MILAN®

Engineered in Spain

M 240
scientific
calculator

Disposal of Waste Equipment by Users in Private Household in the European Union

Table of Contents

Before using the calculator

Handling Precautions

- Press the RESET button on the back of the calculator before using it for the first time.
- Even if the calculator is operating normally, replace the battery at least once every three years. Dead battery can leak, causing damage to and malfunction of the calculator. Never leave the dead battery in the calculator.
- Avoid use and storage in areas subject to extreme temperatures. Very low temperatures can cause slow display response, total failure of the display, and shortening of battery life. Also avoid leaving the calculator in direct sunlight, near a window, near a heater or anywhere else it might become exposed to very high temperatures. Heat can cause discoloration or deformation of the calculator's case, and damage to its internal circuitry.

- Avoid use and storage in areas subject to humidity or dust. Never to leave the calculator where it might be splashed by water or exposed to large humidity or dust. These adverse conditions may damage its internal circuitry.
- Avoid any strong impact on the calculator, e.g. prevent it from dropping onto the floor.
- Never twist or bend the calculator. Avoid carrying the calculator in the pocket of your trousers or other tight-fitting clothing where it might be subject to twisting or bending.
- Never try to disassemble the calculator.
- Avoid pressing the keys of the calculator with a ballpoint pen or other pointed object.
- Use a soft, dry cloth to clean the exterior of the unit. If the calculator becomes very dirty, wipe it off with a cloth moistened in a week solution of water and a mild neutral household detergent. Bring out all excess moisture before wiping the calculator. Never use thinner, benzine or other volatile agents to clean the calculator. Doing so may remove printed markings and damage the case.

Removing the Hard Case

The hard case should be removed by sliding it downwards. It can then be affixed to the back of the calculator as shown below.
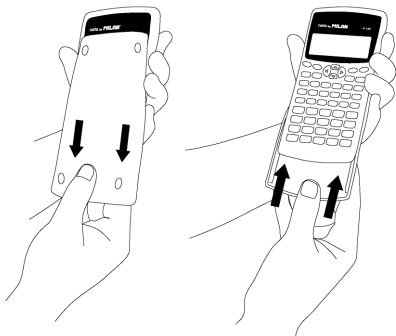
Turning the Calculator On and Off

To turn the calculator on, press ON .
To turn the calculator off, press SHIFT AC (OFF), that is, press and release the SHIFT key, and then press AC (which has OFF printed in orange above it). Since the calculator has *Static Memory*,

turning it off does not affect any information you have stored.

To save energy, the calculator turns itself off after 10 minutes of no use.

Power Supply

- This calculator is powered by two AAA batteries. Always make sure that the positive ($+$) and negative ($-$) terminals of the batteries are facing correctly when you load them into the calculator.
- Low battery power can cause any stored information to become corrupted or completely lost. Always keep written records of all important data.
- Never charge batteries, try to take batteries apart, or allow batteries to become shorted. Do not expose batteries to direct heat or dispose of them by incineration.
- Remove the batteries if you do not plan to use the calculator for a long time

How to replace the battery?

1. Press [SHIFT] [AC] ([OFF]) to switch the calculator off.
2. Remove the screw that holds the battery cover in place and then remove the battery cover.
3. Remove the old batteries.
4. Wipe off the sides of the new batteries with a dry, soft cloth.
5. Load them into the calculator.
6. Put the battery cover back in place and secure it in place with the screw.
7. Press [ON] to turn power on.

About the Keyboard

Each key may have up to three functions: one printed on its face, a shifted function (in orange), and an ALPHA function (in blue). Press the appropriate function key ([SHIFT] or [ALPHA]) before pressing the key for the desired function.

For instance, to use the $\sin^{-1}$ function, press and release the [SHIFT] key, then press [sin]. In this manual, this type of operations will be summarized as [SHIFT] [sin] ([sin⁻¹]).

SHIFT function

ALPHA function

sin^{-1} D

sin
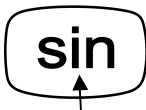
Direct function

Acoustic feedback

Acoustic feedback of the keyboard can be switched on and off by alternatively pressing [SHIFT] (3)([◁ⁱⁱ)]).

About the Display

This calculator has a two-line display. It allows viewing both the calculation formula and its result at the same time.

The first line can simultaneously display 12 characters. However, entries up to 79 characters can be entered for a single calculation. In this case, entries with more than 12 characters will scroll to the left. When an entry reaches the 73rd character, the cursor will change from " _ " to " ■ " to let you know that only 7 more characters can be entered.

$$\sin(\pi \div 4)^\wedge 20$$
$$7.976\ 144\ 666 \times 10^{-03}$$
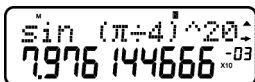
For numbers bigger or equal than 1,000 a separator symbol facilitates reading the result by placing the separator "," among every set of three digits.

Cursor keys

The cursor keys allow you to move around on the screen.
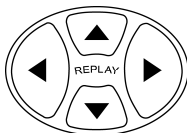
Display Annunciators

The display may show different indicators, which illustrate the current state of the calculator.

Annunciator	Description
S	The [SHIFT] key is active. At the moment you press a key the keypad will unshift, and the S

	annunciator will disappear.
Ⓐ	The (ALPHA) key is active. At the moment you press a key the alpha mode will be exited, and the **Ⓐ** annunciator will disappear.
M	The independent memory is storing a value.
STO	The calculator is waiting for the user to input a variable name. Then a value will be assigned to this variable. This annunciator appears after keying in (SHIFT) (RCL)((STO)).
RCL	The calculator is waiting for the user to input a variable name to recall the variable's value. This annunciator appears after pressing (RCL).
SD	The calculator is in the "statistical" mode.
Ⓓ	The default angle unit is set to degrees.
Ⓡ	The default angle unit is set to radians.
Ⓖ	The default angle unit is set to grads.
FIX	A fixed number of decimal places has been set.
SCI	A fixed number of significant

	digits has been set.
▲ or ▼	Calculation history memory data is available. This allows browsing over previous formulas and replay them.
Disp	The display is showing an intermediate result in a multi-statement calculation.

