DONAU TECH

Instruction Manual

Model no.: K-DT6003

Technical basics

On/off function

Press [ON] key to turn the calculator on. Turn it off by pressing [SHIFT] and [OFF] simultaneously.

Replacing the battery

AG13 or LR44 one button battery can be used to power the calculator. It is advised to replace the battery when the display dims. Proceed with caution, according to the instructions:

1. Unscrew the screws visible on the back of the calculator.
2. To pry the case open, insert a flat bladed screwdriver into the slot between both parts of the case and rotate it slightly until the case comes apart.
3. Remove the battery, setting it aside as to not mix it with the new one.
4. Use a dry cloth to ensure that no visible particles can interfere with connection of the battery.
5. Insert the battery with its plus terminal (flat side) up.
6. Snap together both parts of the calculator case.
7. Tighten the screws with suitable amount of force.

Auto power–off function

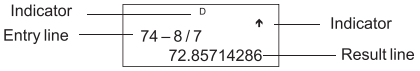
The calculator turns off automatically after approximately 6 minutes of inactivity to save power and battery life. It can be reactivated by pressing [ON] key.

Adjusting contrast

By pressing [MODE] key 6 times and then selecting 2 from the numeric keys, you can enter contrast adjustment mode. Dim or brighten the screen by pressing and holding [▶] or [◀] key, respectively.

Display readout

The calculator's display consists of two indicators and two lines: entry and the result line.



■ **Entry line**

It is the area used for calculation input. Entry line can hold up to 79 "steps", which count each time you press any number key or operator key ([+], [−], [×], [÷]). It is worth noting that other key operations don t count as steps.

Pressing [Ans] key recalls the last result obtained to be used in subsequent calculation. See **Answer Memory** for more information about using the [Ans] key.

Inputting the 73rd step of calculation will result in changing the cursor from "_" to "■", indicating that the calculator's memory is closing to its limits. It is highly advised to split more complex calculations into parts that will fit the memory.

■ **Results line**

Up to 10 digits of result are displayed on this line, as well as a decimal, a negative sign, a "x10" indicator and a 2–digits positive or negative exponent.

Calculator capabilities

■ **Mode selection**

Pick one of the modes listed below before starting calculations to ensure desired results. In some cases, you will need to click the [MODE] key multiple times to enter the mode described. Pressing it 4 times opens calculator setup, described later in this manual.

Mode name	Shortcut	Types of calculations
COMP	[MODE] [1]	Basic arithmetic
CMPLX	[MODE] [2]	Complex number calculations

SD	MODE MODE 1	Deviation (standard)
REG	MODE MODE 2	Regression calculations
BASE	MODE MODE 3	Base–*n* calculations
EQN	MODE MODE MODE 1	Equation solving
MAT	MODE MODE MODE 2	Matrix calculations
VCT	MODE MODE MODE 3	Vector calculations

Each of these modes is further described in respected parts of the manual, signed with their names and types of calculations.

■ **Returning to default setup/mode**

The defaults of the calculator mode and setup are as following:

Calculation mode	COMP
Angle Unit	Deg
Exponential Display Format	Norm 1, Eng OFF
Complex Number Display Format	$a+bi$
Fraction Display Format	$a^b/_c$
Decimal Point Character	Dot

While in the BASE mode, you can't change the angle unit or other display format (Disp) settings and engineering symbols are turned off. Be sure to check the current calculation mode before starting your calculations.

Mode indicators appear in the upper part of the display, except for the BASE indicators, which appear in the exponent part of the display.

■ SHIFT key usage

This key's main function is to allow you to select the second function of any key you press after [SHIFT]. Check the display for "S" indicator, which signals that [SHIFT] has been pressed. Pressing it again will cancel it.

■ Cursor

Press [▶] or [◀] to move the cursor to the left or right. Holding down any of these keys will allow you to move the cursor at higher speed.

To bring back one of the previous entries back onto the entry line to use it again, simply use [▲] or [▼] while holding [SHIFT]. To reuse a previously made entry by bringing it back into the entry line.

■ Input corrections

To delete a character, use [▶] or [◀] to underline it and then press [DEL]. If you want to replace it, instead of [DEL], make a new entry to replace it.

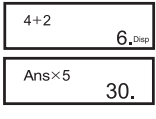
Pressing SHIFT INS will change your cursor to an insert cursor [ ], which allows you to quickly replace characters one by one. New characters will replace the character marked by the insert cursor.

To return to normal cursor, press the combination again or use =.

■ Joining multiple statements (multi–statement)

To create a multi–statement, use a colon (:) to connect them, for example:

4 + 2 ALPHA : Ans × 5 =



■ Latest operation (Replay)

After operation execution is completed, you can press the ▲ key to display the formula again. Pressing the key again will move you further back, enabling you to go through past calculations.

You can edit the formula on the screen by pressing ◀ or ▶ and going into editing mode. You can also skip the first

step and press ◀ or ▶ to bring back latest calculation to edit it right away.

Important! Pressing AC does NOT clear the replay memory, allowing you to recall the last calculation even after pressing it. The memory has the capacity of 128 bytes for both expressions and results.
It is, however, cleared, by each of the below:

- turning off the calculator
- pressing ON key
- initializing modes and settings, by pressing SHIFT CLR 2 (or 3) and =.
- changing calculation mode

Look at examples 1 and 2.

■ Display error position

Executing a mathematically illegal calculation will result in an error position display function pointing at the error. Press [▸] or [◂] to move the cursor to the marked position and correct your entry.
Look at example 3.

■ Independent memory & variables

You can easily streamline your calculations by using variables: A, B, C, D, E, F, M, X, Y. They can store any real number for repeated use.

M is also used for independent memory, which is convenient for calculating cumulative totals.
Look at example 4.

To clear a variable value (or independent memory) use press 0 SHIFT STO and variable's letter . For instance , if you want to clear variable A, you will need to press 0 , SHIFT STO and A .

To clear all stored variable values press SHIFT CLR 1 (Mcl) and =
Look at example 5.

■ Using stacks

Calculator temporarily stores values or commands in memory areas called stacks. They have 10 and 24 levels respectively. All matrix calculations use up to two levels of the matrix stack. Squaring, cubing or inverting a matrix uses one stack level.

A stack error (Stk ERROR) occurs whenever you try to perform a calculation that is too big to be stored in stack memory.

Example:

6 × ((4 + 8 ÷ (2 + 1) × 4) ÷ 5) + 7 =

Numbers 6, 4, 8, 2 and 1 have been saved in a numeric stack in that order, on level from 1 to 5. Meanwhile, seven commands have been saved to a command stack.

Numeric stack

①	**6**
②	**4**
③	**8**
④	**2**
⑤	**1**
⋮	

Command stack

1	×
2	(
3	(
4	+
5	÷
6	(
7	+

■ Order of operations

Each calculation is performed in the following order of precedence:

① Coordinate transformation: Pol (x, y), Rec (r, θ)

② Type A functions: They require entering values before the function key is pressed.
x^3, x^2, x^{-1}, $x!$, ° ′ ″
$\hat{x}$, $\hat{x}_1$, $\hat{x}_2$, $\hat{y}$
Angle unit conversion (DRG▶)
Metric conversions

③ Power and roots ^(x^y), $\sqrt[x]{\ }$

④ $a^b/_c$

⑤ Abbreviated multiplication format in front of π, e (natural logarithm base), memory name, or variable name: 2π, 3e, 5A, πA, etc.

⑥ Type B functions which require pressing the function key before entering:
$\sqrt{\ }$, $\sqrt[3]{\ }$, log, ln, e^x, 10^x, sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$, sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, (–)

⑦ Abbreviated multiplication format in front of Type B functions, e.g. $2\sqrt{7}$, Alog2.
⑧ Permutation and combination: $_nP_r$, $_nC_r$
⑨ Dot (•)
⑩ ×, ÷
⑪ +, –

Operations are performed from left to right. If operations of the same precedence occur, they are performed from right to left. To give operations higher priority, put it into parentheses.

Remember! Negative number, as an argument, must be enclosed in parentheses.

Example:
$(-6)^4 = 1296$
$-6^4 = -1296$

■ Capacity and accuracy

Internal digits: 12 digits.
Accuracy is ±1 at the 10th digit.

