **x** values. See Example 71.

Example

Example 1

■ Change 123 x 456 as 12 x 457

123 [x] 456 [=]	MAIN DEG 123 * 456 ↑ 56088.
[▸] [▸] [▸] [DEL]	MAIN DEG 12 * 456 ↑
[▸] [▸] [▸] 7	MAIN DEG 12 * 457_ ↑
[ENTER]	MAIN DEG 12 * 457 ↑ 5484.

Example 2

■ After executing 1+ 2, 3 + 4, 5 + 6, use replay function to recall

1 [+] 2 [=] 3 [+] 4 [=] 5 [+] 6 [=]	MAIN DEG 5 + 6 ↑ 11.
[▲]	MAIN DEG 5 + 6 ↑
[▲]	MAIN DEG 3 + 4 ↑ ↓
[▲]	MAIN DEG 1 + 2 ↓

Example 3

■ 14 ÷ 0 x 2.3 mistakenly input instead of 14 ÷ 10 x 2.3

14 [÷] 0 [x] 2.3 [ENTER]	MAIN DEG DIVIDE BY 0 .
After 5 Sec	MAIN DEG 14 / 0 * 2.3 ↑
[◂] [2nd] [INS] 1 [ENTER]	MAIN DEG 14 / 10 * 2.3 ↑ 3.22

Example 4

[(3 x 5) + (56 ÷ 7) – (74 – 8 x 7)] = 5

3 [x] 5 [M+]	MAIN DEG 3 * 5 ↑ M 15.
56 [÷] 7 [M+]	MAIN DEG 56 / 7 ↑ M 8.
[MRC] [ENTER]	MAIN DEG M ↑ M 23.
74 [–] 8 [x] 7 [2nd] [M –]	MAIN DEG 74 – 8 * 7 ↑ M 18.
[MRC] [ENTER]	MAIN DEG M ↑ M 5.
[MRC] [MRC] [CL]	MAIN DEG – ↑

Example 5

① ■ Put the value 30 into variable A

① [2nd] [CL-VAR] 30 [SAVE]	MAIN DEG → A B C X Y ➔
[ENTER]	MAIN DEG 30 → A ↑ 30.

② ■ Multiple 5 to variable A, then put the result into variable B

② 5 [x] [2nd] [RECALL]	MAIN DEG A B C X Y ➔ 30.
[ENTER] [ENTER]	MAIN DEG 5 * 30 ↑ 150.
[SAVE] [▸] [ENTER]	MAIN DEG Ans → B ↑ 150.

③ ■ Add 3 to variable B

③ [P/V RCL] [▸]	MAIN DEG A B C D X Y ➔ ↑ 150.
[ENTER] [+] 3	MAIN DEG B + 3 ↑
[ENTER]	MAIN DEG B + 3 ↑ 153.

④ ■ To clear the contents of all variables

④ [2nd] [CL-VAR] [P/V RCL]	MAIN DEG A B C X Y →

⑤ ■ Set PROG1 = 3 X + 5 Y

⑤ 3 [P/V RCL] [▸] [▸] [▸]	MAIN DEG A B C X Y →
[ENTER] [+] 5 [P/V RCL] [▸] [▸] [▸] [▸]	MAIN DEG A B C X Y →
[ENTER]	MAIN DEG 3 X + 5 Y
[SAVE] [◂] [◂]	MAIN DEG ← PR0G1 PR0G2
[ENTER]	MAIN DEG 3 X + 5 Y → PR0G1 ↑ 0.

⑥ ■ Set X = 55, Y = 6, get 3 X + 5 Y = 195

⑥ [P/V RCL] [◂] [ENTER]	MAIN DEG 3 X + 5 Y ↑
[▾] 55	MAIN DEG X = 55 ↑
[▾] 6	MAIN DEG Y = 6 ↑
[ENTER]	MAIN DEG 3 X + 5 Y ↑ 195.

Example 6

1 + 2 x 3 = 7

1 [+] 2 [x] 3 [=]	MAIN DEG 1 + 2 * 3 ↑ 7.

