TEXAS INSTRUMENTS

SCIENTIFIC

TI-30 SLR +

QUICK REFERENCE GUIDE

Key Index

This indexed keyboard provides a quick page reference to the description of each key.

				11 [AC/ON]
42 [CSR]			39 [DRG►]	
34 [x!]	31 [1/x]	18 [%]	35 [DRG]	11 [CE/C]
29 [$\sqrt{x}$]	36 [sin⁻¹]	36 [cos⁻¹]	36 [tan⁻¹]	31 [$\sqrt[x]{y}$]
29 [x^2]	36 [sin]	36 [cos]	36 [tan]	30 [y^x]
6 [2nd]		33 [10^x]	32 [e^x]	
6 [INV]	8 [EE]	33 [log]	32 [ln x]	14 [÷]
42 [Σ−]	43 [Σx]	43 [Σx^2]	41 [$x \rightleftarrows y$]	41 [P►R]
42 [Σ+]	23 [K]	20 [(]	20 [)]	14 [×]
43 [$\bar{x}$]				41 [R►P]
25 [STO]	7 [7]	7 [8]	7 [9]	14 [−]
43 [σ_{n-1}]				40 [DMS►DD]
25 [RCL]	7 [4]	7 [5]	7 [6]	14 [+]
43 [σ_n]				40 [DD►DMS]
27 [SUM]	7 [1]	7 [2]	7 [3]	14 [=]
7 [π]				
28 [EXC]	7 [0]	7 [.]	7 [+/−]	

Dual Function Keys

Some calculator keys have dual functions, which are accessed by pressing the **[INV]** key just prior to the function key. Each key is described in the appropriate section of this manual.

The TI-30 SLR+ Calculator

The TI-30 SLR+ calculator offers you a wide range of mathematical and statistical capabilities. This manual is designed to help you learn about these capabilities and how to use them effectively.

Features

- Solar power cells located above the display eliminate the need for batteries—they operate your calculator wherever there is a source of light. Any normal reading light is adequate.
- The Liquid Crystal Display (LCD) provides large, easy-to-read numerals and display indicators.
- The AOS™ Algebraic Operating System follows the standard mathematical hierarchy of operation, allowing you to enter even complicated problems simply and directly.
- A durable slide-case protects the calculator when you are not using it.
- 63 calculator functions assist you in performing a wide range of arithmetic, algebraic, trigonometric, and statistical computations.

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Basic Operations

Your calculator is easy to operate because of its AOS™ Algebraic Operating System, which allows you to enter most problems just as they are written. The following instructions and examples can help you develop skill and confidence in problem solving.

Turning the Calculator On

To turn the calculator on, expose the solar cell panel to a good light source. Then press the **[AC/ON]** key to clear the calculator completely. DEG and 0 appear in the display. (When you first expose the solar panel to light, random symbols may appear in the display. These do not affect operation and are cleared when you clear the calculator.)

Under indirect or low-level lighting, covering a portion of the solar panel may cause the display to disappear. Always be sure the entire panel is exposed to light.

Turning the Calculator Off

To turn the calculator off, cover the solar panel so that light can't reach it. The calculator "turns off" about one minute after the light source is removed. (The time may vary slightly.) If the solar panel is exposed to light again within that time, any pending operations and the memory are normally restored.

If no keys are pressed for several minutes, the Automatic Power Down feature turns the calculator off automatically. (The time may vary slightly.)

Never leave the calculator in direct sunlight for long periods, or store it where high temperatures are possible.

The Display

Indicator	Meaning
M	The memory contains a value other than zero.
E	An error condition has occurred.
INV	The [INV] ([2nd]) key has been pressed and the alternate function of the next key pressed will be selected.
STAT	The calculator is in statistical mode.
K	A constant operation is in effect.
DEG	The angle units are set to degrees.
RAD	The angle units are set to radians.
GRAD	The angle units are set to grads.
( )	A parenthetical expression has been started but not completed.

Note that a negative number is displayed with a minus sign immediately to the left of the number, just as negative numbers are normally written.

Dual-Function Keys

The **[INV]** (Inverse) or **[2nd]** key selects the alternate function of the next key pressed. (Notice that "2nd" is marked above the **[INV]** key.)

Although **[INV]** and **[2nd]** are actually the same key, this manual uses key symbols that correspond to the function you are performing. Functions that require the **[INV]** or **[2nd]** key are shown in this manual as:

[INV] [EE] or **[2nd] [Σ −]**

To perform an inverse or second function, press **[INV]** and then press the appropriate function key.

The "second" function of a key is shown above the key itself. For example, π is the second function of the **[EXC]** key. When a key sequence begins with **[2nd]**, look at the symbols printed above the keys to locate that function on your calculator.

When you press the **[INV]** or **[2nd]** key, **INV** appears in the display until you press another key.

If you press **[INV]** or **[2nd]** by accident, press it again to cancel its effect. If you press **[INV]** or **[2nd]** and then a key that does not have an alternate function, the key performs its normal function.

Data Entry Keys

Digit Keys—[0] through [9] enter values 0 through 9.

Decimal Point—[.] enters a decimal point. The calculator operates with a floating decimal point, which is automatically displayed to the right of an integer. When you enter numbers, the decimal is to the right of the digits until you press [.]. The remaining digits you enter become the fractional part of the number.

Pi—[2nd] [π] enters the value of pi correct to 11 digits, but rounded to 8 digits (3.1415927) for display.

Change Sign—[+/−], when pressed after a number entry or a calculation, changes the sign of the displayed number. When pressed after the [EE] key, [+/−] changes the sign of the exponent.

Entering Numbers

You can enter a maximum of eight digits in the display. Any digit keys pressed after the eighth are ignored. However, the calculator can work with 11 digits. To enter a number with more than eight digits, enter it as the sum of two numbers. The display is rounded to 8 digits, but all 11 digits are used in calculations.