Functions	Input Range
10^x	$-9.999999999 \times 10^{99} \leqq x \leqq 99.99999999$
e^x	$-9.999999999 \times 10^{99} \leqq x \leqq 230.2585092$
$\sqrt{x}$	$0 \leqq x < 1 \times 10^{100}$
$\sqrt[3]{x}$	$\lvert x \rvert < 1 \times 10^{100}$
x^2	$\lvert x \rvert < 1 \times 10^{50}$
$1/x$	$\lvert x \rvert < 1 \times 10^{100}$, $x \neq 0$
$x!$	$0 \leqq x \leqq 69$, x is an integer.
sin x, tan x	Deg : $0 \leqq \lvert x \rvert \leqq 4.499999999 \times 10^{10}$ Rad : $0 \leqq \lvert x \rvert \leqq 785398163.3$ Grad : $0 \leqq \lvert x \rvert \leqq 4.999999999 \times 10^{10}$ 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)
cos x	Deg : $0 \leqq \lvert x \rvert \leqq 4.500000008 \times 10^{10}$ Rad : $0 \leqq \lvert x \rvert \leqq 785398164.9$ Grad : $0 \leqq \lvert x \rvert \leqq 5.000000009 \times 10^{10}$
$\sin^{-1} x$, $\cos^{-1} x$	$0 \leqq \lvert x \rvert \leqq 1$
sinh x, cosh x	$0 \leqq \lvert x \rvert \leqq 230.2585092$
$\tan^{-1} x$, tanh x	$0 \leqq \lvert x \rvert \leqq 9.999999999 \times 10^{99}$

$\tanh^{-1} x$	$0 \leqq \lvert x \rvert \leqq 9.999999999 \times 10^{-1}$
$\sinh^{-1} x$	$0 \leqq \lvert x \rvert \leqq 4.999999999 \times 10^{99}$
$\cosh^{-1} x$	$1 \leqq x \leqq 4.999999999 \times 10^{99}$
log x, ln x	$0 < x \leqq 9.999999999 \times 10^{99}$
Pol (x, y)	$\lvert x \rvert, \lvert y \rvert \leqq 9.999999999 \times 10^{49}$ $(x^2 + y^2) \leqq 9.999999999 \times 10^{99}$
Rec (r,θ)	$0 \leqq r \leqq 9.999999999 \times 10^{99}$ θ : Same as sin x
o,,,	$\lvert a \rvert$, b, c $< 1 \times 10^{100}$, $0 \leqq$ b, c
o',,,	$\lvert x \rvert < 1 \times 10^{100}$ Sexagesimal $\leftrightarrow$ Decimal transformation $0^\circ\ 0^\circ\ 0^\circ \leqq \lvert x \rvert \leqq 999999^\circ\ 59^\circ$
^ (x^y)	$x > 0$: $-1 \times 10^{100} < y \log x < 100$ $x = 0$: $y > 0$ $x < 0$: y = n, $\frac{1}{2n+1}$ (n is an integer) However: $-1 \times 100^{100} < y \log \lvert x \rvert < 100$
$\sqrt[x]{y}$	$y > 0$: $x \neq 0$, $-1 \times 10^{100} < 1/x \log y < 100$ $y = 0$: $x > 0$ $y < 0$: $x = 2n+1$, $\frac{1}{n}$, n is an integer.($n \neq 0$) but $-1 \times 10^{100} < 1/x \log \lvert y \rvert < 100$
nPr	$0 \leqq n < 1 \times 10^{10}$, $0 \leqq r \leqq n$ (n, r are integers) $1 \leqq \{n!/(n-r)!\} < 1 \times 10^{100}$
nCr	$0 \leqq n < 1 \times 10^{10}$, $0 \leqq r \leqq n$ (n, r are integers) $1 \leqq [n!/\{r!(n-r)!\}] < 1 \times 10^{100}$
SD (REG)	$\lvert x \rvert < 1 \times 10^{50}$, $\lvert \bar{y} \rvert < 1 \times 10^{50}$, $\lvert n \rvert < 1 \times 10^{100}$ $x\sigma n$, $y\sigma n$, $\bar{x}$, $\bar{y}$: $n \neq 0$ $x\sigma n-1$, $y\sigma n-1$, A, B, r : $n \neq 0, 1$
$a^b/_c$	Total digits of numerator, denominator, and integer: $\leqq 10$

■ Troubleshooting

In case of unexpected results or any errors occurring, follow these steps before moving forward with the diagnostics:

1. Check the formula for any errors.
2. Press SHIFT CLR 2 (Mode) = to initialize all modes and settings.
3. Enter the correct mode and try performing the operation again.

If the error persists or the results are still not as expected, press the ON key to initialize self-check of the calculator.

It will clear all data stored in the memory and check for any discrepancies or abnormalities.

■ Error types

On error encounter, any further calculations become impossible. Check error descriptions to find the correct solution.

Syntax error

There was an attempt to perform a mathematical operation that is illegal.

How to solve it? Press ◀ or ▶ to display the calculation, with the cursor marking the location of the error. Correct it to proceed with your operations.

Arg error

There was an improper use of an argument.

How to solve it? Press ◀ or ▶ to display the location of the error. Correct it to proceed with your operations.

Stack error

Your operation exceeds the numeric or operator stack capacity.

How to solve it? Proceed with stack limits in mind. It is 10 levels for numeric stack and 24 levels for operator stack. Divide your calculation or simplify it to avoid this error.

Math error

Shows up when your input values exceed the allowable input range, function calculations exceed the specified range or the calculator detects an illogical operation, e.g., division by zero.

How to solve it? Make sure all values are within the allowable ranges, including memory areas.

Mathematical expression calculations and editing functions (COMP)

■ Replay Copy

This function lets you copy multiple expressions from replay, connecting them in a single multi-statement.

Example:

1 + 1
2 + 2
3 + 3
4 + 4
5 + 5
6 + 6

Multi-statement: 4 + 4:5 + 5:6 + 6

To copy an expression, simply use ▲ or ▼ to find the expression you are looking for and press SHIFT , ▲ (COPY) . Only those in replay memory, starting from the one you have on screen and ending on the last on your display, are being copied.

You can edit these expressions and form other multi-statement operations. See "Multi-statements" under "Calculator capabilities" to learn more.

■ CALC memory

COMP CMPLX

If you use an expression often, you can store it in CALC memory temporarily and then recall it, inputting values for its variables and calculating quick results. You can store one mathematical expression with up to 79 steps, but remember that it can be used in COMP and CMPLX modes only.

Variable input screen will show the values currently assigned to your variables in the expression, to further streamline your work.

Example: Calculate the result for $Y = 8X - X^2 + 12$ when X = 4 (Result: 28), and when X = 6 (Result: 24).

Key commands you will need:

Function input	ALPHA Y ALPHA = 8 ALPHA X − ALPHA X x^2 + 12
Store the expression	CALC
Input 4 for X	4 =
Input 6 for X	CALC 6 =

Warning! The expression is cleared from the memory when another operation is started, mode is changed or the calculator turned off. Proceed with caution to not lose your work!

■ SOLVE function

Solve expression in Newton's Method, using variable values. Due to the method's limitations, certain initial values can make it impossible to obtain solutions. To solve this issue, try putting in a value close to the estimated solution and calculate again. In some faces, a solution might be unobtainable, even though it exists.
Certain functions might prove difficult to calculate:

- periodic functions
- functions whose graph produce sharp slopes
- discontinuous functions

Lack of equal sign (=) results in SOLVE function producing a solution equal to 0.

Example of use:

$$B = AC - \frac{1}{2}DC^2$$

In this formula, C is the time it would take for an object thrown straight up with initial velocity A to reach height B. D is the gravitational acceleration. Given that B = 12, C = 1.8 and D = 9.8 m/s^2, calculate initial velocity A.
Result: A = 20.7

Basic calculations in COMP mode

■ Arithmetic calculation

Start by entering the COMP mode. To do that, use MODE 1

- For negative values, press [(–)] before you enter the value.
- You can skip all) operations before equal sign.
- To enter a number in mantissa and exponent form, press [EXP] key. *Look at example 6.*
- Arithmetic calculations are performed by pressing the keys in the same sequence as in the expression. *Look at example 7.*

■ Parentheses calculation

Operations inside parentheses are always executed first. Your calculator can use up to 15 levels of consecutive parentheses in a single calculation. *Look at example 8.*

■ Percentage calculation

By pressing [SHIFT] and [%], you can divide the number in the display by 100. Use this sequence to calculate percentages, discounts, add-ons, and percentages ratios. *Look at examples 9-10.*

■ FIX, SCI, RND

Calculator allows you to change the settings of decimal places, significant digits and exponential display format. Simply press the MODE key a number of times, until the screen below is displayed.

```
Fix Sci Norm
1   2   3
```

And press the key corresponding to the settings you want to change:

(Fix) Number of decimal places	1
(Sci) Number of significant digits	2
(Norm) Exponential display format	3

Look at examples 11-13 for further help.