Example 7

– 3.5 + 8 ÷ 2 = 0.5

[(–)] 3.5 [+] 8 [÷] 2 [=]	MAIN DEG – 3.5 + 8 / 2 ↑ 0.5

Example 8

7 + 10 x 8 ÷ 2 = 47

7 [+] 10 [x] 8 [÷] 2 [=]	MAIN DEG 7 + 10 * 8 / 2 ↑ 47.

Example 9

12369 x 7532 x 74103 = 6903680613000

12369 [x] 7532 [x] 74103 [=]	MAIN DEG 12369*7532* →↑ 6.903680613 x10 12

Example 10

6 ÷ 7 = 0.857142857

6 [÷] 7 [=]	MAIN DEG 6 / 7 ↑ 0 . 857142857
[2nd] [FIX] [▸] [▸] [▸]	MAIN DEG F0123456789
[ENTER]	MAIN DEG FIX 6 / 7 ↑ 0.86
[2nd] [FIX] 4	MAIN DEG FIX 6 / 7 ↑ 0.8571
[2nd] [FIX] [•]	MAIN DEG 6 / 7 ↑ 0 . 857142857

Example 11

1 ÷ 6 x 6 = 1

[2nd] [FIX] [▸] [▸] [▸] [▸]	MAIN DEG F0123456789
[ENTER] 1 [÷] 6 [=]	MAIN DEG FIX 1 / 6 ↑ 0.167
[x] 6 [=]	MAIN DEG FIX Ans * 6 1.000

Example 12

RND (1 ÷ 6) x 6 = 1.002

[2nd] [RND] 1 [÷] 6 [=]	MAIN DEG FIX RND (1 / 6) ↑ 0.167

[x]6[=]

MAIN DEG FIX
Ans * 6 ↑
1.002

Example 13

1 ÷ 6000 = 0.0001666...

1[÷]6000[=]

MAIN DEG
1 / 6000 ↑
0.000166667

[2nd][SCI / ENG][▸]

MAIN DEG
FLO SCI ENG

[ENTER]

MAIN DEG SCI
1 / 6000 ↑
$1.666666667_{x10^{-04}}$

[2nd][SCI / ENG][▸]

MAIN DEG SCI
FLO SCI ENG

[ENTER]

MAIN DEG ENG
1 / 6000 ↑
$166.6666667_{x10^{-06}}$

Example 14

0.015 = 1.5 x 10^{-3}

1.5[EXP][(–)]3[ENTER]

MAIN DEG
1.5 E– 3 ↑
0.0015

Example 15

(5 – 2 x 1.5) x 3 = 6

[(]5[–]2[x]1.5[)][x]3[=]

MAIN DEG
(5 - 2 *1.5) * 3 →↑
6.

Example 16

2 + 3 x (5 + 4) = 29

2[+]3[x][(]5[+]4[=]

MAIN DEG
2 + 3 * (5 + 4 ↑
29.

Example 17

(7 – 2) x (8 + 5) = 65

[(]7[–]2[)][(]8[+]5[=]

MAIN DEG
(7 – 2) * (8 + 5 ↑
65.

Example 18

2 x { 7 + 6 x (5 + 4) } = 122

2 [x] [( ] 7 [+] 6 [x] [( ] 5 [+] 4 [=]

MAIN DEG
2 ∗ (7+ 6 ∗ (5+4 ↑
122.

Example 19

(2 + 3) x 10^2 = 500

[( ] 2 [+] 3 [ )] [x] 1 [EXP] 2 [=]

MAIN DEG
(2 + 3) ∗ 1 E2 ↑
500.

Example 20

120 x 30 % = 36

120 [x] 30 [2nd] [%] [=]

MAIN DEG
120 ∗ 30 % ↑
36.

Example 21

88 ÷ 55% = 160

88 [÷] 55 [2nd] [%] [=]

MAIN DEG
88 / 55 % ↑
160.

Example 22

3 x 3 x 3 x 3 = 81

3 [x] 3 [=]

MAIN DEG
3 ∗ 3 ↑
9.

[x] 3 [=]

MAIN DEG
Ans ∗ 3 ↑
27.

[=]

MAIN DEG
Ans ∗ 3 ↑
81.