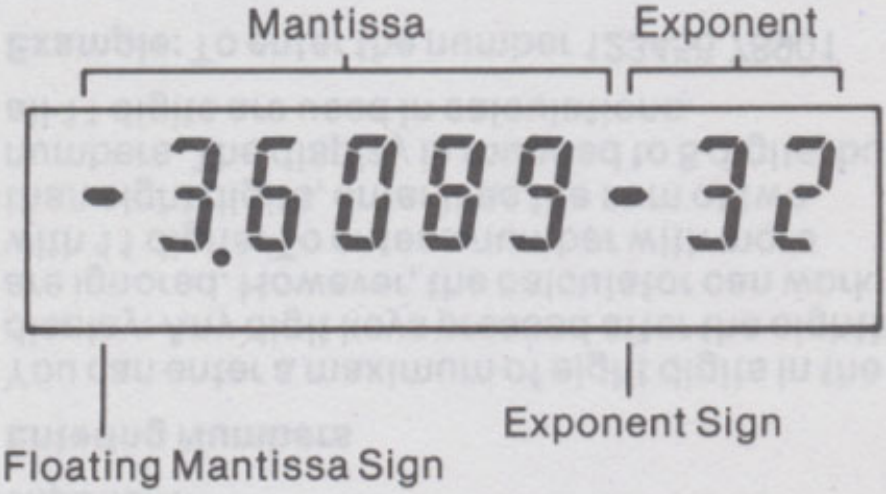
Example: To enter the number 123456.78901

Enter	Press	Display
123456	[+]	123456
.78901	[=]	123456 . 79

The number displayed is the original number rounded to eight digits: 123456.79.

Scientific Notation

You must enter any number smaller than ±0.0000001 or larger than ±99999999 in scientific notation. Enter the number as a mantissa multiplied by 10 raised to some power (exponent), such as -3.6089×10^{-32}.



Exponent Entry—**[EE]**, when pressed after an entry, prepares the calculator to accept the next digits entered as the exponent.

Note: The display doesn't go into scientific notation if more than 5 digits are entered to the left of the decimal. You can, however, enter up to 5 digits to the left of the decimal and 3 digits to the right of the decimal. Only the first 5 are displayed when **[EE]** is pressed, but the whole 8-digit mantissa is used for calculations.

Scientific Notation Conversion—The key sequence **[×] 1 [EE] [=]** converts a number in standard display format to scientific display format. If you press only the **[EE] [=]** keys, the calculator uses only the eight displayed digits in later calculations and discards the internally carried digits.

Scientific Notation (Continued)

Scientific Notation Removal—[INV] [EE] removes the displayed number from scientific notation if it is between $\pm 1 \times 10^{-7}$ and $\pm 9.9999999 \times 10^{7}$ and displays it in standard format. If the displayed value is outside this range, it remains in scientific notation format. However, if a later calculation results in a value in the range of standard notation, that value is displayed in standard notation.

Using Scientific Notation

- To convert a displayed value from standard display format to scientific notation, press [×] 1 [EE] [=] while the value is displayed.
- To enter a number in scientific notation, key in the mantissa (including its sign, if negative), press [EE], and enter the power of ten. The last two digits on the right side of the display indicate the power of 10. (For example, you can write 320,000,000 as 3.2×10^{8}. Enter this number as 3.2 [EE] 8. The display reads 3 . 2 08.)
- To attach a negative sign to the mantissa, press the [+/−] key after entering at least one digit of the number but before pressing [EE].
- To attach a negative sign to the power-of-ten exponent, press the [+/−] key before, after, or while entering the exponent.

No matter how you enter the mantissa in scientific notation, the calculator **normalizes** the number, displaying a single digit to the left of the decimal point, when any function or operation key is pressed.

Using Scientific Notation (Continued)

Data in scientific notation form can be entered along with data in standard form. For example, the problem $3.2 \times 10^3 + 12575.321 = ?$ is entered as: 3.2 **[EE]** 3 **[+]** 12575.321 **[=]**. To convert the answer, 1.5775 04, to standard format, use the removal sequence **[INV]** **[EE]** **[=]**. The answer is 15775.321.

Rounding and Accuracy

Each calculation produces an 11-digit result, even though the displayed result is rounded to 8 digits in standard notation or to a 5-digit mantissa and 2-digit exponent in scientific notation.

Higher-order mathematical functions use iterative calculations. The cumulative error from these calculations in most cases is maintained beyond the eight-digit display. Most calculations are accurate to ± 1 in the last displayed digit.

Error Indication

The display shows an E when overflow or underflow occurs or when you enter an improper operation. No entry from the keyboard is accepted until you press **[CE/C]**, which clears the error condition and all pending operations. You must then start your calculation again.

Correcting Entry Errors

There are several methods of correcting entry errors.

Clear Entry—**[CE/C]**, if pressed before you enter an operation, clears an incorrect number from the display without affecting any calculation in progress. If you enter an incorrect number, press the **[CE/C]** key before you press the operation key.

Pressing **[CE/C]** after an operation or function key (including **[=]**) clears the display, the constant, and all pending operations.

Pressing **[CE/C]** twice (**[CE/C]** **[CE/C]**) always clears the display, the constant, and pending operations. The memory is not affected by this key. If you enter an incorrect operation while there are pending calculations, it is safest to press **[CE/C]** twice and restart the problem.

Note: If you enter an incorrect operation when there are no stored operations (for example, when you press the first operation key in an expression), simply press the correct operation key and continue. This applies to **[+]**, **[−]**, **[×]**, **[÷]**, **[y^x]**, and **[2nd]** **[$\sqrt[x]{y}$]**.

All Clear—**[AC/ON]** sets the angle units to degrees and clears the display, the constant, the memory, and any pending operations. It's a good practice to use **[AC/ON] only** when the calculator is first "turned on" and before beginning any calculation that requires a clear memory.

Basic Operations (Continued)

General Error Conditions

- Entering a number or calculating a result (including memory sum) outside the range of the calculator, $\pm 1.0 \times 10^{-99}$ to $\pm 9.9999499 \times 10^{99}$.
- Dividing a number by zero, calculating [1/x] of zero, or calculating a power or a root of a negative number.
- Calculating the tangent of 90°, 270°, π/2 radians, 3π/2 radians, 100 grads, 300 grads, or their rotation multiples.
- Multiplying numbers with negative exponents when the sum of those exponents (before being normalized) exceeds −99.
- Having more than 4 pending operations or 15 open levels of parentheses.
- Entering a second pending operation while in the statistics mode (STAT in the display).
- Calculating rectangular to polar conversions when both x and y = 0 or when the the sum of their squares exceeds the upper or lower limit of the calculator.
- Exceeding the input range for these functions:

sinx, cosx tanx	$0 \leq \lvert x \rvert 4.5 \times 10^{9}$°
arcsin, arccos	$-1 \leq x \leq 1$
log, lnx	$0 < x \leq 9.9999499 \times 10^{99}$
e^x	$-227.95592 \leq x \leq 230.25850$
10^x	$-99 \leq x \leq 99.999997$
x!	$0 \leq x \leq 69$ (x is an integer)

Statistical Error Conditions

The following errors clear the statistical registers and reset the calculator to normal calculation mode.