■ Continuous calculation function

With this calculator, you can repeat the last operation executed, even if calculations are concluded with the [=] key. To do that, press [=] key. *Look at examples 14-15.*

■ Answer memory

This function stores the most recently calculated result. If you provide input in a form of numeric value or expression, after hitting [=] key the answer will be saved in the memory. To recall it, simply press ANS key. Answer memory stores up to 12 digits for the mantissa and two digits for the exponent.

Answer memory contents are updates by pressing the following buttons: SHIFT %, M+, SHIFT M−, or SHIFT STO followed by a letter (A, B, C, D, E, F, M, X or Y).

Important! If the calculation results in an error, answer memory won't change its value.

If you still have your calculation result on display, it is both in the answer memory and on the display. It can be used as the first value of your next calculation, just note that pressing an operator key will result in the displayed value to change to Ans, indicating it is the value in the answer memory.

Scientific calculation

Logarithms and antilogarithms

You can calculate common and natural logarithms and antilogarithms using [log], [ln], [SHIFT] [10^x], and [SHIFT] [e^x]. *You can see more of this in examples 17-19.*

■ Fraction calculation

Fraction values display as follows:

4 ⌟ 7 ⌟ 12	$4\frac{7}{12}$ is depicted on the example

Values can be displayed in decimal format whenever the total number of digits of fractional values exceeds 10 (integer + numerator + denominator + separator marks).

If you want to enter a mixed number, press [$a\,^b/_c$], enter the numerator and then repeat it for the denominator. For improper fraction, skip the [$a\,^b/_c$] for numerator.

To convert into and from improper fraction, press [SHIFT] and [$^d/_c$]. Converting between decimals and fractional results is possible with [$a\,^b/_c$] . *Look at example 21.*

Calculations containing both fractions and decimals are calculated in decimal format. *Look at* example 22.

■ Angle units conversion

Press [MODE] to display the angle menu. Here you can change angle units between DEG, RAD and GRAD. The relation between them is:

$$180\,^\circ = \pi\text{rad} = 200\text{ grad}$$

After you change the defaults, you can convert any of the other two into your default angle unit. To do that, enter the value you want to convert and press [SHIFT] [DRG▶] to display menu.

D	R	G
1	2	3

Chose the unit you are converting FROM between **D**egrees, **R**adians and **G**radians. Press [=] to complete conversion. *Look at example 23.*

■ **Trigonometry**

It is possible to use standard and inverse trigonometric functions: sin, cos, tan, $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$. *See examples 24-26.*

Remember to set the calculator to the right angle unit before you use these!

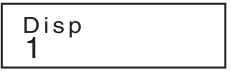
■ **Hyperbolic and inverse hyperbolic functions**

Use [hyp] to calculate the hyperbolic functions and inverse hyperbolic functions alike: sinh, cosh, tanh, $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$. *Look at examples 27-28.*

Remember to set the calculator to the right angle unit before you use these!

■ **Engineering Symbols** (COMP) (EQN) (CMPLX)

To turn engineering symbols on or off, press the [MODE] key a number of times, stopping when the engineering symbol setting screen shows up as seen below.



Press [1] to turn on or [2] to turn off engineering symbols in your calculations. "Eng" indicator on the display is the sign for turned on symbols.

There are nine symbols available for use when engineering symbols are turned on:

Symbol:	Key operation:	Unit
k (kilo)	[SHIFT] [k]	10^3
M (Mega)	[SHIFT] [M]	10^6
G (Giga)	[SHIFT] [G]	10^9
T (Tera)	[SHIFT] [T]	10^{12}
m (milli)	[SHIFT] [m]	10^{-3}
μ (micro)	[SHIFT] [μ]	10^{-6}
n (nano)	[SHIFT] [n]	10^{-9}
p (pico)	[SHIFT] [p]	10^{-12}
f (femto)	[SHIFT] [f]	10^{-15}

Numeric values with engineering symbols are displayed in a range of 1 to 1000. They cannot be used when inputting fractions. When engineering symbols are turned on, all (even standard, non-engineering) calculation results will be displayed using these symbols.

■ **Sexagesimal ↔ Decimal transformation**

Sexagesimal notation is as follows:
17° 27° 33.4° Represent 17 Degree, 27 Minutes, 33.4 Seconds.

You can perform the conversion between decimal and sexagesimal values by [o‘‘‘] and [SHIFT] [o‘‘‘]. *For further information look at examples 29-30.*

■ **Coordinates transformation (Pol (x,y),Rec (r,θ))**

You can convert between rectangular coordinates and polar coordinates by pressing [SHIFT][Pol ( ] and [SHIFT] [Rec ( ]. Results are automatically stored in memory variables **E** and **F**.

Depending on coordinates you are using, press [RCL][E] to display your value of *r* or *x* and [RCL][F] to display *y* or θ. *More information in examples 31-32.*

■ **Engineering Notation Calculations (ENG)**

Results are displayed using engineering notation, which means that mantissa of the value is displayed with the number of decimal places specified, and the exponent is set to a multiple of 3 for display.

Example:

36.049 grams converted to kilograms
→ 36.049×10^{3} (km) 36049 = ENG

0.07125 grams to milligrams
→ 71.25×10^{-3} (mg) 0.07125 = ENG

■ **Probability**

You can use the following probability 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.

[x!] – Calculates the factorial of a specified positive integer x, where $x \leqq 69$.

[RAN#] – Generates a random number between 0.000 and 0.999.

■ Other functions (x^{-1}, $\sqrt{\ }$, $\sqrt[3]{\ }$, $\sqrt[x]{\ }$, x^2, x^3, $\wedge(x^y)$)

If you need additional functions, the calculator also provides the use of square [x^2], cubic [x^3], universal ([$\sqrt[x]{\ }$]), cubic roots ([$\sqrt[3]{\ }$]) and square roots ([$\sqrt{\ }$]), reciprocal ([x^{-1}]), and exponentiation ($\wedge(x^y)$) functions. *Learn more in examples 37-40.*

Complex number calculations CMPLX

■ Mode introduction

To perform these, start by entering CMPLX mode (MODE 2). Complex number result is indicated by "R↔I" indicator in the upper right corner of the calculator display. Replay function is available but remember that complex number (that are also stored) use more of the capacity.

You can only use A, B, C, M variables in CMPLX mode, as the calculator uses the rest of them (D, E, F, X, Y) and their values change. DO NOT use these in your expressions.

Current settings affect your calculations. Check your angle unit settings (Deg, Rad, Gra) to make sure they are set correctly. You can store an expression in CALC memory while in CMPLX mode.

Example:
$(8+2i)+(4+4i)= 12+6i$
"12" is the real part of the result and "6*i*" is the imaginary part. To switch between real and imaginary parts press SHIFT Re↔Im

■ Absolute value and argument calculation

Supposing the imaginary number expressed by the rectangular form $z = a + bi$ is represented as a point in the Gaussian plane, you can determine the absolute value (r) and argument (θ) of the complex number. The polar form is $r\angle\theta$.

The complex number can also be input using the polar form provided.

Example: $\sqrt{2} \angle 45 = 1 + i$ (unit=Deg)

Input: [√] 2 [SHIFT] [∠] 45 [=] [SHIFT] [Re↔Im]

■ **Rectangular ↔ Polar Form conversion**

To pick between rectangular form $(a + bi)$ or polar form $(r\angle\theta)$ to display, select [MODE] and in [1] (Disp) ▶ settings press 1 or 2 for each of these forms respectively.

You can convert complex numbers between their polar and rectangular forms using the combination used within the example, if you need to switch.

Example:

$1 + i \leftrightarrow 1.414213562 \angle 45$

(Angle unit: Deg) 1 [+] [i] [SHIFT] [►r∠θ] [=] [SHIFT] [Re↔Im]

[√] 2 [SHIFT] [∠] 45 [SHIFT] [►a+bi] [=] [SHIFT] [Re↔Im]

■ **Conjugate of a complex number**

For any complex number z where $z = a+bi$, its conjugate $\overline{z} = a-bi$.

For example, to determine the conjugate of the complex number $2.41+3.11i$ (Result: is $2.41-3.11i$)

[SHIFT] [Conjg] [(] 2 [•] 41 [+] 3 [•] 11 [i] [)] [=]

[SHIFT] [Re↔Im]

Base-*n* calculations BASE

To enter BASE mode (and perform base-*n* calculations) press [MODE] key twice and pick [3].