Example 23

■ To calculate ÷ 6 after 3 x 4 = 12

3 [x] 4 [=]

MAIN DEG
3 ∗ 4 ↑
12.

[÷] 6 [=]

MAIN DEG
Ans / 6 ↑
2.

Example 24

123 + 456 = 579 → 789 – 579 = 210

123 [+] 456 [=]	MAIN DEG 123 + 456 ↑ 579.
789 [–] [2nd] [ANS] [ENTER]	MAIN DEG 789 – Ans ↑ 210.

Example 25

ln7 + log100 =3.945910149

[LN] 7 [▸] [+] [LOG] 100 [=]	MAIN DEG ln(7)+log(1➔ ↑ 3.945910149

Example 26

$10^{2} = 100$

[2nd] [10^{x}] 2 [=]	MAIN DEG 10^(2) ↑ 100.

Example 27

$e^{-5} = 0.006737947$

[2nd] [e^{x}] [(–)] 5 [=]	MAIN DEG e^(–5) ↑ 0.006737947

Example 28

$$7\frac{2}{3}+14\frac{5}{7}=22\frac{8}{21}$$

7 [$A^{b}/_{c}$] 2 [$A^{b}/_{c}$] 3 [+] 14 [$A^{b}/_{c}$] 5 [$A^{b}/_{c}$] 7 [=]	MAIN DEG 7⌟2⌟3 +14⌟5⌟ ➔↑ 22 ∪ 8 / 21

Example 29

$$4\frac{2}{4}=4\frac{1}{2}$$

4 [$A^{b}/_{c}$] 2 [$A^{b}/_{c}$] 4 [ENTER]	MAIN DEG 4⌟2⌟4 ↑ 4 ∪ 1 / 2
[2nd] [$A^{b}/_{c}$ ◂ ▸ $^{d}/_{e}$] [ENTER]	MAIN DEG Ans ▸ $A^{b}/_{c}$ ◂ ▸ $^{d}/_{e}$ ↑ 9 / 2
[2nd] [$A^{b}/_{c}$ ◂ ▸ $^{d}/_{e}$] [ENTER]	MAIN DEG Ans ▸ $A^{b}/_{c}$ ◂ ▸ $^{d}/_{e}$ ↑ 4 ∪ 1 / 2

Example 30

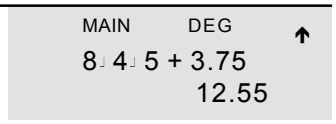
$4\frac{1}{2}=4.5$

4 [A b/c] 1 [A b/c] 2 [2nd] [F ◂ ▸ D] [ENTER]

Example 31

$8\frac{4}{5}+3.75=12.55$

8 [A b/c] 4 [A b/c] 5 [+] 3.75 [ENTER]



Example 32

2 π rad. = 360 deg.

[DRG]

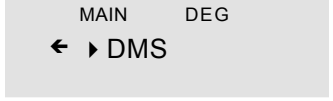
[ENTER] 2 [2nd] [π] [DMS] [▸] [▸] [▸]

[ENTER] [ENTER]

Example 33

1.5 = 1°30'0" (DMS)

1.5 [DMS] [◂]

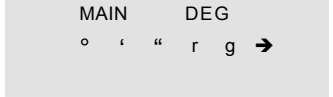


[ENTER] [ENTER]

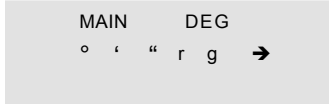
Example 34

2 ᴰ45 ᴵ10.5 ᴵᴵ = 2.752916667

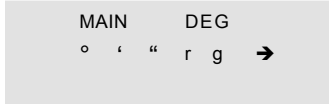
2 [DMS]



[ENTER] 45 [DMS] [▸]



[ENTER] 10.5 [DMS] [▸] [▸]



[ENTER] [ENTER]

MAIN DEG
2° 45 ‘ 10.5 “ ↑
2.752916667

Example 35

sin30 Deg. = 0.5

[DRG]

MAIN DEG
DEG RAD GRD

[ENTER] [SIN] 30 [ENTER]

MAIN DEG
sin (30) ↑
0.5

Example 36

sin30 Rad. = – 0.988031624

[DRG] [▸]

MAIN DEG
DEG RAD GRD

[ENTER] [ENTER]

MAIN RAD
sin (30) ↑
– 0.988031624

Example 37

$\sin^{-1} 0.5$ = 33.33333333 Grad.

