TEXAS INSTRUMENTS

SCIENTIFIC

TI-30 STAT

QUICK REFERENCE GUIDE

Key Index

The following chart is an indexed keyboard. Below each key is a page number which provides a quick reference to the description of that key.

				ON/C 4
[CSR] 40 x! 30	 1/x 30	 % 14	 DRG 33	 OFF 4
[√x] 28 x² 28	[SIN⁻¹] 34 SIN 34	[COS⁻¹] 34 COS 34	[TAN⁻¹] 34 TAN 34	[ˣ√y] 29 yˣ 29
  2nd 5	[EE] 7 EE 7	[10ˣ] 32 LOG 32	[eˣ] 31 LN 31	 ÷ 12
[Σ−] 39 Σ+ 39	 K 21	 (18	) 18	 × 12
[x̄] 40 STO 23	 7 6	 8 6	 9 6	 − 12
[σn-1] 40 RCL 23	 4 6	 5 6	 6 6	 + 12
[σn] 40 SUM 25	 1 6	 2 6	 3 6	 = 12
[π] 6 EXC 26	 0 6	 · 6	 +/− 6	

Dual Function Keys

Alternate functions are marked directly above the function key. To access the alternate function, press the 2nd key before you press the function key.

The TI-30 STAT Calculator

The TI-30 STAT 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

- Easy-to-read Liquid Crystal Display (LCD).
- The AOS™ Algebraic Operating System follows standard mathematical hierarchy of operation, allowing you to enter even complicated problems simply and directly.
- The Constant Memory™ feature holds numbers in memory even when the calculator is turned off.
- The APD™ Automatic Power Down is a power-saving feature that turns the calculator off automatically after 15 to 35 minutes of nonuse.
- 54 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 and Off

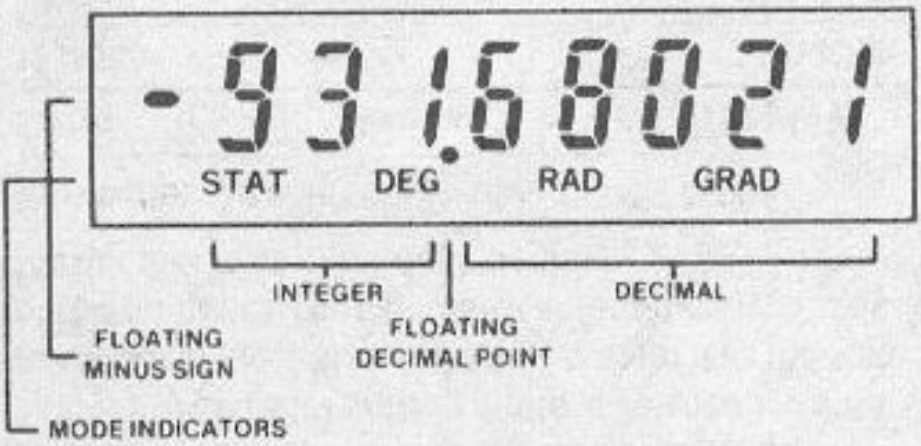
Pressing the ON/C key, located in the upper right corner of the keyboard, turns the calculator on and clears it. When you turn the calculator on, a 0 appears in the display.

The OFF key turns the calculator off. When you turn the calculator off and then back on, the display, all pending operations and operands, and the statistical registers are cleared. However, the calculator's Constant Memory™ feature retains any value you have stored in memory.

APD™ Automatic Power Down

If no key is pressed for a period of about 15 to 35 minutes, the calculator is automatically turned off. This feature increases the operating life of your batteries.

The Display



LCD Digits—You can enter a maximum of eight digits in the display. Any digit keys pressed after the eighth are ignored.

Floating Minus Sign—A negative number is displayed with a minus sign immediately to the left of the number, just as negative numbers are normally written.

Angle Mode Indicators—(Explanation on page 33)
DEG—Indicates degree mode.
RAD—Indicates radian mode.
GRAD—Indicates grad mode.

Statistics Mode Indicator—(Explanation on page 39)
STAT—Indicates statistical mode.

Dual Function Keys

2nd **Second Key**—Selects the second, or alternate, function of the next key pressed. 2nd is cancelled if followed by a key with no second or alternate function or if 2nd is pressed again.

Data Entry Keys

[0] through [9] **Digit Keys**—Enter numbers 0 through 9.

[·] **Decimal Point Key**—Enters a decimal point. A decimal point is automatically displayed to the right of an integer.

[π] **Pi Key** (Use the key sequence [2nd] [π])—Enters the value of pi correct to 11 digits and rounded to 8 digits (3.1415927) for display.

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

Entering Decimal Data

For maximum versatility, your calculator operates with a floating decimal point. When you enter numbers, the decimal is assumed to be to the right of the digits until you press [·]. The remaining digits you enter become the fractional part of the number.