- Calculating standard deviation ($n - 1$ weighting) with only one data point.
- Entering a statistical data point x, such that $x \leqslant \pm 1 \times 10^{-50}$ or $x \geqslant \pm 1 \times 10^{50}$.
- Entering a series of statistical data points (x_i) such that $\Sigma(x_i)^2$ exceeds the upper or lower limit of the calculator.
- Removing the last remaining statistical data point ($n = 1$) using **[2nd] [Σ −]**.

Arithmetic Functions

The calculator uses the Algebraic Operating System (AOS). This system allows key sequences to be interpreted correctly by storing certain quantities and operations until they can be completed following standard algebraic rules. (See "Order of Calculations" later in this section.)

Basic Keys

Addition—[+] completes any previously entered +, −, ×, ÷, y^x, or $\sqrt[x]{y}$ function, when not separated by an open parenthesis, and instructs the calculator to add the next entered value to the displayed number.

Subtraction—[−] completes any previously entered +, −, ×, ÷, y^x, or $\sqrt[x]{y}$ function, when not separated by an open parenthesis, and instructs the calculator to subtract the next entered quantity from the displayed number.

Multiplication—[×] completes any previously entered ×, ÷, y^x or $\sqrt[x]{y}$ function, when not separated by an open parenthesis, and instructs the calculator to multiply the displayed number by the next entered quantity.

Division—[÷] completes any previously entered ×, ÷, y^x, or $\sqrt[x]{y}$ function, when not separated by an open parenthesis, and instructs the calculator to divide the displayed number by the next entered quantity.

Equals—[=] completes all previously entered operations.

Using the Basic Keys

As you work the examples below, notice the straightforward way the numbers and functions are entered.

Example: 23.79 + 0.54 − 6 = 18.33

Enter	Press	Display
	[CE/C]	0.
23.79	[+]	23.79
.54	[−]	24.33
6	[=]	18.33

In the following examples, notice that you do not need to press [CE/C] if the previous problem has been completed with an [=].

Example: − 3.7 − (− 7.09) + .014 = 3.404

Enter	Press	Display
3.7	[+/−] [−]	−3.7
7.09	[+/−] [+]	3.39
.014	[=]	3.404

Example: − 4 × 7.3 ÷ 2 = − 14.6

Enter	Press	Display
4	[+/−] [×]	−4.
7.3	[÷]	−29.2
2	[=]	−14.6

Order of Calculations

The calculator follows algebraic rules that assign priorities to the mathematical operations. Without these rules, problems like $5 \times 4 + 3 \times 2$ might be interpreted as:

$5 \times (4 + 3) \times 2 = 70$
or $(5 \times 4) + (3 \times 2) = 26$
or $((5 \times 4) + 3) \times 2 = 46$

Algebraic rules state that multiplication is to be performed before addition. So the correct answer is $(5 \times 4) + (3 \times 2) = 26$.

The mathematical operations are listed below in the order of their priority.

1. Single-variable functions (trigonometric, logarithmic, square, square root, factorial, percent and reciprocal) are performed immediately.
2. Exponentiation (y^x) and roots ($\sqrt[x]{y}$) are performed next.
3. Multiplicaton and division are performed next.
4. Addition and subtraction are performed after all other operations are completed.
5. The [=] key completes all operations.

Operations are performed strictly according to their relative priority as stated in the rules. The calculator recalls each stored operation and quantity for execution at the correct time. When you are familiar with the order of these operations, most problems are easy to solve because of the straightforward way they can be entered.

Order of Calculations (Continued)

The keys on the right side of the keyboard are positioned in a way that helps you remember the order of calculation.

[y^x] Exponentiation and roots
[÷] Division and
[×] Multiplication
[−] Subtraction and
[+] Addition
[=] Equals (completes all operations)

All single-variable functions are performed on the displayed number immediately.

Combining Operations

You can use the result of one calculation as the first number in a second calculation. Just press the appropriate operation key while the result is in the display.

Example: Add 25, 36, and 74, and divide the result by 3.

Enter	Press	Display
	[CE/C]	0.
25	[+]	25.
36	[+]	61.
74	[=]	135.
	[÷]	135.
3	[=]	45.

Percent

The [%] key converts the displayed number from a percentage to a decimal. (For example, enter 25 and press [%]. The decimal number .25 is displayed.)

You can compute add-ons, discounts, and percentages by pressing [%] after an arithmetic operation.

[+] n [%] [=] adds n% to displayed number.

[−] n [%] [=] subtracts n% from displayed number.

[×] n [%] [=] multiplies displayed number by n%.

[÷] n [%] [=] divides displayed number by n%

Percent Examples

What is the total cost of a $15 item with a 5% sales tax?

Enter	Press	Display
15	[+]	15.
5	[%] [=]	15.75

How much is paid for a $5 item that has been discounted 15%?

Enter	Press	Display
5	[−]	5.
15	[%] [=]	4.25

Percent Examples (Continued)

What is 2.5% of 15?

Enter	Press	Display
15	[×]	15.
2.5	[%] [=]	0.375

25 is 15% of what number?

Enter	Press	Display
25	[÷]	25.
15	[%] [=]	166.66667

Parentheses

The [(] and [)] keys isolate particular numerical expressions for separate mathematical interpretation. You can use parentheses to group operations so that they are completed in a different order than is provided for by the calculator.

You should use parentheses when a mathematical sequence can't be directly entered using the AOS order of calculation or when you are in doubt about how the calculator will evaluate an expression.

Some problems require that you tell the calculator exactly how to evaluate the problem. For example,

$4 \times (5 + 9) \div (7 - 4) = ?$

To evaluate this expression using only the order of calculation would require many independent steps. Intermediate results would have to be stored, and the problem could not be input as it is written.