[DRG] [▸]

MAIN RAD
DEG RAD GRD

[ENTER] [2nd] [$\sin^{-1}$] 0.5 [ENTER]

MAIN GRAD
$\sin^{-1}$ (0.5) ↑
33.33333333

Example 38

cosh1.5+2 = 4.352409615

[2nd] [HYP] [COS] 1.5 [▸] [+] 2 [=]

MAIN DEG
cosh (1.5) + 2 ➔↑
4.352409615

Example 39

$\sinh^{-1} 7$ = 2.644120761

[2nd] [HYP] [2nd] [$\sin^{-1}$] 7 [=]

MAIN DEG
$\sinh^{-1}$ (7) ↑
2.644120761

Example 40

■ If x = 5 , y = 30, what are r , θ ? Ans : r = 30.41381265 θ = 80.53767779 °

[2nd] [R◂▸P]

MAIN DEG
R▸Pr R▸P θ ➔

[ENTER] 5 [2nd] [,] 30	MAIN DEG R ▸ Pr (5, 30) ↑
[ENTER]	MAIN DEG R ▸ Pr (5, 30) ↑ 30.41381265
[2nd] [R◂▸P] [▸]	MAIN DEG R▸Pr R▸P $\underline{\theta}$ →
[ENTER] 5 [2nd] [,] 30	MAIN DEG R▸P θ (5, 30) ↑
[ENTER]	MAIN DEG R▸P θ (5, 30) ↑ 80.53767779

Example 41

■ If r = 25 , θ = 56°, what are x , y ? Ans : x = 13.97982259 y = 20. 72593931

[2nd] [R◂▸P] [◂] [◂]	MAIN DEG ← P▸Rx P▸Ry
[ENTER] 25 [2nd] [,] 56	MAIN DEG P▸Rx (25, 56) →↑
[ENTER]	MAIN DEG P▸Rx (25, 56) →↑ 13.97982259
[2nd] [R◂▸P] [◂]	MAIN DEG ← P ▸ Rx P ▸ Ry
[ENTER] 25 [2nd] [,] 56	MAIN DEG P▸Ry (25, 56) →↑
[ENTER]	MAIN DEG P▸Ry (25, 56) →↑ 20.72593931

Example 42

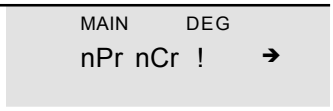
7 ! ÷ [(7 – 4) !] = 840

7 [PRB]	MAIN DEG nPr nCr ! →
[ENTER] 4 [ENTER]	MAIN DEG 7 nPr 4 ↑ 840.

Example 43

7 ! ÷ [(7 – 4) ! x 3 !] = 35

7 [PRB] [▸]

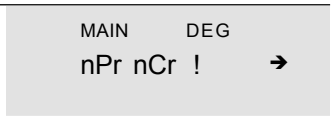


[ENTER] 4 [ENTER]

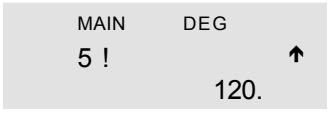
Example 44

5 ! = 120

5 [PRB] [▸] [▸]



[ENTER] [ENTER]



Example 45

■ Generates a random number between 0 and 1

[PRB] [◂] [◂]

[ENTER] [ENTER]

Example 46

■ Generates a random integer between 7 and 9

[PRB] [◂]

[ENTER] 7 [2nd] [,] 9 [ENTER]

Example 47

$$\frac{1}{1.25}=0.8$$

1.25 [2nd] [X^{-1}] [=]

Example 48

$$2^2+\sqrt{4+21}=9$$

2 [X 2] [+] [√] 4 [+] 21 [=]	MAIN DEG 2 2 + √ (4+21) ↑ 9.

Example 49

$\sqrt[3]{27} = 3$

3 [2nd] [x√] 27 [=]	MAIN DEG 3 x √ (27) ↑ 3.