You can enter numbers up to 8 digits in length into the calculator directly from the keyboard. However, the calculator can work with 11 digits. If you need to enter a number of more than eight digits, enter it as the sum of two numbers. The calculator automatically rounds the number to an eight-digit display.

Example: To enter the number 123456.78901

Enter	Press	Display
1234566	[+]	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 $\pm 1 \times 10^{-7}$ 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}.

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

[×] 1 [EE] [=] **Scientific Notation Key Sequence**—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 for subsequent calculations and discards the internally carried digits.

[2nd] [EE] **Scientific Notation Removal Key Sequence**—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 display format. If the displayed number is outside the range listed above, the key sequence is ignored, and the number remains in scientific notation format.

Using Scientific Notation

Procedures for using scientific notation are listed below.

- 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 are used to indicate the exponent of 10. (For example, you can write the number 320,000,000 as 3.2×10^8. Following the previous instructions, enter this number as 3.2 [EE] 8. The display reads 3.2 08.)
- To attach a negative sign to the mantissa and to the power-of-ten exponent, press the change sign [+/−] key after entering the number.

Regardless of 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. (Watch what happens to the decimal point and the exponent in the display when you enter 6025 [EE] 20 [=].)

Data in scientific notation form can be entered intermixed 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 [2nd] [EE] = . The answer is 15775.321.)

Note: The display does not go into scientific notation format if more than 5 numbers are entered to the left of the decimal point. If you want to enter a mantissa of more than 5 digits, you can enter up to 5 integers and 3 decimal numbers. Only the first 5 are displayed when [EE] is pressed, but the entire 8-digit mantissa is used for calculations.

Rounding and Accuracy

Each calculation produces an 11-digit result, even though the display can only show 8 digits. The result is, therefore, rounded to an 8-digit standard display or to a 5-digit mantissa and 2-digit exponent for 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.

Clearing Data Entry

[ON/C] **Clear Entry/Clear Key**—Removes an incorrect entry from the display when pressed before any function or operation key is pressed.

When pressed after an operation or function key (including [=]), this key clears the display, the constant, and all pending operations.

Pressing [ON/C] twice always clears the display, the constant, and pending operations. The user memory is not affected by this key.

Error Indication

The display shows **Error** when overflow or underflow occurs or when you request an improper mathematical operation. When this occurs, no entry from the keyboard (except [OFF]) is accepted until [ON/C] is pressed. Pressing [ON/C] clears the error condition and all pending operations. You must then start over at the beginning of your problem.

Error messages appear for the following reasons.

- Number entry or calculation result (including memory sum) outside the range of the calculator, $\pm 1.0 \times 10^{-99}$ to $\pm 9.9999 \times 10^{99}$.
- Dividing a number by zero.
- Calculating [LOG], [LN], or [1/x] of zero or calculating the 0th root of any number.
- Calculating [LOG], [LN], a power, or a root of a negative number.
- Inverse of sine or cosine (arcsine, arccosine) when the absolute value is greater than 1.
- Tangent of 90°, 270°, $\pi/2$ radians, $3\pi/2$ radians, 100 grads, 300 grads, or their rotation multiples.
- Having more than 15 open levels of parentheses or more than four pending operations.
- Factorial of any number except zero or a positive integer ≤ 69.
- Multiplying a number greater than 1×10^{99} by another number (decimal or integer).

- Pressing [+], [−], [×], [÷], [y^x], [(], [)], [K], or [=] while in the statistical mode (STAT appears).

The following error conditions cause the statistical registers to be cleared and the calculator to reset to normal calculation mode.

- Calculating standard deviation (n − 1 weighting) with only one data point.
- Entering a statistical data point x, such that $x \leq \pm 1 \times 10^{-50}$ or $x \geq \pm 1 \times 10^{50}$.
- Entering a series of statistical data points (X_1) such that $\Sigma(x_1)^2$ exceeds the upper or lower limit of the calculator.
- Removing last statistical data point (n = 1) using [2nd] [Σ −].

Arithmetic Functions

This calculator uses the AOS™ Algebraic Operating System. This advanced system allows key sequences to be interpreted correctly by storing certain quantities and operations until they can be completed following standard algebraic rules. A more complete discussion of this system occurs later in this section.

Basic Keys

[+] **Add Key**—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 quantity to the displayed number.

[−] **Subtract Key**—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.

[×] **Multiply Key**—Completes any previously entered x, ÷, 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.

[÷] **Divide Key**—Completes any previously entered x, ÷, 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 Key**—Combines all previously entered numbers and operations. This key is used to obtain both intermediate and final results.

Example problems that use these basic keys are given below. As you work the problems, notice the straightforward manner in which the numbers and functions are entered.