To see the benefit of parentheses, try the following experiment. Press [(] 5 [+] 9 [)]. The value 14 is displayed. The calculator evaluates 5 + 9 and replaces it with 14 even though the [=] key is not pressed.

By using parentheses, you can enter your problem just as you have written it down. The calculator remembers each operation and evaluates each part of the expression as soon as all necessary information is available. All operations included within the parentheses are completed as soon as you press [)].

Parentheses (Continued)

Example: $4 \times (5 + 9) \div (7 - 4) = 18.666667$

Enter	Press	Display	Comments
4	[×][(]	4.	(4 ×) stored pending evaluation of ( ).
5	[+]	5.	(5 +) stored.
9	[)]	14.	(5 + 9) evaluated.
	[÷]	56.	calculator evaluates (4 × 14).
	[(]	56.	(56 ÷) stored pending evaluation of ( ).
7	[−]	7.	(7 −) stored.
4	[)]	3.	(7 − 4) evaluated.
	[=]	18.666667	4 × (5 + 9) ÷ (7 − 4)

There are limits on how many operations and associated numbers can be stored. You can open as many as 15 parentheses at any one time and can have four operations pending, but only in the most complex situations would you approach these limits. If you attempt to open more than 15 parentheses or if the calculator tries to store more than four operations, the error symbol appears in the display.

Parentheses (Continued)

The following example requires the storage of four pending operations and shows the order of evaluation provided by the calculator's operating system.

Example: $5 + (8 \div (9 - (2 \div 3))) = 5.96$

Enter	Press	Display	Comments
5	[+][(]	5.	(5 +) stored
8	[÷][(]	8.	(8 ÷) stored
9	[−][(]	9.	(9 −) stored
2	[÷]	2.	(2 ÷) stored
3	[)]	0.6666667	(2 ÷ 3) evaluated
	[)]	8.3333333	(9 − (2 ÷ 3)) evaluated
	[)]	0.96	(8 ÷ (9 − (2 ÷ 3)))
	[=]	5.96	5 + (8 ÷ (9 − (2 ÷ 3)))

Because the [=] key completes all operations, it could have been used here instead of the three [)] keys. Try working this problem again and pressing [=] instead of the first [)].

When you press [)], the expression is evaluated back to the nearest open parenthesis and replaced with a single value. Knowing this, you can structure the order of interpretation for whatever purpose you want. You can also check intermediate results.

Calculations With a Constant

The constant key [K] simplifies repetitive calculations by storing a number and its associated operation for repeated use. A recurring sequence, such as $+3$, $\times(-17.3)$, or y^7, can be stored and used by the calculator to operate on any displayed number.

To enter a constant operation:

1. Enter the repetitive number, m.
2. Enter the desired operation.
3. Press [K].

m [+] [K]	Adds m to each subsequent entry
m [−] [K]	Subtracts m from each subsequent entry
m [×] [K]	Multiplies each subsequent entry by m
m [÷] [K]	Divides each subsequent entry by m
m [y^x] [K]	Raises each subsequent entry to the mth power
m [2nd] [$\sqrt[x]{y}$] [K]	Takes the mth root of each subsequent entry

After storing the constant, you can complete each calculation by simply entering the new number and pressing [=]. To eliminate the constant, clear the calculator or press any of the above arithmetic keys.

Arithmetic Functions (Continued)

Calculations with a Constant (Continued)

Example:

$$31 + 1.8026 = 32.8026$$
$$745.797 + 1.8026 = 747.5996$$
$$-8.002 + 1.8026 = -6.1994$$
$$3.2 \times 10^{-2} + 1.8026 = 1.8346$$

Enter	Press	Display
	[CE/C]	0.
1.8026	[+] [K]	1.8026
31	[=]	32.8026
745.797	[=]	747.5996
8.002	[+/−] [=]	−6.1994
3.2	[EE]	3.2 00
2	[+/−] [=]	1.8346 00

Example: Evaluate $(3.75)^{-3.2}$, $(.1066)^{-3.2}$, $(.0692)^{-3.2}$

Enter	Press	Display
	[CE/C]	0.
3.2	[+/−] [y^x] [K]	−3.2
3.75	[=]	0.0145579
.1066	[=]	1291.7455
.0692	[=]	5148.2603

Memory Usage

The calculator has one memory that can store data as long as the calculator is on. This feature allows you to store a number in memory for repeated use in a calculation or to keep a running total during a calculation.

The memory keys do not affect any calculation in progress, so you can use them at any time.

Clearing the Memory

To clear the memory only, press the **[STO]** key when a 0 is in the display.

Be very careful when clearing the calculator while you have data stored in the memory. In general, use the **[CE/C]** key, which does not erase the memory, to clear the calculator. Use the **[AC/ON]** key to clear the calculator **only** when you first turn it on or when you begin a calculation that requires a clear memory.

Memory Store

The **[STO]** key stores the displayed quantity in the memory without removing it from the display. Any previous value you have stored in the memory is replaced by the new entry.

Memory Recall

The **[RCL]** key recalls the contents of the memory into the display without affecting the content of the memory.

Memory Usage (Continued)

Example: Evaluate $2.4x^4 - 3x^2 + x$ when $x = 3.5$

Enter	Press	Display	Comments
2.4	[×]	2.4	
3.5	[STO] [y^x]	3.5	Store x
4	[−]	360.15	$2.4x^4$
3	[×]	3.	
	[RCL]	3.5	Recall x
	[x^2]	12.25	x^2
	[+]	323.4	$2.4x^4 - 3x^2$
	[RCL]	3.5	Recall x
	[=]	326.9	Answer

You can see that storing x the first time it is entered saves you from keying in x the other two times it is needed. A single press of the [RCL] key brings the value of x to the display each time. Notice also that using [STO] and [RCL] did not interfere with calculator operations.

Sum to Memory

The **[SUM]** key adds the displayed value to the memory content. This key does not affect the displayed number or calculations in progress.

Note: The **[CE/C]** key does not clear the memory. You can, of course, press **[AC/ON]** to clear the calculator and memory before starting a new calculation. However, to prevent adding a new number to the existing contents of the memory, you should store the first value in a memory operation by pressing **[STO]**, as shown in the following example.