Example 50

7 4 = 2401

7 [∧] 4 [=]	MAIN DEG 7 ^ 4 ↑ 2401.

Example 51

1yd 2 = 9 ft2 = 0.000000836 km 2

1 [2nd] [CONV] [▼] [▸]	MAIN DEG →ft 2 yd 2 m 2 ➔↑ ↓
[ENTER]	MAIN DEG ft 2 yd 2 m 2 ➔ 1.
[◂]	MAIN DEG ft 2 yd 2 m2 ➔ 9.
[▸] [▸] [▸]	MAIN DEG ← km 2 hectars ➔ 0.000000836

Example 52

3 x G = 2.00177955 x 10 −10

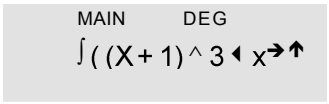
3 [x] [CONST] [▸] [▸]	MAIN DEG c g G Vm N_A ➔ 6.6725985 x 10 −11
[ENTER] [ENTER]	MAIN DEG 3 * 6.6725985 ➔↑ 2.00177955 x 10 −10

Example 53

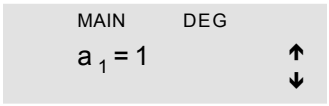
$\int_1^5 (x+1)^3\,dx = 320$

[2nd] [∫ dx]	MAIN DEG ∫ (◂ dx ↑

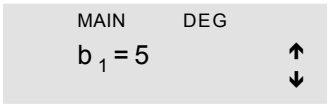
[( )] [2nd] [$\mathcal{X}$] [+] 1 [ )] [∧] 3



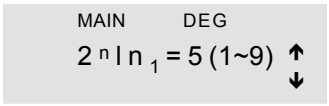
[ENTER] 1



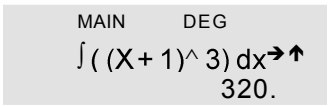
[▼] 5



[▼]



[ENTER]

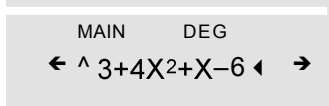


Example 54

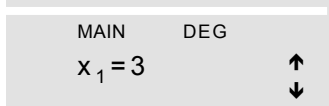
$$f(x)=x^3+4x^2+x-6 \Rightarrow f'(3)=(3x^2+8x+1)\Big|_{x=3}=52$$

[2nd] [d/dx]

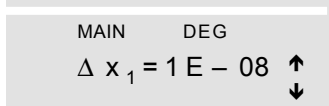
[2nd] [$\mathcal{X}$] [∧] 3 [+] 4 [2nd] [$\mathcal{X}$] [X²] [+]
[2nd] [$\mathcal{X}$] [−] 6



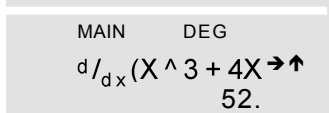
[ENTER] 3



[▼]



[ENTER]



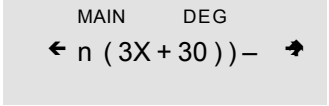
Example 55

$$\begin{cases} f_1(x)=\sin(3x+30) \\ f_2(x)=\cos^3(x) \end{cases}$$

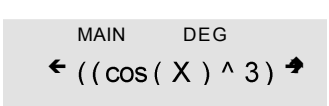
$$\Rightarrow f_1'(10)-f_2'(30)=\left[\,3\cos(3x+30)\,\right]\Big|_{X=10}-\left\{-\left[\,3\cos(x)^2\times\sin(x)\,\right]\Big|_{X=30}\right.$$

$$=0.0458144893\,(\text{Rad})=2.625\,(\text{Deg.})$$

[2nd] [d/dx] [SIN] 3 [2nd] [$\mathcal{X}$] [+] 30
[▶] [▶] [−]



[2nd] [d/dx] [( ] [COS] [2nd] [$\mathcal{X}$] [ )] [∧] 3



[ENTER] 10

MAIN DEG
$x_1 = 10$ ↑ ↓

[▼]