Calculator Setup

Calculator Modes

It is important to enter the correct mode before start a calculation. The table below details the available modes.

Type of calculation	Key operations to switch to the correct mode	Selected mode
Basic arithmetic calculations	$\boxed{\text{MODE}}\ \boxed{1}$	COMP
Statistical calculations	$\boxed{\text{MODE}}\ \boxed{2}$	SD

| Regression calculations | $\boxed{\text{MODE}}$ $\boxed{3}$ | REG |

Pressing the $\boxed{\text{MODE}}$ key more than once sequentially displays additional setup screens.

In all the sections below, the main title of each section is preceded by the required mode to perform the described calculations.

Important note!
If you want to restore the initial default calculator mode, press $\boxed{\text{SHIFT}}$ $\boxed{\text{CLR}}$ $\boxed{2}$ **(** $\boxed{\text{MODE}}$ **)** $\boxed{=}$ **.**

Item	Default value
Calculation Mode	COMP
Angle units	Deg
Exponential Display Format	Norm 1
Fraction Display Format	$a\frac{b}{c}$
Decimal Point Character	Dot

Making Corrections during Input

One of the first things you need to know is how to correct numbers and delete or insert characters.

Key	Description
$\boxed{\blacktriangleleft}$ and $\boxed{\blacktriangleright}$	Move the cursor to the desired location

(DEL)	Erase the character immediately to the left of "_". If the cursor is placed at on top of a character, it deletes the number or function at the current cursor position.
(SHIFT)(DEL) ((INS))	The first time it is pressed, it changes to an insert cursor ⌐. Inputting something when the insert cursor is on the display insert the input at the insert cursor position. Pressing (SHIFT)(DEL)((INS)) or (=) when the insert cursor is "on" returns the cursor to its default behavior.

Replay a Calculation

When you press (=) a calculation is performed, and the calculation formula is stored in the replay memory. You may know that there is something in the replay memory because the ▲ annunciator appears in the LCD. When you key in (▲), the previous formula and result is displayed. Pressing (▲) again back steps sequentially from the newest to the oldest calculations.

If you are viewing a replay memory calculation, pressing (◄) or (►) makes the display change into editing mode. On the other hand, if you press

the $\boxed{\blacktriangleleft}$ or $\boxed{\blacktriangleright}$ key immediately after you finish a calculation, the editing screen for that calculation is displayed.

Multi-statements

A multi-statement is an expression that is made up of two or more smaller expressions, which are joined using a colon (:).

Example: Multiply 3×3 and then use the result as exponent of 2^{Ans}.

3 $\boxed{\times}$ 3 $\boxed{\text{SHIFT}}$ $\boxed{x^2}$ $\boxed{(\ :\ )}$ 2 $\boxed{x^y}$ $\boxed{\text{Ans}}$ $\boxed{=}$

The following screen illustrates this example:

```
┌─────────────────────────┐
│  "               ■      │
│ 3×3:2^Ans               │
│                         │
│                    0.   │
└─────────────────────────┘
```
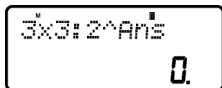
Next, you should press $\boxed{=}$, and the screen changes to:

```
┌─────────────────────────┐
│  "          ■           │
│ 3×3                     │
│                     ▲   │
│                  9. Disp│
└─────────────────────────┘
```
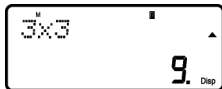
Note that this shows the first statement, and the annunciator **Disp** appears in the screen to indicate that this is just an intermediate result. Pressing $\boxed{=}$ we can view the second statement and the final result:

```
2^Ans
          5 I2.
```
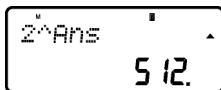
Basic Calculations

In order to perform basic calculations press the $\boxed{\text{MODE}}$ key, and then press $\boxed{1}$ to set the calculator into the *COMP mode*:

COMP ....MODE 1

Arithmetic Calculations

Precedence Order of the Operations

The following order of precedence applies to all calculations:

1. Coordinate transformation: from polar to rectangular or vice versa ($\boxed{\text{P}\rightarrow\text{R}}$ or $\boxed{\text{R}\rightarrow\text{P}}$).
2. Type A functions. These are all functions in which the user first enters a value, and then the function key is pressed. E.g.: $\boxed{x!}$, $\boxed{x^2}$, $\boxed{x^3}$, $\boxed{x^{-1}}$, $\boxed{\circ\,,\,\prime\prime}$, etc. Angle unit conversions ($\boxed{\text{DRG}\blacktriangleright}$).
3. Powers: $\boxed{x^2}$, $\boxed{x^3}$, $\boxed{x^y}$.
4. $\boxed{a\%}$.

5. Abbreviated multiplication format in front of $\boxed{\pi}$, $\boxed{e^x}$, $\boxed{\ln}$, memory name, or variable name: 4π, $2e$, $2A$, πB, etc.

6. Type B functions. With these functions, the user first enters a function key and then the value is entered. E.g.: $\boxed{\ln}$, $\boxed{\log}$, $\boxed{\sqrt{\ }}$, $\boxed{\sqrt[3]{\ }}$, $\boxed{e^x}$, $\boxed{10^x}$, $\boxed{\sin}$, $\boxed{\cos}$, $\boxed{\tan}$, $\boxed{\sin^{-1}}$, $\boxed{\cos^{-1}}$, $\boxed{\tan^{-1}}$, $\boxed{\sinh}$, $\boxed{\cosh}$, $\boxed{\tanh}$, $\boxed{\sinh^{-1}}$, $\boxed{\cosh^{-1}}$, $\boxed{\tanh^{-1}}$, $\boxed{(-)}$.

7. Abbreviated multiplication format in front of Type B functions, e.g. $A\sqrt{2}$, etc.

8. Permutations and combinations: $\boxed{nPr}$, $\boxed{nCr}$.

9. $\boxed{\times}$, $\boxed{\div}$.

10. $\boxed{+}$, $\boxed{-}$.