Example:
$$\begin{aligned} 28 \times 7 &= 196 \\ 173 + 16 &= 189 \\ \text{Total} \quad & 385 \end{aligned}$$

Enter	Press	Display	Memory
28	[×]	28.	0
7	[=] [STO]	196.	196
173	[+]	173.	196
16	[=] [SUM]	189.	385
	[RCL]	385.	385

For a complicated expression, solving the entire problem sequentially can be risky. A mistake would mean starting over. By keeping a running total in memory, each part of the expression is independent of the previous calculations.

Memory Exchange

The **[EXC]** key swaps the value in memory with the displayed value. The displayed value is stored, and the previously stored value is displayed.

The store and recall operations are combined into this single key. You can use this key anywhere in the solution of a problem without disturbing the sequence of calculations.

The **[EXC]** key permits you to solve one problem and store the result while solving a second problem. Thus you can compare the results of both problems. You can also use this key to temporarily store numbers and use them as needed.

Example: Evaluate $A^2 + 2AB + B^2$ for $A = .258963$ and $B = 1.25632$

Enter	Press	Display	Comments
.258963	[STO] [x^2] [+]	0.0670618	Store A, calculate A^2
1.25632	[×]	1.25632	Enter B
	[EXC]	0.258963	Store B, recall A
	[×]	0.3253404	A × B
2	[+]	0.7177426	$A^2 + 2AB$
	[RCL]	1.25632	Recall B
	[x^2]	1.5783399	B^2
	[=]	2.2960826	Answer

Algebraic Functions

The keys described in this section perform algebraic functions. All of these are single-variable functions except for [y^x] and [2nd] [$\sqrt[x]{y}$], which are two-variable functions.

Single-variable functions operate only on the displayed value without interfering with calculations in progress.

The [y^x] and [2nd] [$\sqrt[x]{y}$] keys are the only algebraic function keys that do not act immediately on the displayed value. Both are two-variable functions; that is, they require a second value before the function can be performed.

Note: The display is blank during the short time the calculator computes a result. Be sure the calculator has completed an operation before pressing the next key.

Powers and Roots

Square Key—[x^2] calculates the square of the number in the display.

Example: $(4.235)^2 = 17.935225$

Enter	Press	Display
4.235	[x^2]	17.935225

Square Root—[2nd] [$\sqrt{x}$] calculates the square root of the number in the display. The value must be positive.

Example: $\sqrt{6.25} = 2.5$

Enter	Press	Display
6.25	[2nd] [$\sqrt{x}$]	2.5

Algebraic Functions (Continued)

Powers and Roots (Continued)

Example: $(\sqrt{3.1452} - 7 + (3.2)^2)^{1/2} = 2.2390782$

Enter	Press	Display
3.1452	[2nd] [$\sqrt{x}$] [−]	1.7734712
7	[+]	−5.2265288
3.2	[x^2]	10.24
	[=]	5.0134712
	[2nd] [$\sqrt{x}$]	2.2390782

Powers—[y^x] raises the displayed value y to the xth power. The order of entry is y [y^x] x. The y value must be positive, and both x and y can be fractional.

Example: $2.86^{-.42} = 0.64317107$

Enter	Press	Display
2.86	[y^x]	2.86
.42	[+/−]	−0.42
	[=]	0.6431707

Roots—[2nd] [$\sqrt[x]{y}$] takes the xth root of the displayed value y. The order of entry is y [2nd] [$\sqrt[x]{y}$] x. The y value must be positive, and both x and y can be fractional.

Example: $\sqrt[3.12]{1460} = 10.332744$

Enter	Press	Display
1460	[2nd] [$\sqrt[x]{y}$]	1460.
3.12	[=]	10.332744

There is a restriction on these functions—the variable y must be positive. If y is negative, the error symbol E appears in the display after x and an operation key are pressed.

Accuracy for powers and roots is within ±1 in the 8th significant digit except for values of y very near 1 and very large exponents or very small roots. The error increases as y approaches 1 and the exponent becomes very large or when roots become very small.

Reciprocal

The [1/*x*] key divides the displayed value x into 1. ($x \neq 0$.)

Example: $\frac{1}{3.2} = 0.3125$

Enter	Press	Display
3.2	[1/*x*]	0.3125

Natural Logarithm and Antilogarithm

Natural Logarithm—[ln*x*] calculates the natural logarithm (base e) of the number x in the display. (x > 0.)

Example: ln 1.2 = 0.1823216

Enter	Press	Display
1.2	[ln*x*]	0.1823216

Natural Antilogarithm—[2nd] [e^x] calculates the natural antilogarithm of the displayed number. This sequence raises the constant e to the displayed power.

Example: $e^{3.81} = 45.150438$

Enter	Press	Display
3.81	[2nd] [e^x]	45.150439

Example: $e^{(7.5 + \ln 1.4)} = 2531.2594$

Enter	Press	Display	Comments
	[CE/C] [(]	0.	
7.5	[+]	7.5	Enters 7.5
1.4	[ln*x*]	0.3364722	ln 1.4
	[)]	7.8364722	(7.5 + ln 1.4)
	[2nd] [e^x]	2531.2594	Answer

Note that you do not need to press the [=] key since the logarithm function produces the final result.

Common Logarithm and Antilogarithm

Common Logarithm—**[log]** calculates the common logarithm (base 10) of the number x in the display. ($x > 0$.)

Example: log 32.01 = 1.5052857

Enter	Press	Display
32.01	**[log]**	1.5052857

Common Antilogarithm—**[2nd] [10^x]** calculates the common antilogarithm of the displayed value. This sequence raises 10 to the displayed power.

Example: $10^{-7.12} = 7.5858 \times 10^{-8}$

Enter	Press	Display
7.12	**[+/−] [2nd] [10^x]**	7.5858−08

Example: $\log (800 + 10^{2.30103}) = 3$

Enter	Press	Display	Comments
	[CE/C] [(]	0.	
800	**[+]**	800.	Enter 800
2.30103	**[2nd] [10^x]**	200.	$10^{2.30103}$
	[)]	1000.	$800 + 10^{2.30103}$
	[log]	3.	Answer

The results from logarithms, when displayed in normal form rather than in scientific notation, are accurate within ± 1 in the last displayed digit, allowing for rounding.