MAIN DEG
$\Delta x_1 = 1\,E-08$ ↑ ↓

[▼] 30

MAIN DEG
$x_2 = 30$ ↑ ↓

[▼]

MAIN DEG
$\Delta x_2 = 1\,E-08$ ↑ ↓

[ENTER]

MAIN DEG
$d/_{dx}(\sin(3X$ →↑
0.045814893

[2nd] [ANS] [x] 180 [÷] [2nd] [π] [ENTER]

MAIN DEG
Ans * 180 / π ↑
2.625

Example 56

$$\cos\left[\int_1^5 (x+1)^3\,dx\right] = \cos(320) = 0.766044443$$

[COS] [2nd] [$\int dx$] [( ] [2nd] [X] [+] 1 [ )] [$\wedge$] 3

MAIN DEG
← (∫ ((X+1)^3 ◂ →↑

[ENTER] 1

MAIN DEG
$a_1 = 1$ ↑ ↓

[▼] 1

MAIN DEG
$b_1 = 5$ ↑ ↓

[▼] 5

MAIN DEG
$2^n In_1 = 5\ (1\sim9)$ ↑ ↓

[ENTER]

MAIN DEG
cos(∫((X+1) →↑
0.766044443

Example 57

$$\begin{cases} \int_1^5 (x+1)^3\,dx = 320 \\ \int_3^8 (x+1)^3\,dx = 1576.25 \end{cases}$$

[2nd] [$\int dx$] [( ] [2nd] [X] [+] 1 [ )] [$\wedge$] 3

MAIN DEG
∫((X+1)^3 ◂ x→↑

[ENTER] 1 [▼] 5 [▼] [ENTER]

MAIN DEG
∫((X+1)^3) dx→↑
320.

[ENTER]	MAIN DEG $a_1 = 1$ ↑ ↓
3	MAIN DEG $a_1 = 3$ ↑ ↓
[▼] 8	MAIN DEG $b_1 = 8$ ↑ ↓
[▼]	MAIN DEG $2^n In_1 = 5$ (1~9) ↑ ↓
[ENTER]	MAIN DEG ∫ ((X + 1)^ 3) dx➔↑ 1576.25

Example 58

$$\int_{-0.5}^{0.5} \frac{1}{(x^2-3x+2)}dx = 0.58789835$$

[2nd] [∫dx] 1 [÷] [(] [2nd] [$\mathcal{X}$] [x^2] [–] 3 [2nd] [$\mathcal{X}$] [+] 2 [)]	MAIN DEG ← / (X^2 –3X + 2) ◂ ➔↑
[ENTER] [(–)] 0.5 [▼] 1.5 [▼] [ENTER]	MAIN DEG DIVIDE BY 0 ↑ .
After 5 Sec	MAIN DEG ← (X^2 –3X + 2))dx➔↑
[ENTER] [▼] 0.5	MAIN DEG $b_1 = 0.5$ ↑ ↓
[▼] [ENTER]	MAIN DEG ∫ (1 / (X^2 – 3X + ➔↑ 0.58789835

Example 59

■ Enter data : $X_{USL} = 6$, $X_{LSL} = 2$, $X_1 = 3$, $FREQ_1 = 2$, $X_2 = 5$, $FREQ_2 = 9$, then find out $\bar{x} = 4.6363636$, $Sx = 0.809039835$, $Cax = 0.318181818$, and $Cpx = 0.864241622$

[MODE] 1	STAT DEG 1-VAR 2-VAR ➔
[ENTER] [DATA] [▸]	STAT DEG ← LIMIT-SET ➔
[ENTER] 6	STAT DEG X USL = 6 ↑ ↓

[▼] 2	STAT DEG X LSL = 2 ↑
[DATA]	STAT DEG DATA-INPUT →
[ENTER] 3	STAT DEG X_1 = 3 ↑ ↓
[▼] 2	STAT DEG $FREQ_1$ = 2 ↑ ↓
[▼] 5 [▼] 9	STAT DEG $FREQ_2$ = 9 ↑ ↓
[STATVAR]	STAT DEG n $\bar{x}$ Xmax → 11.
[▸]	STAT DEG n $\bar{x}$ Xmax → 4.636363636
[▸] [▸] [▸]	STAT DEG ← Xmin Sx σX → 0.809039835
[▸] [▸] [▸] [▸]	STAT DEG ← $\sum$X $\sum X^2$ Cax → 0.318181818
[▸]	STAT DEG ← Cpx Cpkx t → 0.864241622