All operations are performed from left to right. However, if you concatenate operations of the same precedence, they will be carried out from right to left. E.g.:

$$\boxed{\log}\ \boxed{\sin}\ \boxed{\sqrt{\ }}\,\theta \;\rightarrow\; \log\left(\sin\left(\sqrt{\theta}\right)\right)$$

When to use parentheses?
Any operations enclosed in parentheses are performed first.

Example:

$5 \times 3 + 4 = 19$

$5 \times (3 + 4) = 35$

All $\boxed{\ )\ }$ operations before $\boxed{=}$ can be neglected, since the calculator understands that the user aimed to close all pending parentheses before computing the result.

Negative numbers within a calculation must be enclosed within parentheses. The negative sign $(-)$ is treated as a Type B function, so when the calculation includes a high-priority Type A function (or power or root operations), parentheses are required to ensure a correct result.

Example:

$$\left(-2\right)^2 = 4$$

$$-2^2 = -4$$

Remember: **Any negative numbers within an expression should be enclosed within parentheses.**

However, it is not necessary to enclose negative exponents within parentheses. E.g.:

$$4.55 \times 10^{-3} \quad \rightarrow \quad 4.55 \; \boxed{\times} \; \boxed{\text{EXP}} \; \boxed{(-)} \; 3 \; \boxed{=}$$

Percentage Operations

Percentage means "parts per hundred". It can also be expressed as a fraction with a denominator of 100. Thus, a 10 percent solution may be expressed as 10%, 10/100, 0.10, or 10 parts per 100 parts.

Example 1:

To calculate 10% or 1200

$$1200 \; \boxed{\times} \; 10 \; \boxed{\text{SHIFT}} \; \boxed{=} \; (\%)$$

Result: 120

Example 2:

To increase 1200 by 10%

1200 ✖ 10 (SHIFT) = (%) +

Result: 1320

Example 3:

To find out what percentage of 1200 is 120

120 ➗ 1200 (SHIFT) = (%)

Result: 10%

Example 4:

To reduce 1200 by 20%

1200 ✖ 20 (SHIFT) = (%) −

Result: 960

Fraction Calculations

Decimal / Fraction Conversion

This calculator can work directly with fractions. Fractions can be classified according to 3 groups:

- Proper Fractions: The numerator is smaller than the denominator

  E.g. $\frac{1}{3}$, $\frac{3}{7}$, etc.

- Improper Fractions: The numerator is greater than (or equal to) the denominator

  E.g. $\frac{4}{3}$, $\frac{13}{7}$, etc.

- Mixed Fractions: A combination of an integer number and a proper fraction to express the decimal part.

This calculator allows using any of these 3 types of fractions. To input an improper or proper fraction, you should key in the numerator, then press $(a\%)$, and next enter the denominator. The symbol ⌐ is displayed in the screen to separate one number from another (e.g. numerator from denominator).

As stated above, mixed fractions are formed by an integer number and a fraction combined into one "mixed" number. Again, to enter a mixed fraction you should first key in the integer number, then press $(a\%)$, enter the numerator, press $(a\%)$ again, and next enter the denominator.

Operating with Fractions
Example 1: calculations with proper fractions

$$\frac{1}{3} + \frac{2}{5} = \frac{11}{15}$$

1 $(a\%)$ 3 ⊞ 2 $(a\%)$ 5 ⊟
Result: 11 ⌐ 15

This fraction can be converted into a decimal number by pressing $(a\%)$.

Example 2: conversions decimal / fraction

$$\frac{3}{4} = 0.75$$

3 $(a\%)$ 4 ⊟
Result: 3 ⌐ 4
$(a\%)$

Result: 0.75

$\boxed{a\%}$

Result: 3 ⌐4

Example 3: calculations with mixed fractions

$$2\frac{1}{3}+1\frac{1}{2}=3\frac{5}{6}$$

2 $\boxed{a\%}$ 1 $\boxed{a\%}$ 3 $\boxed{+}$ 1 $\boxed{a\%}$ 1 $\boxed{a\%}$ 2 $\boxed{=}$

Result: 3 ⌐5 ⌐6

Example 4: simplifying a fraction

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

2 $\boxed{a\%}$ 4 $\boxed{=}$

Result: 1 ⌐2

Operations involving fractions and decimal values result always in a decimal number.

Example 5: $a\frac{b}{c}$

$$\frac{3}{4}+1.5=2.25$$

3 $\boxed{a\%}$ 4 $\boxed{+}$ 1.5 $\boxed{=}$

Result: 2.25

It should be noted that when the total number of digits of a fractional value (i.e. integer + numerator + denominator + separator marks) exceeds 10 characters, the values are automatically displayed in decimal format.

Improper Fraction / Mixed Fraction Conversion

The same amount can be represented either with an improper fraction or a mixed fraction. This

conversion can be carried out simply pressing $\boxed{a\%}$ and $\boxed{\text{SHIFT}}\boxed{a\%}$.

Example 1:

$$1\frac{3}{4}=\frac{7}{4}$$

1 $\boxed{a\%}$ 3 $\boxed{a\%}$ 4 $\boxed{=}$
Result: 1 ⌐ 3 ⌐ 4

$\boxed{\text{SHIFT}}$ $\boxed{a\%}$ ($\boxed{d/c}$)
Result: 7 ⌐ 4

$\boxed{\text{SHIFT}}$ $\boxed{a\%}$ ($\boxed{d/c}$)
Result: 1 ⌐ 3 ⌐ 4

Sexagesimal calculations

This calculator can carry out sexagesimal calculations using degrees (or hours), minutes, and seconds, converting between sexagesimal and decimal values.

Example 1: convert the decimal value 3.24 to a sexagesimal value and then back to a decimal value.

3.24 $\boxed{=}$
Result: 3.24

$\boxed{\circ\, ,\, ,,}$
Result: 3 ° 14 ° 24

$\boxed{\circ\, ,\, ,,}$
Result: 3.24

We can carry out arithmetic operations that involve sexagesimal numbers.