Calculations in BASE can be done in decimal values, as well as in binary, octal, and hexadecimal systems. You can't use scientific functions nor input values that include decimal part and an exponent. If a value with a decimal part is provided, the unit automatically cuts off the decimal part. Negative values for binary, octal, and hexadecimal system values are made with two's complement.

You can easily specify the default number system that will be applied to all input and displayed values. If needed, individual values can be converted to different systems.

In BASE you can use logical operators between your calculations: and (logical product), or (logical sum), xor (exclusive or), xnor (exclusive nor), not (bitwise complement) and neg (negation).

Allowable ranges for values are as follows:

Binary	$1000000000 \leqq x \leqq 1111111111$ $0 \leqq x \leqq 0111111111$
Octal	$4000000000 \leqq x \leqq 7777777777$ $0 \leqq x \leqq 3777777777$
Decimal	$-2147483648 \leqq x \leqq 2147483647$
Hexadecimal	$80000000 \leqq x \leqq$ FFFFFFFF $0 \leqq x \leqq$ 7FFFFFF

Example 1: Performing a calculation with binary result in mind:

$10111_2 + 11010_2 = \boldsymbol{110001_2}$

To achieve this in binary mode: AC BIN → 0. b

10111 + 11010 =

Example 2: Performing a calculation with octal result in mind:

$7224_8 + 10_{10} = 7236_8$

To achieve this in octal mode: AC OCT → 0. o

LOGIC LOGIC LOGIC 4 (o) 7224 ÷

LOGIC LOGIC LOGIC 1 (d) 10 =

Example 3: Performing a calculation with hexadecimal and a decimal result:

144_{16} or $1010_2 = 14E_{16}$ or 334_{10}

To achieve this in hexadecimal mode: AC HEX → 0. H

144 LOGIC 2 (or)

LOGIC LOGIC LOGIC 3 (b) 1010 =

And in decimal: DEC

Example 4: Conversion of 15_{10} to binary, octal, hexadecimal values.
(Answers: 1111_2, 17_8, F_{16})

Binary mode:	AC BIN	0. b
	LOGIC LOGIC LOGIC 1 (d) 15 =	1111. b
Octal mode:	OCT	17. o
Hexadecimal mode:	HEX	F. H

Example 5: Conversion of 665_{10} to binary.

Binary mode:	AC BIN	0. b
	LOGIC LOGIC LOGIC 1 (d) 665 =	Math ERROR b

The calculation result produced a math ERROR because the value in the binary system was greater than the calculation range specified for the calculator. Indicator "Math ERROR" indicates overflow (too many digits to display).

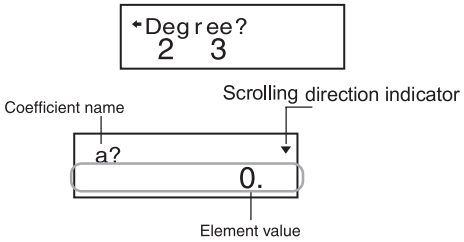
Equation calculations EQN

This mode allows you to solve equation with up to three degrees and simultaneous linear equations with up to three unknowns. To enter this mode, press MODE key three times to enter the EQN Mode and press 1.

■ Quadratic and cubic equations

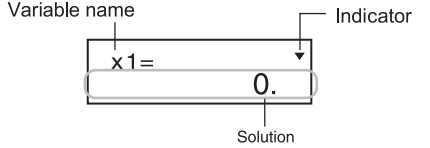
Entering the EQN Mode and pressing ▶ displays the initial cubic/quadratic settings screen where you can specify the degree of the equation and your inputs (values for coefficients). Pick 2 for quadratic or 3 for cubic.

Cubic equation: $ax^3 + bx^2 + cx + d=0$
Quadratic equation: $ax^2 + bx + c = 0$



Scrolling direction indicator is an arrow that shows you the correct direction to scroll to view other solutions. Any time you put in a value for the final coefficient (c or d, depending on equation type), you can use either ▲ or ▼ to move between coefficients and make additional changes if needed.

Remember! Complex numbers can't be put in as coefficients.



Calculation solution will appear as soon as the final coefficient has been provided. If the indicator is present, to view all the solutions, use ▲ or ▼. To return to the input screen, press AC key.

Some coefficients can cause the calculation to take more time.

Example 1: Solving $ax^3-bx^2-cx+2=0$ ($a=-1$, $b=-2$, $c=1$)

(Degree?) 3
(a?) (−) 1 =
(b?) (−) 2 =
(c?) 1 =
(d?) 2 =
($x1=1$) ▼
($x2=-2$) ▼
($x3=-1$)

In case of complex number showing up as a result of the equation, the real part of the first solution will appear first and "R↔I" indicator will be shown. Press [SHIFT] [Re↔Im] to toggle the display between real and imaginary parts of the solution.

Example 2: Solving equation with imaginary parts as part of the solution.

$4x^2 + 2x + 7 = 0$ (x=0.25 ± 1.2990038106*i*)

Degree?:	2
a?:	4 =
b?:	(−) 2 =
c?:	7 =

(x1 =0.25 + 1.299038106*i*)
(x2=0.25 - 1.299038106*i*)

■ Simultaneous equations

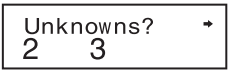
Simultaneous Linear Equations with Two Unknowns:

$a_1x + b_1y = c_1$
$a_2x + b_2y = c_2$

Simultaneous Linear Equations with Three Unkno ns:

$a_1x + b_1y + c_1z = d_1$
$a_2x + b_2y + c_2z = d_2$
$a_3x + b_3y + c_3z = d_3$

When you enter the EQN mode, you will be asked to specify the number of unknown.



Example 2: Solving simultaneous equations

$$2x + y + z = 20$$
$$2x - 2y + 4z = 26$$
$$4x - 2y + 3z = 30$$

(x=5, y=4, z=6)

Unknowns?:	3
a1? — d1?:	2 = 1 = 1 = 20
a2? — d2?:	2 = (↔) 2 = 4 = 26
a3? — d3?:	4 = (↔) 2 = 3 = 30
x=5	▼
y=4	▼
z=6	

Statistical calculations SD REG

■ Standard deviation calculation (SD)

Press MODE twice and then press 1 to enter the SD mode. Make sure your statistical memory is cleared by pressing SHIFT CLR 1 (Scl) = before any further calculations.

Input data using <x-data> DT

It is used to calculate values for n, Σx, Σx^2, $\bar{x}$, σn and σn-1, which you can recall using the key combinations from the table below.

Value type	Key combination
Σx^2	SHIFT S-SUM 1
Σx	SHIFT S-SUM 2
n	SHIFT S-SUM 3
$\bar{x}$	SHIFT S-VAR 1
σn	SHIFT S-VAR 2
σn-1	SHIFT S-VAR 3

Example: Calculating $\sigma n-1$, σn, $\bar{x}$, n, Σx, and Σx^2 for the following data: 24, 23, 21, 24, 23, 21, 20, 26

First, input the data: 24 DT 23 DT 21 DT 24 DT 23 DT 21 DT 20 DT 26 DT

Number of data (n) = 8	SHIFT S-SUM 3 =
Sum of values (Σx) = 182	SHIFT S-SUM 2 =
Sum of Squares of Values(Σx^2): 4168	SHIFT S-SUM 1 =
Arithmetic Mean($\bar{x}$): 22.75	SHIFT S-VAR 1 =
Population Standard Deviation (σ_n): 1.854049622	SHIFT S-VAR 2 =
Sample Standard Deviation(σ_{n-1}): 1.982062418	SHIFT S-VAR 3 =

Data input precautions

To save time, you can press DT twice if you want to input the same data again. It can help to streamline your work with larger data (more entries). Furthermore, to put data a number of times at once, for example putting 12 for 27 times, press 27 SHIFT ; 12 DT. Also works in any order possible.

Use ▲ or ▼ to scroll through your data. If you used the combination above to put in multiple entries at once, their frequency (Freq) will also be shown. To edit the data, simply put in the new value and confirm with =. If you press DT instead, the value will be registered as new data. You can also delete data by pressing SHIFT CL. Deleting causes all the data to shift up.

Remember that all the data from the input you provide is stored in calculator memory. If the message "Data Full" shows up, you won't be able to put any new input as you reached the capacity of the calculator. If this happens, press =.

On the screen above, press 1 to register your new input without saving it into memory. You won't be allowed to display or edit it. Press 2 to exit data input without registering any new data. Press SHIFT CL to delete data you just put in.