Example 60

■ Enter data : X_{USL} = 6, X_{LSL} = 2, Y_{USL} = 9, Y_{LSL} = 3, X_1 = 3, Y_1 = 4 ; X_2 = 5 , Y_2 = 7, then find out $\bar{x}$ = 4, Sx = 1.414213562, Cax = 0 , Cay = 0.166666667

[MODE] 1 [▸]	STAT DEG 1 -VAR 2 -VAR →
[ENTER] [DATA] [▸]	STAT DEG ← LIMIT-SET →
[ENTER] 6 [▼] 2 [▼] 9 [▼] 3	STAT DEG Y LSL = 3 ↑
[DATA]	STAT DEG DATA-INPUT →
[ENTER] 3 [▼] 4 [▼] 5 [▼] 7	STAT DEG Y_2 = 7 ↑ ↓

[STATVAR] [▸]	STAT DEG n $\bar{x}$ Xmax → 4.
[▸] [▸] [▸]	STAT DEG ← Xmin Sx σX → 1.414213562
[▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸] [▸]	STAT DEG ← x' y' Cax → 0.
[▸] [▸] [▸]	STAT DEG ← Cay Cpy → 0.166666667

Example 61

■ Enter data : a_x = 2, X_1 = 3, $FREQ_1$ = 2, X_2 = 5 , $FREQ_2$ = 9, then find out t = –3.417682776, P(t) = 0.0003, Q(t) = 0.4997, R(t) =0.9997

[MODE] 1	STAT DEG 1-VAR 2-VAR →
[ENTER] [DATA] [▸] [▸]	STAT DEG ← DISTR
[ENTER] 2	STAT DEG a_x = 2 .
[DATA] [ENTER] 3 [▾] 2 [▾] 5 [▾] 9	STAT DEG $FREQ_2$ = 9 ↑
[STATVAR] [◂] [◂] [◂] [◂]	STAT DEG ← Cp Cpk t →↑ – 3.417682776
[▸]	STAT DEG ← P(t) Q(t) → 0.0003
[▸]	STAT DEG ← P(t) Q(t) → 0.4997
[▸]	STAT DEG ← R(t) 0.9997

Example 62

■ Enter data : X_1 = 3, Y_1 = 4, X_2 = 5, Y_2 = 7, set y = 6, x = 5, get x'(6) = 4.333333333, y'(5) = 7

[MODE] 1 [▸]	STAT DEG 1-VAR 2-VAR →

[ENTER][DATA][ENTER]3[▼]4[▼]5[▼]7	STAT DEG $Y_2 = 7$ ↑ ↓
[STATVAR][◀][◀][◀][◀][◀][◀][◀][◀]	STAT DEG ← x' y' Cax →
[ENTER]6[ENTER]	STAT DEG x'(6) 4.333333333
[STATVAR][◀][◀][◀][◀][◀][◀][◀]	STAT DEG ← x' y' Cax →
[ENTER]5[ENTER]	STAT DEG y'(5) 7.

Example 63

■ Based on Example 59, change $Y_1 = 4$ as $Y_1 = 9$ and $X_2 = 5$ as $X_2 = 8$, then find Sx = 3.535533906

[DATA]	STAT DEG DATA-INPUT →
[ENTER][▼]9	STAT DEG $Y_1 = 9$ ↑ ↓
[▼]8	STAT DEG $X_2 = 8$ ↑ ↓
[STATVAR][▶][▶][▶][▶]	STAT DEG ← Xmin Sx σX → 3.535533906

Example 64

$31_{10} = 1F_{16} = 11111_2 = 37_8$

[MODE]2	Base-n d
31[ENTER]	Base-n d31 ↑ 31^d
[dhbo]	Base-n BASE d h b → d
[ENTER]	Base-n D H B O 31 d
[▶]	Base-n D H B O 1F h

[▸]