Example 2:

3º 28' 54" × 2.2 = 7º 39' 34.8"

3 $\boxed{\circ,,,}$ 28 $\boxed{\circ,,,}$ 54 $\boxed{\circ,,,}$ $\boxed{\times}$ 2.2 $\boxed{=}$

Result: 7 ° 39 ° 34.8

FIX, SCI, RND

Some of the settings of the calculator can be changed at any time, depending on the user preferences. Thus, you can adjust the number of decimal positions, the number of significant digits, or the exponential display format. These settings are adjusted by pressing the $\boxed{\text{MODE}}$ key a number of times until you reach the following setup screen:

```
Fix Sci Norm
 1   2   3
```
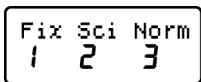
Once in this screen, press number $\boxed{1}$, $\boxed{2}$ or $\boxed{3}$ to adjust the desired setting:

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

Memory Calculations

In order to perform basic calculations press the $\boxed{\text{MODE}}$ key, and then press $\boxed{1}$ to set the calculator into the *COMP mode*:

COMP ....MODE 1

Answer Memory

Every time the calculator computes the result of an expression, the result is automatically stored in the *Answer Memory*.

Therefore, the *Answer Memory* is updated whenever the user presses any of the following keys:

Function	Keys
Carry out current operation	$\boxed{=}$
Add to memory	$\boxed{\text{M+}}$
Subtract from memory	$\boxed{\text{M–}}$
Percentage calculation	$\boxed{\text{SHIFT}}\ \boxed{=}$ (i.e. $\boxed{\%}$)
Store in memory	$\boxed{\text{SHIFT}}\ \boxed{\text{STO}}$ followed by a variable name (A through F, X, Y or M)

You can recall *Answer Memory* contents by pressing ⌈Ans⌋. The contents of Answer Memory do not change if the operation performed by any of the above key operations results in an error.

Answer Memory can store up to 12 digits for the mantissa and 2 digits for the exponent.

Independent Memory

Variable M is used as independent memory. Thus, you can input a value directly into memory with ⌈SHIFT⌋ ⌈RCL⌋(⌈STO⌋), add it to memory pressing ⌈M+⌋, or subtract it from memory with ⌈SHIFT⌋ ⌈M+⌋(⌈M−⌋). Independent memory is convenient for calculating cumulative totals.

To clear independent memory M, press ⌈0⌋ ⌈SHIFT⌋ ⌈RCL⌋(⌈STO⌋) ⌈M+⌋ (M).

Example:

	$15 \times 3 = 45$	15 ⌈×⌋ 3 ⌈SHIFT⌋⌈RCL⌋(⌈STO⌋) ⌈M+⌋
(+)	$48 - 6 = 42$	48 ⌈−⌋ 6 ⌈M+⌋
(−)	$82 + 8 = 90$	82 ⌈+⌋ 8 ⌈SHIFT⌋⌈M+⌋(⌈M−⌋)
	(total) -3	⌈RCL⌋ ⌈M+⌋

Registers

The calculator has nine general purpose registers that can be accessed as program variables (A through F, M, X and Y). These registers can be used to store data, constants, results, etc.

Data stored in a particular register (e.g. A) can be deleted by pressing $\boxed{0}$ $\boxed{\text{SHIFT}}$ $\boxed{\text{RCL}}(\boxed{\text{STO}})$ $\boxed{(-)}$ $(\boxed{A})$.

All the registers can be cleared at once by keying in $\boxed{\text{SHIFT}}$ $\boxed{\text{MODE}}(\boxed{\text{CLR}})$ $\boxed{1}$(Mcl) $\boxed{=}$.

Example:

$24.3 \times 4 = 97.2$

$$\frac{24.3}{5} = 4.86$$

24.3 $\boxed{\text{SHIFT}}$ $\boxed{\text{RCL}}(\boxed{\text{STO}})$ $\boxed{(-)}(\boxed{A})$ $\boxed{\times}$ 4 $\boxed{=}$

Result: 97.2

$\boxed{\text{ALPHA}}$ $\boxed{A}$ $\boxed{\div}$ 5 $\boxed{=}$

Result: 4.86

Scientific Function Calculations

In order to perform scientific function calculations press the $\boxed{\text{MODE}}$ key, and then press $\boxed{1}$ to set the calculator into the *COMP mode*:
COMP ....MODE 1

When using scientific functions, certain types of calculations may require some time to be completed. Before starting the next calculation, wait for the result of the previous formula to appear on the display.
The following constants will be used below:
$\pi \approx 3.14159265...$

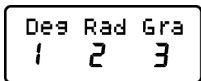$e \approx 2.71828183...$

Trigonometric / Inverse Trigonometric Functions

This calculator can operate with trigonometric functions using either degrees, radians or grads.

$$\left(90° = \frac{\pi}{2} \text{radians} = 100 \text{ grads}\right)$$

You can set the default angle unit (degrees, radians or grads), by pressing the $\boxed{\text{MODE}}$ key twice until you reach the following angle unit setup screen:

```
Deg Rad Gra
 1   2   3
```

Press the number key ($\boxed{1}$, $\boxed{2}$, $\boxed{3}$) that corresponds to the angle units you want to use.

Example 1:
cos(23º 35' 2") = 0.916475268

$\boxed{\text{MODE}}$ $\boxed{\text{MODE}}$ $\boxed{1}$
$\boxed{\cos}$ 23 $\boxed{\circ\,\prime\,\prime\prime}$ 35 $\boxed{\circ\,\prime\,\prime\prime}$ 2 $\boxed{\circ\,\prime\,\prime\prime}$ $\boxed{=}$
Result: 0.916475268

Example 2:
$$\sin^{-1}\left(\frac{\sqrt{2}}{2}\right) = 0.785398163$$

$\boxed{\text{MODE}}$ $\boxed{\text{MODE}}$ $\boxed{2}$
$\boxed{\text{SHIFT}}$ $\boxed{\sin}$ $(\boxed{\sin^{-1}})$ $\boxed{(}$ $\boxed{\sqrt{}}$ 2 $\boxed{\div}$ 2 $\boxed{)}$ $\boxed{=}$
Result: 0.785398163