Displaying or editing individual data inputs will be unavailable if you change to another mode or change regression type.

■ Regression calculation (REG)

For this type of calculation, you will need to enter REG mode. To do this, press [MODE] twice and [2] after that

On this screen, you can pick 1 out of 6 regression types, by pressing buttons 1-3. To see the hidden three, press ([1], [2], or [3]) depending on what is shown by the indicator.

Types of regressions:

[1] (Lin)	Linear regression
[2] (Log)	Logarithmic regression
[3] (Exp)	Exponential regression
[▶] [1] (Pwr)	Power regression
[▶] [2] (Inv)	Inverse regression
[▶] [3] (Quad)	Quadratic regression

As was previously mentioned, ALWAYS start data input with [SHIFT] [CLR] [1] (Scl) [=] to clear statistical memory. This will ensure good results of the calculation. Input data by using sequence: <x-data> [,] <y-data> [DT]

The values produced by a regression calculation depend on your values input. Results can also be recalled using the key operation shown below.

To recall this type of value:	Perform this key operation:
Σx^2	SHIFT S-SUM 1
Σx	SHIFT S-SUM 2
n	SHIFT S-SUM 3
Σy^2	SHIFT S-SUM ▶ 1
Σy	SHIFT S-SUM ▶ 2
Σxy	SHIFT S-SUM ▶ 3
$\bar{x}$	SHIFT S-VAR 1
$x\sigma_n$	SHIFT S-VAR 2
$x\sigma_{n-1}$	SHIFT S-VAR 3
$\bar{y}$	SHIFT S-VAR ▶ 1
$y\sigma_n$	SHIFT S-VAR ▶ 2
$y\sigma_{n-1}$	SHIFT S-VAR ▶ 3
Regression coefficient A	SHIFT S-VAR ▶ ▶ 1
Regression coefficient B	SHIFT S-VAR ▶ ▶ 2
Regression calculation other than quadratic regression	
Correlation coefficient r	SHIFT S-VAR ▶ ▶ 3
$\hat{x}$	SHIFT S-VAR ▶ ▶ ▶ 1
$\hat{y}$	SHIFT S-VAR ▶ ▶ ▶ 2

And to recall results in the case of a quadratic regression, look at the table below. They can be used inside of expressions the same way as variables.

To recall this type of value:	Perform this key operation:
Σx^3	SHIFT S-SUM ▶ ▶ 1
Σx^2y	SHIFT S-SUM ▶ ▶ 2
Σx^4	SHIFT S-SUM ▶ ▶ 3
Regression coefficient C	SHIFT S-VAR ▶ ▶ 3
$\hat{x}_1$	SHIFT S-VAR ▶ ▶ ▶ 1
$\hat{x}_2$	SHIFT S-VAR ▶ ▶ ▶ 2
$\hat{y}$	SHIFT S-VAR ▶ ▶ ▶ 3

Linear regression

The formula is as follows: $y = A + Bx$.

Example: Determining the regression formula and data correlations to find out atmospheric pressure at 18 °C and the temperature at 1000 hPa. Then, calculate the

coefficient of determination (r^2) and sample covariance $\left(\frac{\Sigma xy - n \cdot \bar{x} \cdot \bar{y}}{n-1}\right)$.

Temperature	Atmospheric Pressure
10°C	1003 hPa
15°C	1005 hPa
20°C	1010 hPa
25°C	1011 hPa
30°C	1014 hPa

First, turn on the REG mode and clear the data as suggested. Then put in the data (what we know).

SHIFT CLR 1 (Scl) = (Stat clear)

10 , 1003 DT

15 , 1005 DT

20 , 1010 DT 25 , 1011 DT

30 , 1014 DT

Regression coefficient A = 997.4	SHIFT S-VAR ▶ ▶ 1 =
Regression coefficient B = 0.56	SHIFT S-VAR ▶ ▶ 2 =
Correlation Coefficient r = 0.982607368	SHIFT S-VAR ▶ ▶ 3 =
Atmospheric Pressure at 18 °C = 1007.48	18 SHIFT S-VAR ▶ ▶ ▶ 2 =
Temperature at 1000 hPa = 4.642857143	1000 SHIFT S-VAR ▶ ▶ ▶ 1 =
Coefficient of Determination = 0.965517241	SHIFT S-VAR ▶ ▶ 3 x^2 =
Sample Covariance = 35	(SHIFT S-SUM ▶ 3 − SHIFT S-SUM 3 × SHIFT S-VAR 1 × SHIFT S-VAR ▶ 1) ÷ (SHIFT S-SUM 3 − 1) =

Logarithmic, Exponential, Power, and Inverse Regression

These types of regression use t e same key operations as linear one to recall results. Their formulas are as follows:

Logarithmic Regression	$y = A + B \cdot \ln x$
Exponential Regression	$y = A \cdot e^{B \cdot x}$ $(\ln y = \ln A + Bx)$
Power Regression	$y = A \cdot x^{B}$ $(\ln y = \ln A + B \ln x)$
Inverse Regression	$y = A + B \cdot 1/x$

■ Quadratic Regression

The regression formula for quadratic regression is:

x_i	y_i
20	1.1
32	14.4
45	18.7
102	23.2
119	58.4

$y = A + Bx + Cx^2$.

Example: Perform the regression to determine terms for the data listed below and determine values of $\hat{y}$ for $x_i = 12.3$ and x for $y_i = 42$

To do that, enter REG mode (▶ 3 (Quad and clear the data (SHIFT CLR 1 (Scl) =) Then do as follows:

Data inputs	20 , 1.1 DT 32 , 14.4 DT 45 , 18.7 DT 102 , 23.2 DT 119 , 58.4 DT
Regression Coefficient A =10.41975616	SHIFT S-VAR ▶ ▶ 1 =
Regression Coefficient B = - 0.167849643	SHIFT S-VAR ▶ ▶ 2 =
Regression Coefficient C = 4.1792463 ×10^{-3}	SHIFT S-VAR ▶ ▶ 3 =
$\hat{y}$ when x_i is 12.3 =8.987483717	12.3 SHIFT S-VAR ▶ ▶ ▶ 3 =
$\hat{x}_1$ when y_i is 42 = 109.2985058	42 SHIFT S-VAR ▶ ▶ ▶ 1 =

■ Data Input Precautions

You can put the same data twice by pressing DT twice. You can also input multiple entries by pressing SHIFT ; to input how many times it should occur . For example: 20 , 30 SHIFT ; 5 DT will put 20 and 30 data five times . You can do this in any order. Standard deviation precautions also apply.

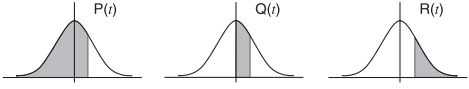
Normal distribution (SD Mode)

To use normal distribution calculations, you need to enter SD Mode. To do that, press [MODE] key twice and pick [1]. In both SD Mode and REG Mode, [M+] key operates as [DT].

Pressing [SHIFT] [DISTR] to display the screen below.
Putting in a value from [1] to [4] will result in selecting the probability distribution calculation you want to perform.

P(	Q(	R(	→t
1	2	3	4

Example: Determine the normalized variate (→t) for x = 43 and normal probability distribution P(t) for the following data: 40, 41, 41, 42, 44, 43, 43, 45



Data input	40 [DT] 41 [DT] [DT] 42 [DT] 44 [DT] 43 [DT] [DT] 45 [DT]
→t = 0.396525792	43 [SHIFT] [DISTR] [4] (→t) [=]
P(t) = 0.39358	[SHIFT] [DISTR] [1] (P() [(−)] 0.27 [)] [=]

Integration calculations COMP

Use this function to obtain the definite integral of a function. To calculate using integration calculation, press [MODE] key and [1] to enter COMP Mode. Remember to set Rad (Radian) units if you are going to perform trigonometric function integration calculations.

For a successful integration calculation, you will need four inputs:

- a function with the variable x,

- a and b to define the integration range of the definite integral,
- n, the number of partitions (equivalent to N = 2^n) for integration that uses Simpson's rule.

You can specify the number of partitions (integer, 1 to 9) or you can skip this input entirely.

$\int dx$ expression , a , b , n)

Example: $\int_1^5 (2x^2 + 3x + 8)\,dx$ = ***150.6666667***

(number of partitions n = 6)

$\int dx$ 2 ALPHA X x^2 + 3 ALPHA X +

8 , 1 , 5 , 6) =

Display contents are cleared while an integration calculation is being performed internally. It is good to have that in mind, as internal integration calculations may take a considerably more time.