Factorial

The [x!] key calculates the factorial (x) (x – 1) (x – 2) . . . (2) (1) of the value in the display for integers $0 \leqslant x \leqslant 69$. (0! = 1 by definition.)

Example: $36! = 3.7199 \times 10^{41}$

Enter	Press	Display
36	[x!]	3.7199 41

Trigonometric Functions

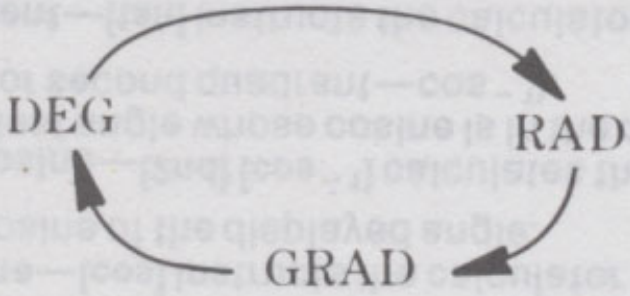
The trigonometric functions include sine, cosine, and tangent and their inverses (arcsine, arccosine, and arctangent). Whether the angle is entered or is a calculated result, you must select the appropriate angle unit setting to get correct answers.

Setting the Angle Units

The angle units setting only affects trigonometric calculations. Setting the angle units is an easy step to perform—**and to forget!** Neglecting this step is responsible for a large part of errors when using trigonometric functions.

The **[DRG]** key selects the units for angle measurement (degrees, radians, or grads).

When you first turn the calculator on, angle units are set to degrees. Pressing the **[DRG]** key once changes angle units to radians. Press this key again and your angles are measured in grads (right angle = 100 grads). The angle setting rotates each time you push the key.



The display indicates the current angle setting. DEG is displayed for degrees, RAD is displayed for radians, and GRAD is displayed for grads.

Memory registers and calculations in progress are not affected by changing angle settings.

Trigonometric Functions (Continued)

The Trigonometric Keys

Sine—[sin] instructs the calculator to find the sine of the displayed angle.

Arcsine—[2nd] [sin^{-1}] calculates the smallest angle whose sine is in the display (first or fourth quadrant—sin^{-1}).

Cosine—[cos] instructs the calculator to find the cosine of the displayed angle.

Arccosine—[2nd] [cos^{-1}] calculates the smallest angle whose cosine is in the display (first or second quadrant—cos^{-1}).

Tangent—[tan] instructs the calculator to find the tangent of the displayed angle.

Arctangent—[2nd] [tan^{-1}] calculates the smallest angle whose tangent is in the display (first or fourth quadrant—tan^{-1}).

You can calculate trigonometric values for angles greater than one revolution. However, in radians the rounded value of π limits accuracy at very large rotation multiples of π and $\pi/2$.

Example: $\sin 30° = 0.5 = \sin 390°$

Enter	Press	Display
(select degrees)	[AC/ON]	DEG
30	[sin]	0.5
390	[sin]	0.5

Calculating Trig Functions

Sine and cosine functions are accurate throughout all displayed digits, except where previously noted in radians. The tangent of $\pm 90°$, $\pm \pi/2$ radians, or ± 100 grads results in an error condition because the function is undefined at these points.

Example: $(\sin(.3012\pi))^{-\tan(16.2°)} = 1.0626654$

Enter	Press	Display	Comments
(select radians)		RAD	
	[CE/C] [(]	0.	
.3012	[×]	0.3012	
	[2nd] [π]	3.1415927	
	[)]	0.9462477	(.3012π)
	[sin]	0.8112271	Sin (.3012π)
	[y^x]	0.8112271	
16.2	[DRG] [DRG] [tan]	0.2905269	Tan 16.2°
	[+/−] [=]	1.0626654	Answer

Because certain angles have identical function values within one revolution, the angle returned by each function is restricted as indicated on the next page.

Calculating Trig Functions (Continued)

Arc Function for x≥0	Quadrant of Resultant Angle
arcsin x ($\sin^{-1}$ x)	1st (0 to 90°, π/2, or 100 G)
arcsin − x ($\sin^{-1}$ − x)	4th (0 to − 90°, − π/2, or − 100 G)
arccos x ($\cos^{-1}$ x)	1st (0 to 90°, π/2, or 100 G)
arccos − x ($\cos^{-1}$ − x)	2nd (90° to 180°, π/2 to π, or 100 to 200 G)
arctan x ($\tan^{-1}$ x)	1st (0 to 90°, π/2, or 100 G)
arctan − x ($\tan^{-1}$ − x)	4th (0 to − 90°, − π/2, or − 100 G)

Arcsin .5, for example, always returns 30° as the angle even though sin 150° = .5 and sin 390° = .5 as well.

Example: $\sin^{-1}$ .712 = 45.397875 degrees
= 0.7923424 radians
= 50.442083 grads

Enter	Press	Display
(select degrees)		DEG
.712	[2nd] [$\sin^{-1}$]	45.397875
(select radians)		RAD
.712	[2nd] [$\sin^{-1}$]	0.7923424
(select grads)		GRAD
.712	[2nd] [$\sin^{-1}$]	50.442083

Degree, Radian, Grad Conversions

It is often necessary to convert calculated angle values from one unit of measure to another. These key sequences do not affect any calculations in progress.

[2nd] [DRG►] instructs the calculator to change the angle unit setting and convert the displayed value to its equivalent value in the new setting. Before you begin, be sure the calculator is set to the correct angle units for the angle to be converted.

Conversion	Key Sequence
Degrees to Radians	[2nd] [DRG►]
Degrees to Grads	[2nd] [DRG►] [2nd] [DRG►]
Grads to Degrees	[2nd] [DRG►]
Grads to Radians	[2nd] [DRG►] [2nd] [DRG►]
Radians to Degrees	[2nd] [DRG►] [2nd] [DRG►]
Radians to Grads	[2nd] [DRG►]

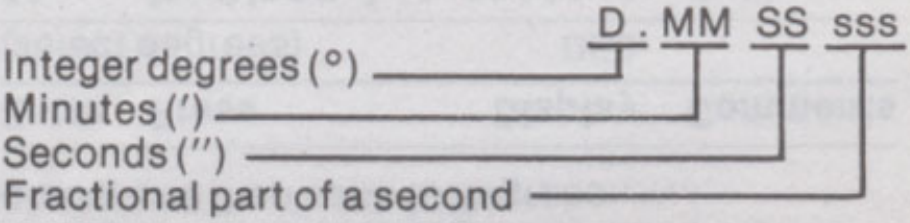
Example: Express 50 degrees in radians, then grads, and then back to degrees.