Example 3:
$$\sin^{-1}\left(\frac{\sqrt{2}}{2}\right) = 0.25\pi(\text{rad})$$

$\boxed{\text{MODE}}$ $\boxed{\text{MODE}}$ $\boxed{2}$
$\boxed{\text{SHIFT}}$ $\boxed{\sin}$ $(\boxed{\sin^{-1}})$ $\boxed{(}$ $\boxed{\sqrt{}}$ 2 $\boxed{\div}$ 2 $\boxed{)}$ $\boxed{=}$
$\boxed{\text{Ans}}$ $\boxed{\div}$ $\boxed{\pi}$ $\boxed{=}$
Result: 0.25

Example 4: $2\pi = 6.283185307$

$$2 \boxed{\pi} \boxed{=}$$
Result: 6.283185307

Hyperbolic / Inverse Hyperbolic Functions

The hyperbolic functions are analogs of the ordinary trigonometric functions: Just as the points $(\cos\theta, \sin\theta)$ define a circle, the points $(\cosh\theta, \sinh\theta)$ define the right half of a rectangular hyperbola.

Example 1:

$$\sinh(1.5) = 2.129279455$$

$$\boxed{hyp} \boxed{sin} 1.5 \boxed{=}$$
Result: 2.129279455

Example 2:

$$\sinh^{-1} 10.02 = 3.000211057$$

$$\boxed{hyp} \boxed{SHIFT} \boxed{sin} (\boxed{sin^{-1}}) 10.02 \boxed{=}$$
Result: 3.000211057

Logarithms

This calculator allows dealing with logarithms in an easy way. The base-10 logarithm of a given number is the power or exponent to which the

base must be raised in order to produce the given number.

Example 1:

$\log 1000 = 3$

$\boxed{\log}\ 1000\ \boxed{=}$

Result: 3

Another widely used base for logarithms (beyond 10) is the mathematical constant $e \approx 2.7183$. This type of logarithm is known as natural logarithm (ln), and can be easily used as illustrated below in the example.

Example 2:

$\ln e = 1$

$\boxed{\ln}\ \boxed{\text{ALPHA}}\ \boxed{\ln}\ (\boxed{e})\ \boxed{=}$

Result: 1

Roots and Exponents

The keyboard arrangement of this calculator disposes roots and exponents in a single row for their easy localization. Using them is quite intuitive:

Example 1:

$\sqrt[3]{125} + \sqrt[3]{-64} = 1$

$\boxed{\text{SHIFT}}\ \boxed{x^3}(\boxed{\sqrt[3]{\ }})\ 125\ \boxed{+}$
$\boxed{\text{SHIFT}}\ \boxed{x^3}(\boxed{\sqrt[3]{\ }})\ \boxed{(-)}\ 64\ \boxed{=}$

Result: 1

Example 2:

$$3^4 + 2^7 - 4^3 = 145$$

3 $\boxed{x^y}$ 4 $\boxed{+}$ 2 $\boxed{x^y}$ 7 $\boxed{-}$ 4 $\boxed{x^3}$ $\boxed{=}$

Result: 145

Permutations and Combinations

Example 1: Determine how many different 4-digit values can be produced using the numbers 1 through 5, taking into account that numbers cannot be duplicated within the same 4-digit value (i.e. 1234 is allowed, but 1123 is not).

5 $\boxed{SHIFT}$ $\boxed{\times}$ $(\boxed{nPr})$ 4 $\boxed{=}$

Result: 120

Example 2: Determine how many different 3-member groups can be organized in a group of 8 individuals .

8 $\boxed{SHIFT}$ $\boxed{\div}$ $(\boxed{nCr})$ 3 $\boxed{=}$

Result: 56

Random Numbers

Example: Generate a random number between 0.000 and 0.999.

$\boxed{SHIFT}$ $\boxed{\bullet}$ $(\boxed{Ran\#})$ $\boxed{=}$

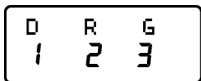Result (this result differs each time): 0.513

Factorials

Example: Compute the factorial of 10.

10 $\boxed{x!}$ $\boxed{=}$

Result: 3628800

Angle Unit Conversion

To access the angle unit conversion menu, press $\boxed{\text{SHIFT}}$ $\boxed{\text{Ans}}$ ($\boxed{\text{DRG▸}}$).

```
 D   R   G
 1   2   3
```

Pressing the number key $\boxed{1}$, $\boxed{2}$ or $\boxed{3}$ converts the displayed value to the corresponding angle unit.

Example 1: Convert 2.25 radians to degrees.

First of all, we should set the calculator in Deg. mode (which corresponds to the final units we want to obtain):

$\boxed{\text{MODE}}$ $\boxed{\text{MODE}}$ $\boxed{1}$ (Deg. mode)

Next, we introduce the value (2.25) followed by the specification of the units in which the number is expressed (radians).

2.25 $\boxed{\text{SHIFT}}$ $\boxed{\text{Ans}}$ ($\boxed{\text{DRG▸}}$) $\boxed{2}$ $\boxed{=}$

Result: 128.9155039

Example 2: Convert 45 degrees to radians.

$\boxed{\text{MODE}}$ $\boxed{\text{MODE}}$ $\boxed{2}$ (to set Rad. mode)

$$45 \; \boxed{\text{SHIFT}} \; \boxed{\text{Ans}} \boxed{(\text{DRG}\triangleright)} \; \boxed{1} \; \boxed{=}$$

Result: 0.785398163

And if you want to convert this into a π factor:

$$\boxed{\text{Ans}} \; \boxed{\div} \; \boxed{\pi} \; \boxed{=}$$

Result: 0.25

Example 3: Convert $\dfrac{\pi}{2}$ radians to degrees.

$$\boxed{\text{MODE}} \; \boxed{\text{MODE}} \; \boxed{1} \; \text{(to set Deg. mode)}$$
$$\boxed{(} \; \boxed{\pi} \; \boxed{\div} \; 2 \; \boxed{)} \; \boxed{\text{SHIFT}} \; \boxed{\text{Ans}} \boxed{(\text{DRG}\triangleright)} \; \boxed{2} \; \boxed{=}$$

Result: 90

Conversion Polar / Rectangular coordinates

Coordinates can be expressed in many different spaces. This calculator allows mutual conversion between Rectangular (also known as Cartesian) and Polar coordinates.