Differential calculations COMP

Use it to obtain the derivative of a function. Usable only in COMP mode (MODE , 1). Remember to set Rad (Radian) units if you are going to perform trigonometric function differential calculations.

Differential calculations require three inputs to work properly:

- a function of variable x,
- the point (a) at which the differential coefficient is calculated,
- the change in x (Δx).

SHIFT d/dx expression , a , Δx)

Input of Δx isn't necessary. Appropriate value will be substituted automatically by the calculator.

Discontinuous points and extremes in x changes might result in errors and accuracy. Proceed with caution.

Example: Determining the derivative at $x=2$ for $y = 2x^2 - 6x + 12$ when the increase or decrease in x is $\Delta x = 7 \times 10^{-4}$. The result is 2.

SHIFT d/dx 2 ALPHA X x^2 − 6 ALPHA X + 12 , 2 ,

7 EXP (−) 4) =

Matrix calculations MAT

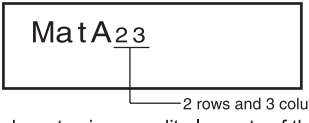
With this function you can create three by three matrices (3 columns, 3 rows) and execute calculations including adding, subtracting, multiplying, transposing and inverting matrices.

To start, enter MAT mode by pressing MODE button three times and following with a 2.

Before you start performing matrix calculations, you need to create one. It is possible to have three matrices simultaneously, named A, B and C. They are stored in the memory. Results of your calculations will be stored in MatAns memory for further calculations. Matrix calculations can use up to two levels of the stack. Squaring, cubing or inverting takes one level. See "Stacks" to learn more.

■ Creating and editing a matrix

To create a matrix, press SHIFT MAT 1 (Dim) and specify its name (A, B or C). Next, you need to specify its dimensions (rows and columns). Follow instructions on the display.



Use the cursor keys to view or edit elements of the matrix. To exit, press AC.

To go back to editing a matrix again, press SHIFT MAT 2 (Edit) and pick the correct name. Editing display will be shown.

■ Matrix addition, subtraction, and multiplication

You can add, subtract and multiply matrices. To learn how to do that, check the example below.

An error occurs if you try to add or subtract matrices whose dimensions vary, or multiply a matrix whose number of columns is different from that of the matrix by which you are multiplying it.

Example: $\begin{bmatrix} 1 & 3 \\ 6 & 0 \\ -3 & 7 \end{bmatrix}$ multiplied by $\begin{bmatrix} -2 & -3 & 4 \\ 1 & 0 & 5 \end{bmatrix}$

$$= \left(\begin{bmatrix} 1 & -3 & 19 \\ -12 & -18 & 24 \\ 13 & 9 & 23 \end{bmatrix} \right)$$

Matrix A (3x2)	SHIFT MAT 1(Dim) 1(A) 3 = 2 =
Element input	1 = 3 = 6 = 0 = (−) 3 = 7 = AC
Matrix B (2x3)	SHIFT MAT 1(Dim) 2(B) 2 = 3 =
Element input	(−) 2 = (−) 3 = 4 = 1 = 0 = 5 = AC
MatA × MatB	SHIFT MAT 3(Mat) 1(A) × SHIFT MAT 3(Mat) 2(B) =

■ Scalar product of a matrix

How to obtain the fixed multiple of a matrix.

Example: Multiplying Matrix C $= \begin{bmatrix} 4 & -1 \\ 3 & 2 \end{bmatrix}$ by $2 = \begin{bmatrix} 8 & -2 \\ 6 & 4 \end{bmatrix}$

Matrix C (2x2)	SHIFT MAT 1 (Dim) 3(C) 2 = 2 =
Element input	4 = (−) 1 = 3 = 2 = AC
2 × MatC	2 × SHIFT MAT 3(Mat) 3(C) =

■ Determinant of a matrix

How to obtain the determinant of a matrix. If a non-square matrix is specified, error will occur as a result.

Matrix A $= \begin{bmatrix} -20 & 31 & 29 \\ 6 & 15 & 35 \\ -26 & -15 & -28 \end{bmatrix}$ Result: det(C) = −16402

Matrix A (3x3)	SHIFT MAT 1(Dim) 1(A) 3 = 3 =
Element input	(−) 20 = 31 = 29 = 6 = 15 = 35 = (−) 26 = (−) 15 = (−) 28 = AC
Det MatA	SHIFT MAT ▶ 1(Det) SHIFT MAT 3(Mat) 1(A) =

■ Transposing a matrix

Follow this procedure to transpose a matrix.

Example: To transpose Matrix B =

$$\begin{bmatrix} 1 & 6 & -3 \\ 3 & 0 & 7 \end{bmatrix}$$ Result: $$\left(\begin{bmatrix} 1 & 3 \\ 6 & 0 \\ -3 & 7 \end{bmatrix}\right)$$

Matrix B (3x2)	SHIFT MAT 1(Dim) 2(B) 3 = 2 =
Element input	1 = 6 = (−) 3 = 3 = 0 = 7 = AC
(TrnMatB)	SHIFT MAT ▶ 2(Trn) SHIFT MAT 3(Mat) 2(B) =

■ Inverting a matrix

How to invert a square matrix. If there's no inverse for the value on the matrix or the matrix isn't square, you will encounter an error.

Example: Inverting Matrix C =

$$\begin{bmatrix} -20 & 31 & 29 \\ 6 & 15 & 35 \\ -26 & -15 & -28 \end{bmatrix}$$ Result: $$\left(\begin{bmatrix} -0.062 & 0.066 & 0.031 \\ 0.046 & 0.055 & -0.031 \\ -0.089 & -0.050 & -0.055 \end{bmatrix}\right)$$

Matrix C (3x3)	SHIFT MAT 1(Dim) 3(C) 3 = 3 =
Element input	(−) 20 = 31 = 29 = 6 = 15 = 35 = (−) 26 = (−) 15 = (−) 28 = AC
(MatC^{-1})	SHIFT MAT 3(Mat) 3(C) x^{-1} =

■ Absolute value of a matrix

You can use the procedure described below to determine the absolute value of a matrix. Below, you can see the absolute value of a previous example's MatC^{-1}.

$$\left(\begin{bmatrix} 0.062 & 0.066 & 0.031 \\ 0.046 & 0.055 & 0.031 \\ 0.089 & 0.050 & 0.055 \end{bmatrix}\right)$$

(AbsMatAns) SHIFT Abs SHIFT MAT 3(Mat) 4(Ans) =

Vector calculations VCT

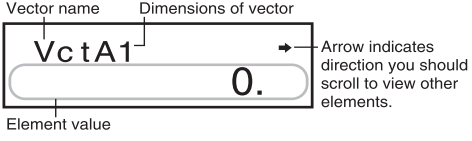
Here you will find information on how to create a vector with a dimension up to three, and how to execute available

calculations. You will learn how to add, subtract, and multiply vectors, and how to obtain the scalar product, inner product, outer product, and absolute value of a vector.

You can have up to three vectors, named A, B and C, which are held in the calculator memory. At least one vector is required to proceed with calculations. They are usable only in VCT mode. To enter VCT mode, press MODE key three times, and then press 3.

■ Creating and editing vectors

To create a vector, press SHIFT VCT 1 (Dim), specify its name (A, B or C) and its dimensions, then follow instructions and settings on the display and input values that make the vector.



You can use ◀ or ▶ to move about the vector to view or edit its components. Press AC at any time to exit the vector editing screen. If you want to go back and edit a vector, press SHIFT VCT 2 (Edit) and specify its name.

■ Adding and subtracting vectors

How to add and subtract vectors of the same dimensions.

If used for vectors of different dimensions, error will occur.

Example: Adding Vector A = (2, -3,-5) to Vector B = (5, 6, -7), Result: (7, 3, −12)

Creating 3-dimensional Vector A	SHIFT VCT 1 (Dim) 1 (A) 3 =
Element input for A	2 = (−) 3 = (−) 5 = AC
Creating 3-dimensional Vector B	SHIFT VCT 1 (Dim) 2 (B) 3 =
Element input for B	5 = 6 = (−) 7 = AC
(VctA + VctB)	SHIFT VCT 3 (Vct) 1 (A) + SHIFT VCT 3 (Vct) 2 (B) =

■ Scalar product of a vector

Use the calculation shown below to obtain the scalar product (fixed multiple) of a vector.