Enter	Press	Display	Comments
(select degrees)		DEG	
50	[2nd] [DRG►]	0.8726646	Radians
	[2nd] [DRG►]	55.555556	Grads
	[2nd] [DRG►]	50.	Degrees

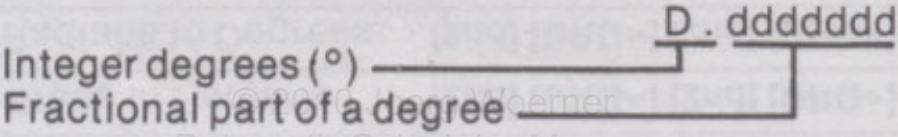
Degree Format Conversions

An angle measured in degrees, minutes, and seconds (DMS) must be converted to decimal degrees (DD) before it can be used in calculations.

The positions of the digits in degrees, minutes, and seconds are:



The positions of the digits in decimal format are:



[2nd] [DMS►DD] converts the displayed value from degrees/minutes/seconds to decimal degrees. Enter the angle as D.MMSSsss (including leading zeros as needed to place the digits in the proper positions) and press **[2nd] [DMS►DD]**.

[2nd] [DD►DMS] converts the displayed value from decimal degrees to degrees/minutes/seconds.

Example: Convert 30.2718 in degrees/minutes/seconds format to decimal degrees and back again to degrees/minutes/seconds.

Enter	Press	Display	Comments
30.2718	**[2nd] [DMS►DD]**	30.455	DD format
	[2nd] [DD►DMS]	30.2718	DMS format

Polar/Rectangular Conversions

You can convert coordinates from polar to rectangular form and vice versa. These key sequences clear any pending calculations.

Note: Polar/rectangular conversions do not function in the Statistics mode.

Polar to Rectangular—**[2nd] [P►R]** converts from polar to rectangular coordinates. To perform the conversion, follow these steps:

1. Set the calculator to the correct angle units.
2. Enter the r coordinate.
3. Press **[2nd] [$x \rightleftarrows y$]**.
4. Enter the θ coordinate.
5. Press **[2nd] [P►R]**. The y coordinate is displayed.
6. Press **[2nd] [$x \rightleftarrows y$]**. The x coordinate is displayed.

Rectangular to Polar—**[2nd] [R►P]** converts from rectangular to polar coordinates. To perform the conversion, follow these steps:

1. Set the calculator to the correct angle units.
2. Enter the x coordinate.
3. Press **[2nd] [$x \rightleftarrows y$]**.
4. Enter the y coordinate.
5. Press **[2nd] [R►P]**. The θ coordinate is displayed.
6. Press **[2nd] [$x \rightleftarrows y$]**. The r coordinate is displayed.

Statistical Functions

In many situations, you may find yourself making decisions based on a set of data. This data could be test scores, sales figures, game statistics, etc. The statistical keys on your calculator can help you evaluate this data.

Note: After completing a statistical calculation, press **[2nd] [CSR]** to resume normal operation.

Entering and Removing Data

You can enter data points by pressing [Σ+] after each entry and remove an incorrect entry by pressing **[2nd]** [Σ−]. The total number of entries is displayed after each entry.

Data Entry—[Σ+] enters data points x_i for calculation of mean, variance, and standard deviation. The first entry with this key sets the calculator in the statistical mode, and STAT appears in the display. After you enter a data value and press [Σ+], the current total number of data points (n) is displayed.

Note: The arithmetic functions, [+], [−], [×] and [÷], powers and roots with [y^x], parentheses [(] [)], constant [K] and [=] are all invalid in the statistical mode and will cause an error condition.

Data Removal—**[2nd]** [Σ−] removes unwanted data points x_i. After you remove x_i, the current number of data points (n) is displayed.

Clear Statistical Registers—**[2nd] [CSR]** clears the statistical registers and resets the calculator for normal calculations. Press this key when you have completed your statistical calculations.

Statistical Calculation Keys

When you have entered your data, you can calculate the mean, variance, standard deviation, and other statistical values by pressing the necessary keys.

Mean—[2nd] [$\bar{x}$] calculates the mean of the data entered.

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

where i = 1, 2, 3, . . . n
n = total number of data points

Sum of Data—[2nd] [Σx] calculates the sum of the entered data.

Sum of Squares—[2nd] [Σx^2] calculates the sum of the squares of the entered data.

Population Standard Deviation—[2nd] [σ_n] calculates standard deviation using n weighting (for population data).

$$\sigma_n = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n}}$$

Sample Standard Deviation—[2nd] [σ_{n-1}] calculates standard deviation using n – 1 weighting (for sample data).

$$\sigma_{n-1} = \sqrt{\frac{\Sigma(x_i - \bar{x})^2}{n-1}}$$

Note: A population is a large set of items, and a sample is a smaller portion selected from the population. The difference between sample standard deviation and population standard deviation becomes very small for 30 or more randomly sampled data points.

Statistical Calculation Keys (Continued)

Population Variance—[2nd] [σ_n] [x^2] calculates variance using n weighting (for population data).

$$Var_n = \frac{\Sigma(x_i - \bar{x})^2}{n}$$

Sample Variance—[2nd] [σ_{n-1}] [x^2] calculates variance using n – 1 weighting (for sample data).

$$Var_{n-1} = \frac{\Sigma(x_i - \bar{x})^2}{n-1}$$

Example: Analyze the following test scores: 96, 81, 87, 74, 92, assuming that the five students are the entire population.