Calculation results are automatically assigned to registers E and F. These registers are accessible by pressing $\boxed{\text{RCL}} \boxed{\cos} \boxed{(\text{E})}$ and $\boxed{\text{RCL}} \boxed{\tan} \boxed{(\text{F})}$, respectively.

Example 1: Convert polar coordinates $r = 2.9$ and $\theta = 40^\circ$ into rectangular coordinates (x,y).

$$\boxed{\text{SHIFT}} \; \boxed{-} \; \boxed{(\text{P}\triangleright\text{R})} \; 2.9 \; \boxed{,} \; 40 \; \boxed{=}$$

Result: 2.221528885

This result corresponds to the *x* coordinate, and has been stored in register E. To recall the value of coordinate *y* , press:

RCL   tan (F)

Result: 1.864084068

If you want to see again the *x* coordinate, you must recall register E by pressing RCL   cos

(E).

Example 2: Convert rectangular coordinates $(2,\sqrt{2})$ into polar coordinates (r,θ) .

SHIFT   ▣ + ((R→P)) 2 , √ 2 =

Result: 2.449489743

RCL   tan (F)

Result: 35.26438968

Engineering Notation

When we have to express very big or very small numbers, it is useful to use *scientific notation*, that is, instead of typing all the zeros, the number is expressed as a coefficient multiplied by a power of ten:

$$230000000 = 2.3 \times 10^{8}$$

Normally, the coefficient can be any real number (2.3 in the previous example), and the exponent is an integer (8).

The only difference between *engineering notation* and scientific notation is that in *engineering*

notation the exponent is restricted to multiples of 3. Therefore, the previous number would be expressed as:

$$230000000 = 230 \times 10^6$$

Using only the exponents that are multiples of 3 allows to memorize a number of prefixes associated to every exponent:

Magnitude prefixe	Metric Symbol	Power of Ten
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	k	10^3
unit	$-$	10^0
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}

Example 1: Convert 0.00238 meters into millimeters.

0.00238 [=] [ENG]

Result: 2.38×10^{-3}

To go back to the magnitude in meters:

[SHIFT] [ENG]

Result: 0.00238×10^0

Example 2: Convert 12320 meters into kilometers.

12320 [=] [ENG]

Result: 12.32×10^3

Statistical Calculations

Data Input Considerations

- In the two statistical modes (SD and REG), the [M+] key operates as data input ([DT]).
- Make sure you clear statistical memory by means of [SHIFT] [MODE]([CLR]) [1] [=] before starting any data input.
- To input data you should follow the key sequence:

  <data_1> [M+]([DT])
  <data_2> [M+]([DT])
  <data_3> [M+]([DT])
  […]
  <data_n> [M+]([DT])

- **Be careful!** If you press [M+] [M+], this will input the same data twice.
- Multiple entries of the same data can also be introduced by means of [SHIFT] [,]([;]).

Example: Input the data 25 ten times:

$$25 \; \boxed{\text{SHIFT}} \; \boxed{\text{,}} \; (\boxed{\text{;}}) \; 10 \; \boxed{\text{M+}} (\boxed{\text{DT}})$$

- The existing data can be viewed by means of the cursor keys:

- To delete a data value, you should look for it using the cursor keys and then key in $\boxed{\text{SHIFT}}$ $\boxed{\text{M+}}$ ($\boxed{\text{L CL J}}$). Deleting a data value causes all following values to be shifted up.

- When scrolling through data, the calculator shows both the data item and a separate screen for the data frequency (Freq) in the case you introduced multiple entries of the same data using $\boxed{\text{SHIFT}}$ $\boxed{\text{,}}$ ($\boxed{\text{;}}$) to specify the number items of the same data values.

  It is possible to replace a data value while scrolling through data by entering the new value, and then pressing the $\boxed{\text{=}}$ key to replace the old value with the new one. This also means that if you want to carry out some other operation (e.g. execute a statistical calculation, etc.), you should always press the $\boxed{\text{AC}}$ key first to exit data display.

- After changing a value on the display, if you press $\boxed{\text{M+}}$ ($\boxed{\text{DT}}$) instead of the $\boxed{\text{=}}$ key, the value you input is registered as a new data item, and the old value is leaved as it was.

Memory Limit

All data values are stored in the calculator memory. If there is no memory left for data storage, the calculator will show the screen:

```
Data Full
```
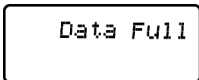
If this happens, you will not be able to input any more data. In this case, press the ⬛ key, to display the following screen:

```
EditOFF ESC
  1       2
```
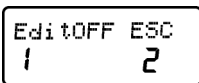
Press ⎡1⎤ if you want to register the value you just input, without saving it in memory. If you do this, however, you will not be able to display or edit any of the data you have input. On the contrary, press ⎡2⎤ to exit data input without storing the value you just input.

Standard Deviation mode

To perform statistical calculations using standard deviation press the ⎡MODE⎤ key, and then press ⎡2⎤ to set the calculator into the *SD mode*:

SD .... ⎡MODE⎤ ⎡2⎤

The MILAN M-240 calculator allows you to perform statistical calculations on raw data.

Once data is stored in memory, several operations can be carried out in SD mode. These operations are reached through two menus (S-SUM and S-VAR):

- SHIFT 1 (S-SUM)
  - 1 = sum of squares of values
  - 2 = sum of values
  - 3 = number of samples
- SHIFT 2 (S-VAR)
  - 1 = mean
  - 2 = population standard deviation
  - 3 = sample standard deviation

Once you reach any of these two menus, you should press the number key (1 , 2 , 3) that corresponds to the function you want to compute, followed by the key =.