Example: Multiplying Vector C = (2.2, 19) by 7, Result: (15.4, 133)

Creating 2-dimensional Vector C	SHIFT VCT 1(Dim) 3(C) 2 =
Element input for C	2 • 2 = 19 = AC
(7 × VctC)	7 × SHIFT VCT 3(Vct) 3(C) =

■ Inner product of two vectors

How to obtain (•) the inner product of two vectors.

Example: Calculation of inner product (•) of Vectors A and B (Result = 27).

(VctA • VctB)	SHIFT VCT 3(Vct) 1(A) SHIFT VCT ▶ 1(Dot) SHIFT VCT 3(Vct) 2(B) =

■ Outer product of two vectors

How to obtain the outer product of two vectors. An error occurs in the above procedure if you specify vectors of different dimensions.

Example: Outer product of Vectors B (5, 6, -7) and Vector C (1, -2, 3). Result: (4, -22, -16)

(VctB × VctC)	SHIFT VCT 3(Vct) 2(B) × SHIFT VCT 3(Vct) 3(C) =

■ Absolute value of a vector

Use the calculation shown below to obtain the absolute value of a vector (its size).

Example 1: Determining the absolute value of Vector A. Result: 6.164414003.

(AbsVctA)	SHIFT Abs SHIFT VCT 3(Vct) 1(A) =

Example 2: Calculating the size of the angle (angle unit: Deg) formed by vectors A = (–1, 0, 1) and B = (1, 2, 0), and the size 1 vector perpendicular to both A and B.

$\cos\theta = \frac{(A \cdot B)}{|A||B|}$, which becomes $\theta = \cos^{-1}\frac{(A \cdot B)}{|A||B|}$

Size 1 vector perpendicular to both A and B = $\frac{A \times B}{|A \times B|}$

3-dimensional Vector A	SHIFT VCT 1(Dim) 1(A) 3 =
Element input for A	(−) 1 = 0 = 1 = AC
3-dimensional Vector B	SHIFT VCT 1(Dim) 2(B) 3 =
Element input for B	1 = 2 = 0 = AC
(VctA · VctB)	SHIFT VCT 3(Vct) 1(A) SHIFT VCT ▶ 1(Dot) SHIFT VCT 3(Vct) 2(B) =
(Ans÷(AbsVctA × AbsVctB))	÷ (SHIFT Abs SHIFT VCT 3(Vct) 1(A) × SHIFT Abs SHIFT VCT 3 (Vct) 2(B)) =
($\cos^{-1}$Ans) Result: 108.4349488°)	SHIFT $\cos^{-1}$ Ans =
(VctA × VctB)	SHIFT VCT 3(Vct) 1(A) × SHIFT VCT 3(Vct) 2(B) =
(AbsVctAns)	SHIFT Abs SHIFT VCT 3(Vct) 4 (Ans) =
(VctAns÷Ans) Result: (−0.666666666, 0.333333333, −0.666666666)	SHIFT VCT 3(Vct) 4(Ans) ÷ Ans =

Metric conversions COMP

You can pick out of 20 different conversion pairs built in the calculator for quick and easy conversion. When converting a negative value, remember to put it within parentheses. To perform metric conversions, switch to COMP mode by pressing MODE key and 1.

Example: Converting -10 degrees Celsius to Fahrenheit.

((−) 10) SHIFT CONV 38 =

(−32) °C→°F
−25.6

■ **Conversion pair table**

Based on NIST Special Publication 811 (1995).

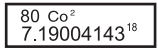
Conversion type:	Pair number:	Conversion type:	Pair number:
in → cm	01	oz → g	21
cm → in	02	g → oz	22
ft → m	03	lb → kg	23
m → ft	04	kg → lb	24
yd → m	05	atm → Pa	25
m → yd	06	Pa → atm	26
mile → km	07	mmHg → Pa	27
km → mile	08	Pa → mmHg	28
n mile → m	09	hp → kW	29
m → n mile	10	kW → hp	30
acre → m^2	11	kgf/cm^2 → Pa	31
m^2 → acre	12	Pa → kgf/cm^2	32
gal (US) → r	13	kgf•m → J	33
r → gal (US)	14	J → kgf•m	34
gal (UK) → r	15	lbf/in^2 → kPa	35
r → gal (UK)	16	kPa → lbf/in^2	36
pc → km	17	°F → °C	37
km → pc	18	C → °F	38
km/h → m/s	19	J → cal	39
m/s → km/h	20	cal → J	40

Scientific constants COMP

A total of 40 commonly-used scientific constants, such as the speed of light in a vacuum and Planck's constant, are built-in for quick and easy lookup whenever you need them. To use them, switch to COMP mode (MODE and 1). Check the scientific constant table for a complete list of available constants. To bring any of them onto your display, simply input the number that corresponds to a constant.

Example: Calculating total energy a person weighing 80 kg has ($E = mc^2$).
Result: $7.19004143 \times 10^{18}$ Joules

80 CONST 28 x^2 =



28 is the “speed of light in vacuum” constant number.

■ Scientific constant table

The below data are based on ISO Standard (1992) data and CODATA recommended values (1998).

Constant:	Constant number:
proton mass (mp)	01
neutron mass (mn)	02
electron mass (me)	03
muon mass (mμ)	04
Bohr radius (a_0)	05
Planck constant (h)	06
nuclear magneton (μN)	07
Bohr magneton (μB)	08
Planck constant, rationalized ($\hbar$)	09
fine-structure constant (α)	10
classical electron radius (re)	11
Compton wavelength (λc)	12
proton gyromagnetic ratio (γp)	13
proton Compton wavelength (λcp)	14
neutron Compton wavelength (λcn)	15
Rydberg constant (R_∞)	16
atomic mass unit (u)	17
proton magnetic moment (μp)	18
electron magnetic moment (μe)	19
neutron magnetic moment (μn)	20
muon magnetic moment ($\mu\mu$)	21
Faraday constant (F)	22
elementary charge (e)	23
Avogadro constant (NA)	24
Boltzmann constant (k)	25

Constant:	Constant number:
molar volume of ideal gas (Vm)	26
molar gas constant (R)	27
speed of light in vacuum (C_0)	28
first radiation constant (C_1)	29
second radiation constant (C_2)	30
Stefan-Boltzmann constant (σ)	31
electric constant (ε_0)	32
magnetic constant (μ_0)	33
magnetic flux quantum (ϕ_0)	34
standard acceleration of gravity (g)	35
conductance quantum (G_0)	36
characteristic impedance of vacuum (Z_0)	37
Celsius temperature (t)	38
Newtonian constant of gravitation (G)	39
standard atmosphere (atm)	40

Additional examples

Example 1: changing 245 × 789 as 24 × 790

245 [×] 789 [=]	245 × 789 = 193305.
[▶] [▶] [▶] [DEL]	24 × 789 = 193305.
[▶] [▶] 90	24 × 790 = 193305.
[=]	24 × 790 = 18960 .

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

1 [+] 2 [=] 3 [+] 4 [=] 5 [+] 6 [=]	5 + 6 = 11.
[▲]	5 + 6
[▲]	3 + 4
[▲]	1 + 2

Example 3: 11÷0×3.2 mistakenly input instead of 11 ÷ 10 × 3.2

11 [÷] 0 [×] 3.2 [=]	Math ERROR
[◀]	11 ÷ 0 × 3.2
[◀] [SHIFT] [INS] 1 [=]	11 ÷ 10 × 3.2 = 3.52

Example 4: Storing a sum of calculations.

3 × 5 SHIFT STO M+	M = 15.
49 ÷ 7 M+	49 ÷ 7 = 7.
RCL M+	M = 22.
66 - 8 × 7 SHIFT M-	66 - 8 × 7 = 10.
RCL M+	M = 12.
0 SHIFT STO M+	M = 0

Example 5: Storing and using value in variables

15 SHIFT STO A	A = 15.
5 × ALPHA A =	5 × A = 75.
SHIFT STO B	B = 75.
RCL A	A = 15.
SHIFT CLR 1 (Mcl) =	Mem clear 0.

Example 6: $(2 + 3) \times 10^{-2} = 0.05$

(2 + 3) × 1 EXP (-) 2 =	(2 + 3) × 1 E–2 = 0.05

Example 7: $3 + 5 \times (2 + 11) = 68$

3 + 5 × (2 + 11 =	3 + 5 × (2 + 11 = 68.

Example 8: $3 \times \{8 + 4 \times (2 + 6) \} = 120$

3 × (8 + 4 × (2 + 6 =	3 × (8 + 4 × (2 + 6 = 120.