Enter	Press	Display	Comments
	[CE/C]		
	[2nd] [CSR]	0.	Clear
96	[Σ+]	1.	1st Entry
81	[Σ+]	2.	2nd Entry
97	[Σ+]	3.	3rd Entry (incorrect)
97	[2nd] [Σ–]	2.	3rd entry removed
87	[Σ+]	3.	3rd Entry (correct)
74	[Σ+]	4.	4th Entry
92	[Σ+]	5.	5th Entry
	[2nd] [$\bar{x}$]	86.	Mean (class average)
	[2nd] [σ_n]	7.8230429	Standard Deviation
	[x^2]	61.2	Variance

Appendix A: Hyperbolic Functions

Calculating a Hyperbolic Function

To solve problems involving hyperbolic functions, use the exponential ([2nd] [e^x]) capability of your calculator.

hyperbolic sine (sinh) $x = \frac{1}{2}(e^x - e^{-x}) = \frac{e^{2x}-1}{2e^x}$

hyperbolic cosine (cosh) $x = \frac{1}{2}(e^x + e^{-x}) = \frac{e^{2x}+1}{2e^x}$

hyperbolic tangent (tanh) $x = \frac{(e^x - e^{-x})}{(e^x + e^{-x})} = \frac{e^{2x}-1}{e^{2x}+1}$

Example: $\tanh 2.99 = 0.9949551$

Enter	Press	Display
2.99	[x]	2.99
2	[=] [2nd] [e^x] [STO] [−]	395.44037
1	[=] [+] [(] [RCL] [+]	395.44037
1	[=]	0.9949551

Inverse Hyperbolic Functions

$\sinh^{-1} x = \ln(x + \sqrt{x^2+1})$

$\cosh^{-1} x = \ln(x + \sqrt{x^2-1})$ for $x \geq 1$

$\tanh^{-1} x = \frac{1}{2}\left(\frac{1+x}{1-x}\right)$ for $-1 < x < 1$

Example: $\sinh^{-1} 86.213 = 5.1500018$

Enter	Press	Display
86.213	[+] [(] [x^2] [+]	7432.6814
1	[)] [2nd] [$\sqrt{x}$] [=]	172.4318
	[ln x]	5.1500018

Appendix B: Conversion Factors

English to Metric

To Find	Multiply	By
microns	mils	25.4
centimeters	inches	2.54
meters	feet	0.3048
meters	yards	0.9144
kilometers	miles	1.609344
grams	ounces	28.349523
kilograms	pounds	4.5359237×10^{-1}
liters	gallons (U.S.)	3.7854118
liters	gallons (Imp.)	4.546090
milliliters (cc)	fl. ounces	29.573530
sq. centimeters	sq. inches	6.4516
sq. meters	sq. feet	9.290304×10^{-2}
sq. meters	sq. yards	8.3612736×10^{-1}
milliliters (cc)	cu. inches	16.387064
cu. meters	cu. feet	2.8316847×10^{-2}
cu. meters	cu. yards	7.6455486×10^{-1}

Temperature Conversions

$$°F = \frac{9}{5}\,°C + 32$$

$$°C = \frac{5}{9}\,(°F - 32)$$

Appendix C: Service Information

In Case of Difficulty

1. If the digits fail to appear on the display:
   a. Be sure that no part of the solar panel is covered.
   b. Check the intensity of the light source. The light may be too dim to operate the calculator.
2. Press **[AC/ON]** and try the calculation again.
3. Review the operating instructions to be certain the calculations were performed properly.

Service Information (Continued)

For Service and General Information

If you have questions about service or the general use of your calculator, please call Consumer Relations at:

1-806-747-1882

Please note that this is a toll number, and collect calls are not accepted.

You may also write to the following address:

Texas Instruments Incorporated
Consumer Relations
P.O. Box 53
Lubbock, Texas 79408

Please contact Consumer Relations:

- Before returning the calculator for service
- For general information about using the calculator

Express Service

Texas Instruments offers an express service option for fast return delivery. Please call Consumer Relations for information.

Calculator Accessories

If you are unable to purchase calculator accessories (such as carrying cases) from your local dealer, you may order them from Texas Instruments. Please call Consumer Relations for information.

Returning Your Calculator for Service

A defective calculator will be either repaired or replaced with the same or comparable reconditioned model (at TI's option) when it is returned, postage prepaid, to a Texas Instruments Service Facility.

Texas Instruments cannot assume responsibility for loss or damage during incoming shipment. For your protection, carefully package the calculator for shipment and insure it with the carrier. Be sure to enclose the following items with your calculator:

- Your full return address
- Any accessories related to the problem
- A note describing the problem you experienced
- A copy of your sales receipt or other proof of purchase to determine warranty status

Please ship the calculator postage prepaid; COD shipments cannot be accepted.

In-Warranty Service

For a calculator covered under the warranty period, no charge is made for service.

Out-of-Warranty Service

For an out-of-warranty calculator, a flat-rate fee by model is charged for service. To obtain the service charge for a particular model, please call Consumer Relations **before** returning the calculator to the Service Facility.

Service Information (Continued)

TI Service Facilities

U.S. Residents

(U.S. parcel post)
Texas Instruments
P.O. Box 2500
Lubbock, Texas 79408

(Other carriers)
Texas Instruments
2305 N. University
Lubbock, Texas 79415

Canadian Residents Only:
Texas Instruments
41 Shelley Road
Richmond Hill, Ontario, L4C 5G4

One-Year Limited Warranty

This Texas Instruments electronic calculator warranty extends to the original consumer purchaser of the product.

Warranty Duration: This calculator is warranted to the original consumer purchaser for a period of one (1) year from the original purchase date.

Warranty Coverage: This calculator is warranted against defective materials or workmanship. **This warranty is void if the product has been damaged by accident, unreasonable use, neglect, improper service, or other causes not arising out of defects in material or workmanship.**

Warranty Disclaimers: Any implied warranties arising out of this sale, including but not limited to the implied warranties of merchantability and fitness for a particular purpose, are limited in duration to the above one year period. Texas Instruments shall not be liable for loss of use of the calculator or other incidental or consequential costs, expenses, or damages incurred by the consumer or any other user.

Some states do not allow the exclusion or limitations of implied warranties or consequential damages, so the above limitations or exclusions may not apply to you.

Legal Remedies: This warranty gives you specific legal rights, and you may also have other rights that vary from state to state.

Warranty Performance: During the above one-year warranty period, your TI calculator will be either repaired or replaced with a reconditioned comparable model (at TI's option) when the product is returned, postage prepaid, to a Texas Instruments Service Facility. The repaired or replacement calculator will be in warranty for the remainder of the original warranty period or for six months, whichever is longer. Other than the postage requirement, no charge will be made for such repair or replacement of in-warranty calculators. Texas Instruments strongly recommends that you insure the product for value, prior to mailing.

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