Statistical Calculus SHIFT 1 (S-SUM)		
key	operation	formula
1	sum of squares of values	$\sum_{\forall i} x_i^2$
2	sum of values	$\sum_{\forall i} x_i$
3	number of samples	n

Statistical Calculus $\boxed{\text{SHIFT}}$ $\boxed{2}$ **(** $\boxed{\text{S-VAR}}$ **)**		
key	**operation**	**formula**
$\boxed{1}$	mean	$\overline{x} = \dfrac{1}{n}\sum_{i=1}^{n} x_i$
$\boxed{2}$	standard deviation	$\sigma_n = \sqrt{\dfrac{1}{n}\sum_{i=1}^{n}\left(x_i - \overline{x}\right)^2}$
$\boxed{3}$	sample standard deviation	$\sigma_{n-1} = \sqrt{\dfrac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \overline{x}\right)^2}$

Example: Consider the following data that corresponds to the readings of different temperature sensors covering an area to be monitored: 15, 14, 11, 15, 13, 13, 14, 12.

Calculate σ_n, σ_{n-1}, $\overline{x}$, n, $\sum x$ and $\sum x^2$.

You should first set the SD Mode pressing $\boxed{\text{MODE}}$ $\boxed{2}$, and then clear statistical memory by means of $\boxed{\text{SHIFT}}$ $\boxed{\text{MODE}}$ **(** $\boxed{\text{CLR}}$ **)** $\boxed{1}$ $\boxed{=}$. Then, data can be already input following the key sequence:

$$15 \ \boxed{\text{M+}} \ (\ \boxed{\text{DT}}\ )$$
$$14 \ \boxed{\text{M+}} \ (\ \boxed{\text{DT}}\ )$$
$$11 \ \boxed{\text{M+}} \ (\ \boxed{\text{DT}}\ )$$
$$15 \ \boxed{\text{M+}} \ (\ \boxed{\text{DT}}\ )$$
$$13 \ \boxed{\text{M+}} \ (\ \boxed{\text{DT}}\ )$$
$$\boxed{\text{M+}} \ (\ \boxed{\text{DT}}\ )$$
$$14 \ \boxed{\text{M+}} \ (\ \boxed{\text{DT}}\ )$$
$$12 \ \boxed{\text{M+}} \ (\ \boxed{\text{DT}}\ )$$

Population standard deviation:

$$\boxed{\text{SHIFT}} \ \boxed{2} \ (\boxed{\text{S-VAR}}) \ \boxed{2} \ \boxed{=}$$

Result: 1.316956719

Sample standard deviation:

$$\boxed{\text{SHIFT}} \ \boxed{2} \ (\boxed{\text{S-VAR}}) \ \boxed{3} \ \boxed{=}$$

Result: 1.407885953

Arithmetic mean:

$$\boxed{\text{SHIFT}} \ \boxed{2} \ (\boxed{\text{S-VAR}}) \ \boxed{1} \ \boxed{=}$$

Result: 13.375

Number of data:

$$\boxed{\text{SHIFT}} \ \boxed{1} \ (\boxed{\text{S-SUM}}) \ \boxed{3} \ \boxed{=}$$

Result: 8

Sum of values:

$$\boxed{\text{SHIFT}} \ \boxed{1} \ (\boxed{\text{S-SUM}}) \ \boxed{2} \ \boxed{=}$$

Result: 107

Sum of squared of values:

$$\boxed{\text{SHIFT}} \ \boxed{1} \ (\boxed{\text{S-SUM}}) \ \boxed{1} \ \boxed{=}$$

Result: 1445

Regression Calculations

In order to enter in the REG mode to carry out statistical operations using regression, press the $\boxed{\text{MODE}}$ key and then press $\boxed{3}$:

REG .... $\boxed{\text{MODE}}$ $\boxed{3}$

Different types of regression can be selected in the menus that appear after entering the REG mode:

key	operation	
$\boxed{1}$	Lin	Linear regression
$\boxed{2}$	Log	Logarithmic regression
$\boxed{3}$	Exp	Exponential regression
$\boxed{\blacktriangleright}\boxed{1}$	Pwr	Power regression
$\boxed{\blacktriangleright}\boxed{2}$	Inv	Inverse regression
$\boxed{\blacktriangleright}\boxed{3}$	Quad	Quadratic regression

Always press $\boxed{\text{SHIFT}}$ $\boxed{\text{MODE}}$($\boxed{\text{CLR}}$) $\boxed{1}$ $\boxed{=}$ before starting any data input.

To input data you should follow the key sequence:
 \<x-data_1> $\boxed{,}$ \<y-data_1> $\boxed{M+}$($\boxed{\text{DT}}$)
 \<x-data_2> $\boxed{,}$ \<y-data_2> $\boxed{M+}$($\boxed{\text{DT}}$)
 \<x-data_3> $\boxed{,}$ \<y-data_3> $\boxed{M+}$($\boxed{\text{DT}}$)
  [...]
 \<x-data_n> $\boxed{,}$ \<y-data_n> $\boxed{M+}$($\boxed{\text{DT}}$)

Be careful! If you press $\boxed{M+}$ $\boxed{M+}$, this will input the same data twice.

Use the following key operations to carry out the desired regression calculation:

Key operation	Calculation
$\boxed{\text{SHIFT}}$ $\boxed{1}$ ($\boxed{\text{S-SUM}}$) $\boxed{1}$	$\sum x^2$

[SHIFT] [1] [S-SUM] [2]	$\sum x$
[SHIFT] [1] [S-SUM] [3]	n
[SHIFT] [1] [S-SUM] [▶] [1]	$\sum y^2$
[SHIFT] [1] [S-SUM] [▶] [2]	$\sum y$
[SHIFT] [1] [S-SUM] [▶] [3]	$\sum xy$
[SHIFT] [2] [S-VAR] [1]	$\overline{x}$
[SHIFT] [2] [S-VAR] [2]	$x\sigma_n$
[SHIFT] [2] [S-VAR] [3]	$x\sigma_{n-1}$
[SHIFT] [2] [S-VAR] [▶] [1]	$\overline{y}$
[SHIFT] [2] [S-VAR] [▶] [2]	$y\sigma_n$
[SHIFT] [2] [S-VAR] [▶] [3]	$y\sigma_{n-1}$
[SHIFT] [2] [S-VAR] [▶] [▶] [1]	Regression coefficient A
[SHIFT] [2] [S-VAR] [▶] [▶] [2]	Regression coefficient B