Example 9: 360 × 30% = 108

360 × 30 SHIFT %	360 × 30 % = 108.

Example 10: 72 ÷ 45% = 160

72 ÷ 45 SHIFT %	72 ÷ 45 %160.

Example 11: Specifying number of decimal places

6 ÷ 7 =	6 ÷ 7 = 0.857142857
MODE MODE MODE MODE MODE 1 (Fix)	Fix 0 ~ 9 ?
2 (Specifies 2 decimal places.)	6 ÷ 7 = 0.86
MODE MODE MODE MODE MODE 2 (Sci)	Sci 0 ~ 9 ?
4	6 ÷ 7 MAT D SCI $8.571_{\times 10}^{-01}$

* Press [MODE]..... 1(Norm) 1 to clear the Sci specification.

Example 12: Engineering Notation Calculations (110 m = 110000 cm = 0.11 km)

110 = ENG ENG	110 $110000_{\times 10}$
SHIFT ← ENG SHIFT ← ENG	110 $0.11_{\times 10}$

Example 13: RND (1 ÷ 7) × 3 = 0.429

1 ÷ 7 =	1 ÷ 7 0.142857142
MODE MODE MODE MODE MODE 1	Fix 0 ~ 9 ?
3	1 ÷ 7 0.143
SHIFT RND	1 ÷ 7 0.143
× 3 =	Ans × 3 0.429

*Press [MODE]..... 3(Norm) 1 to clear the Fix specification.

Example 14: 5 × 5 × 5 × 5 = 625

5 × 5 =	5 × 5 25.
× 5 =	Ans × 5 125.
=	Ans × 5 625.

Example 15: Calculating ÷4 after 5 x 8 = 10

5 × 8 =	5 × 8 40.
÷4 =	Ans ÷4 10.

Example 16: 123 + 456 = 579 → 789 – 579 = 210

123 + 456 =	123 + 456 579.
789 – Ans =	789 – Ans 210.

Example 17: ln5 + log80 =3.512527899

ln 5 + log 80 =	ln 7 + log 80 3.512527899

Example 18: 10^2 = 100

SHIFT 10^x 2 =	10^2 100.

Example 19: e^8 = 2980.957987

SHIFT e^x 8 =	e 8 2980.957987

Example 20: $5\frac{2}{3}+12\frac{9}{11}=18\frac{16}{33}$

5 [$a^b/_c$] 2 [$a^b/_c$] 3 [$a^b/_c$] + 12 [$a^b/_c$] 9 [$a^b/_c$] 11 =	MAT D SCI 5 ⌟2⌟ 3+ 12⌟ 9⌟ 1→ 18 ⌟16⌟ 33.

Example 21: $4\frac{6}{8} = 4\frac{3}{4} = 4.75 = \frac{19}{4}$

4 [a b/c] 6 [a b/c] 8 [a b/c] =	4⌟6⌟8 4⌟3⌟4
[a b/c]	4⌟3⌟4 4.75
[SHIFT] [d/c]	4⌟3⌟4 19⌟4
[SHIFT] [d/c]	4⌟6⌟9 4⌟3⌟4

Example 22: **Example 22:** $5\frac{3}{4} + 0.75 = 6.5$

5 [a b/c] 3 [a b/c] 4 [a b/c] + 0.75	5⌟3⌟4 + 0.75 6.5

Example 23: 3 π rad. = 540 Deg.

MODE MODE MODE MODE	Deg Rad Grad 1 2 3
1	- 0
3 SHIFT π	3 π 0
SHIFT DRG ▶	D R G 1 2 3
2 =	3 πr 540

Example 24: sin30 Deg. = 0.5

MODE MODE MODE MODE	Deg Rad Grad 1 2 3
1 sin 30 =	sin30 0.5

Example 25: $cos\,(\frac{2\pi}{3}\ rad.) = -0.5$

MODE MODE MODE MODE	Deg Rad Grad 1 2 3
2 cos (2 SHIFT π ÷ 3 =	cos (2π ÷ 3 -0.5

Example 26: $\sin^{-1} 0.5 = 30$ **Deg**

MODE MODE MODE MODE	Deg Rad Grad 1 2 3
1 SHIFT $\sin^{-1}$ 0.5 =	$\sin^{-1}$ 0.5 30

Example 27: cosh3.5 + 2 = 18.57282467

hyp cos 3.5 + 2 =	cosh 3.5 + 2 18.57282467

Example 28: $\sinh^{-1}9 = 2.893443986$

hyp SHIFT $\sin^{-1}$ 9 =	$\sinh^{-1}$ 9 2.893443986

Example 29: 16.788 = 16° 47° 16.8°

16.788 = SHIFT [o,,,]	16.788 16°47°16.8

Example 30: 16° 47' 16.8" = 16.788

16 [o,,,] 47 [o,,,] 16.8 [o,,,] =	16° 47° 16.8° 16° 47° 16.8
[o,,,]	16° 47° 16.8° 16.788

Example 31: Calculating r, θ for x = 7 and y =32

SHIFT Pol (7,32 =	Pol (7,32 32.75667871
RCL F °	F = 77.66091272

Example 32: Calculating x, y for r = 20 and θ =76

SHIFT Rec(20 , 76 =	Rec (20, 76 4.838437912
RCL F	F = 19.40591453

Example 33: $\frac{8!}{3![(8-3)]!} = 56$

8 SHIFT nCr 3 =	8 IC 3 56

Example 34: $\frac{8!}{[(8-3)]!} = 336$

8 SHIFT nPr 3 =	8 IP 3 336

Example 35: 8 != 40320

8 SHIFT x! =	8! 40320

Example 36: Generating a random value between 0.000 ~ 0.999

SHIFT RAN# =	Ran # 0.841

(The above value is a sample only. Results differ each time.)

Example 37: $\frac{1}{125} = 0.8$

1.25 x^{-1} =	1.25^{-1} 0.8

Example 38: $6^2 + 2^3 + \sqrt{40+9} + \sqrt[3]{125} = 56$

6 x^2 + 2 SHIFT x^3 + $\sqrt{\ }$ (40 + 9) + SHIFT $\sqrt[3]{\ }$ 125 =	$6^2 + 2^3 + \sqrt{\ }$ (40 + 9) + $\sqrt[3]{\ }$ 125 56

Example 39: $\sqrt[4]{81} = 3$

4 SHIFT $\sqrt[x]{\ }$ 81 =	4 $\sqrt[x]{\ }$ 81 3

Example 40: $12^5 = 248832$

12 ^ (x^y) 5 =	12 ^ 5 248832

Handling Precautions

- Before using the calculator for the first time, press [ON] key.
- Dead batteries are prone to leaking, causing damage and/or malfunction of the calculator. If you see your display getting dim, check the battery.
- If you run on low battery, you risk memory loss or corruption. Proceed with caution if you are processing complex calculations.
- Don't leave the calculator in areas subjected to temperature extremes. High temperatures and direct sunlight exposure might cause deformation or discoloration of the calculator's case and low temperatures might shorten battery life and display malfunction might occur.
- Avoid using the calculator in areas with high humidity or with high intensity of dust particles. These factors can damage internal circuitry.
- Strong impact (e.g., upon dropping) might result in irreversible damage.
- Never twist or bend the calculator in any way.
- Never try to take the calculator apart.
- Never press the keys of the calculator with a ball-point pen or other pointed object that might damage the keys.

- Exposing the calculator to open flame might cause certain components to suddenly burst, creating the risk of fire and personal injury.

Information for Users on Collection and Disposal of used Batteries.

The symbol in this information sheet means that used batteries should not be mixed with general household waste. For proper treatment, recovery, and recycling of used batteries, please take them to applicable collection points.

For more information about collection and recycling of batteries, please contact your local municipality, your waste disposal service or the point of sale where you purchased the items.

Information on Disposal in other Countries outside the European Union.

This symbol is only valid in the European Union. If you wish to discard used batteries, please contact your local authorities or dealer and ask for the correct method of disposal.

- If you intend to dispose of this product, do not throw it away with normal household waste. According to the EEC Directive (Directive 2002/96/EC) in force in the European Union, separate disposal methods should be applied for used electrical and electronic equipment.
- The solar cell is in the top right part of the calculator, above or below the buttons.
- Importer: Kaso Trade Czarna Rola 28 61-625 Poznań
  Manufacturer: Dongguan K.L.T. & Casine Electronic Technology Co., Ltd.
  ADD: No.37, Hehe Rd, Xiangxi Industrial District, Liaobu Town, Dongguan City, Guangdong Province, China. Printed in PRC.