Base-n
D H B O
11111 b

[▸]

Base-n
D H B O
37 o

Example 65

$4777_{10} = 1001010101001_{2}$

[MODE] 2 [dhbo] [ENTER] [▸] [▸]

Base-n
D H B O
b

[ENTER]

Base-n
b

[dhbo] [▸]

Base-n
BASE d h b →
b

[ENTER] 4777 [ENTER]

Base-n
d4777 ↑
10101001 1b

[⟳]

Base-n
d4777 ↑
10010 2b

[⟳]

Base-n
d4777 ↑
0 3b

[⟳]

Base-n
d4777 ↑
0 4b

Example 66

■ How is $3A_{16}$ expressed as a negative ? Ans : FFFFFFC6

[MODE] 2 [dhbo] [ENTER] [▸]

Base-n
D H B O
h

[ENTER] [NEG] 3 [A] [ENTER]

Base-n ↑
NEG h3A
FFFFFFC6 h

Example 67

$1234_{10} + 1EF_{16} \div 24_{8} = 2352_{8} = 1258_{10}$

[dhbo] [ENTER] [▸] [▸] [▸]

Base-n
D H B O
o

[ENTER] [dhbo] [▸]

Base-n
BASE d h b →
o

[ENTER] 1234 [+]	Base-n d1234 + o
[dhbo] [▸] [▸]	Base-n BASE d h b ➔ o
[ENTER] 1EF [÷]	Base-n ← 1234 + h1EF / o
[dhbo] [◂]	Base-n ← o
[ENTER] 24	Base-n ← 4 + h1EF / o 24 o
[ENTER]	Base-n d1234 + h1EF/ ➔↑ 2352 o
[dhbo] [ENTER] [▸] [▸]	Base-n D H B O 1258 d

Example 68

1010_2 AND (A_{16} OR 7_{16}) = 1010_2

[MODE] 2 [dhbo] [ENTER] [▸] [▸]	Base-n D H B O b
[ENTER] [dhbo] [▸] [▸] [▸] [ENTER] 1010 [AND] [( ]	Base-n ← 1010 AND (↑ b
[dhbo] [▸] [▸] [ENTER] A [OR] [dhbo] [▸] [▸] [ENTER] 7 [ENTER]	Base-n b1010 AND (➔↑ 1010 b

Example 69

(7 – 9 i) + (15 + 12 i) = 22 + 3 i ⇒ ab = 22.20360331, ar = 7.765166018

[MODE] 3	CPLX DEG
7 [+] [(–)] 9 [i] [+] 15 [+] 12 [i] [ENTER]	CPLX DEG Re Im ab ar 22.
[▸]	CPLX DEG Re Im ab ar 3.
[▸]	CPLX DEG Re Im ab ar 22.20360331

[▸]	CPLX DEG Re Im ab ar 7.765166018

Example 70

$$\begin{cases} 3x+5y=5 \\ x-4y=13 \end{cases} \Rightarrow x=5, y=-2$$

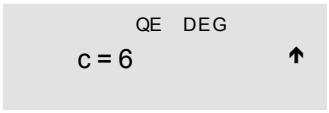
[MODE] 4	VLE DEG ax+by=c, dx+ ➔
[▾] 3	VLE DEG a = 3 ↑
[▾] 5	VLE DEG b = 5 ↑
[▾] 5	VLE DEG c = 5 ↑
[▾] 1	VLE DEG d = 1 ↑
[▾] [(–)] 4	VLE DEG e = – 4 ↑
[▾] 13	VLE DEG f = 13 ↑
[▾]	VLE DEG X Y 5.
[▸]	VLE DEG X Y –2.

Example 71

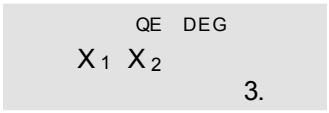
■ $x^2 - 5x + 6 = 0 \Rightarrow x = 2 \text{ or } 3$

[MODE] 5	QE DEG $ax^2 + bx + c = 0$
[▾] 1	QE DEG a = 1 ↑
[▾] [(–)] 5	QE DEG b = – 5 ↑

[▼] 6



[▼]



[▶]