For statistical regressions other than quadratic regression:

Key operation	Calculation
[SHIFT] [2] [S-VAR] [▶] [▶] [3]	Correlation coefficient r
[SHIFT] [2] [S-VAR] [▶] [▶] [▶] [1]	$\hat{x}$
[SHIFT] [2] [S-VAR] [▶] [▶] [▶] [▶] [2]	$\hat{y}$

In the case of quadratic regression, use the key operations of the table below:

Key operation	Calculation
[SHIFT] [1] [S-SUM] [▶] [▶] [1]	$\sum x^3$
[SHIFT] [1] [S-SUM] [▶] [▶] [2]	$\sum x^2 y$
[SHIFT] [1] [S-SUM] [▶] [▶] [3]	$\sum x^4$
[SHIFT] [2] [S-VAR] [▶] [▶] [3]	Regression coefficient C
[SHIFT] [2] [S-VAR] [▶] [▶] [▶] [1]	$\hat{x}_1$
[SHIFT] [2] [S-VAR] [▶] [▶] [▶] [2]	$\hat{x}_2$
[SHIFT] [2] [S-VAR] [▶] [▶] [▶] [3]	$\hat{y}$

Linear Regression

The regression formula for linear regression is:

$y = A + Bx$

Example: Consider the following table with the annual average temperature and latitude of some European capitals.

City	Temperature (° Celsius)	Latitude (°)
Amsterdam	13	54
Athens	24	37
Bonn	13	52
Brussels	14	52
Copenhagen	11	54
Dublin	13	53
Lisbon	19	39
London	14	53

Luxemburg	14	50
Madrid	19	40
Paris	15	49
Rome	22	42

Determine the equation of the regression line of the average temperature (x) with respect to the latitude (y), and the correlation coefficient for both variables. Next, use the regression formula to estimate the expected average temperature for a city located at latitude 44 ° North.

First of all, we should enter the data:

13 (,) 54 [M+] ([DT])
24 (,) 37 [M+] ([DT])
13 (,) 52 [M+] ([DT])
14 (,) 52 [M+] ([DT])
11 (,) 54 [M+] ([DT])
13 (,) 53 [M+] ([DT])
19 (,) 39 [M+] ([DT])
14 (,) 53 [M+] ([DT])
14 (,) 50 [M+] ([DT])
19 (,) 40 [M+] ([DT])
15 (,) 49 [M+] ([DT])
22 (,) 42 [M+] ([DT])

Now, we can already compute the Regression Coefficient A (as described in the table above):

[SHIFT] (2)([S-VAR]) (▶) (▶) (1) (=)
Result: 71.67927107

Regression Coefficient B:

[SHIFT] (2)([S-VAR]) (▶) (▶) (2) (=)

Result: -1.492938497

Correlation coefficient *r*:

$$\boxed{\text{SHIFT}} \boxed{2} (\boxed{\text{S-VAR}}) \boxed{\blacktriangleright} \boxed{\blacktriangleright} \boxed{3} \boxed{=}$$

Result: -0.940496859

Expected average temperature for a city at latitude 44 ° North:

$$44 \boxed{\text{SHIFT}} \boxed{2} (\boxed{\text{S-VAR}}) \boxed{\blacktriangleright} \boxed{\blacktriangleright} \boxed{\blacktriangleright} \boxed{1} \boxed{=}$$

Result: 18.54012817

Logarithmic, Exponential, Power, Inverse and Quadratic Regression

The table below shows the regression formulas for each type of regression.

Logarithmic Regression	$y = A + B \cdot \ln x$
Exponential Regression	$y = A \cdot e^{B \cdot x}$
Power Regression	$y = A \cdot x^B$
Inverse Regression	$y = A + B \cdot \dfrac{1}{x}$
Quadratic Regression	$y = A + B \cdot x + C \cdot x^2$

All the types of regression described in the previous table can be recalled using the same key operations as those of linear regression.

Warning:

After introducing statistical data in the calculator's memory under the SD or REG modes, it is not allowed to display or edit individual data items any longer. Therefore, to display individual data items, you should either (1) change to another mode; or (2) change the regression type (Lin, Log, Exp, Pwr, Inv, Quad).

Handling Errors

When you have a problem...

If calculation results are incorrect or if an error occurs, carry out the following steps:

- Press $(SHIFT)$ $(MODE)$$($ (CLR) $)$ $($ 2 $)$ (Mode) $\blacksquare$, to initialize all modes and settings.
- Check the formula you are working with to confirm it is correct.
- Check if you have entered the correct mode and try performing the calculation again.

If the above steps do not correct the problem, press the key ON, which makes the calculator perform a self-check operation and delete all data stored in memory if any abnormality is detected.

Error Messages

The calculator is locked up while an error message is on the display. Press AC to clear the error, or press ◄ or ► to display the calculation and correct the problem.

Math ERROR

Causes:

- The result of a formula is outside the allowable calculation range.
- Attempt to perform a function calculation using a value that exceeds the allowable input range.
- Attempt to perform an illogical operation (e.g. division by zero, etc.)

Action:

- Check your input values and make sure they are all within the allowable ranges. Pay special attention to values stored in the registers A through F, X, Y or M.

Stack ERROR

Cause:

- The capacity of any of the two memory stacks has been exceeded.

Action:

- Simplify the calculation. The numeric stack has 10 levels and the operator stack has 24 levels.
- Divide your calculation into two or more separate parts.

Syntax ERROR

Cause:

• Attempt to perform an illegal mathematical operation.

Action:

• Press ◁ or ▷ to display the calculation with the cursor located at the location of the error and make the required corrections.

Arg ERROR

Cause:

• Improper use of an argument.

Action:

• Press ◁ or ▷ to display the location of the cause of the error and make sure you use the arguments as required.