Example: 23.79 + 0.54 − 6 = 18.33

Enter	Press	Display
	ON/C	0
23.79	+	23.79
.54	−	24.33
6	=	18.33

In the following examples, notice that you do not need to press ON/C if the preceding 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

Percent

[%] **Percent Key**—Converts the displayed number from a percentage to a decimal. (For example: enter 43.9 and press [%]. The decimal number 0.439 is displayed.)

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

[+] **n** [%] [=] adds **n**% to the number displayed.
[−] **n** [%] [=] subtracts **n**% from the number displayed.
[×] **n** [%] [=] multiplies the displayed number by **n**%.
[÷] **n** [%] [=] divides the number displayed by **n**%.

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 2%?

Enter	Press	Display
5	[−]	5
2	[%] [=]	4.9

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

Combining Operations

You can use the result of one calculation as the first number in a second calculation. You do not need to re-enter the number from the keyboard.

Input Error Correction

At any point in a calculation, you can press [ON/C] twice to clear all calculations, including any errors, and start over.

If you enter an incorrect number, press the [ON/C] key before you press the operation key. The incorrect number clears without affecting any calculation in progress.

If you enter an incorrect operation when there are no stored operations, simply press the correct operation and continue. This applies to [+], [−], [×], [÷], [y^x], and [2nd] [$\sqrt[x]{y}$].

If you enter an incorrect operation while there are pending calculations, it is safest to press [ON/C] and restart the problem.

Order of Calculations

Your calculator follows standard algebraic rules that assign priorities to the various mathematical operations and permit you to efficiently combine 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) immediately replace the displayed value with their respective functions.
2. Exponentiation (y^x) and roots ($\sqrt[x]{y}$) are performed as soon as the single-variable functions are completed.
3. Multiplicaton and division are performed as soon as the special functions, exponentiation, root extraction, and other multiplication and division are completed.
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 remembers all stored operations and recalls each and its associated number for execution at the correct time. Once you are familiar with the order of these operations, most problems are easy to solve because of the straightforward manner in which they can be entered into the calculator.

Note: The keys on the right side of the keyboard are positioned in such a way as to help you remember the AOS™ 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.

Parentheses

( ) Parentheses 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 whenever a mathematical sequence cannot be directly entered using the AOS™ order of calculations or when you are in doubt about how the calculator is going to reduce an expression.

Some problems require that you instruct the calculator exactly how to evaluate the problem and produce the correct answer. For example,

$4 \times (5 + 9) \div (7 - 4)^{(2 + 3)} = ?$

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

To illustrate the benefit of parentheses, try the following experiment: press (5 + 9). The value 14 displays automatically. The calculator evaluates 5 + 9 and replaces it with 14 even though the = key is not pressed. Because of this function of parentheses, the order of calculation rules now apply within each set of parentheses.

By using the parenthesis, 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 parenthesis pair are completed as soon as the close parenthesis is encountered.

Example: $4 \times (5 + 9) \div (7 - 4) = 18.666667$
(Key in this expression and follow the path to completion.)

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 fifteen 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 do attempt to open more than 15 parentheses or if the calculator tries to store more than four operations, an **Error** message appears in the display.

The following example, requiring the storage of 4 pending operations, shows the order of interpretation provided by the calculator's operating system.

Example: 5 + (8 ÷ (9 − (2 ÷ 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 whenever it is used, it could have been used here instead of the three [)] keys. Try working this problem again and pressing [=] instead of the first [)].

Each time a close parenthesis is encountered, the contents are evaluated back to the nearest open parenthesis and are replaced with a single value. Knowing this, you can structure the order of interpretation for whatever purpose you want. Specifically, you can check intermediate results.

Calculations with a Constant

[K] **Constant Key**—Stores a number and its associated operation for repetitive calculations. Enter the number, then the operation, then press [K].

You can simplify repetitive calculations by using the constant feature of the calculator. You can enter a recurring sequence such as $+3$, $x^{(-17.3)}$, or y^7, and it can be stored and used by the calculator to operate on any displayed number. To use the constant feature, enter the repetitive number, m, enter the desired operation, and 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 **m**th power
m [2nd] [$\sqrt[x]{y}$] [K]	takes the **m**th root of each subsequent entry

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

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
	[ON/C]	0.
1.8026	[+] [K]	1.8026
31	[=]	32.8026
745.797	[=]	747.5996
8.002	[+/−] [=]	−6.1994
3.2	[EE]	3.200
2	[+/−] [=]	1.834600

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

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

Memory Usage

Your calculator can store data in memory even while the calculator is turned off. This feature allows you to store often used numbers in memory or to keep a running total of figures over a long period of time without having to write them down and re-enter them each time the calculator is turned on.

Use of the memory does not affect any calculations in progress, so you can use memory operations whenever needed.

Memory Store

[STO] **Memory Store 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

[RCL] **Memory Recall Key**—Recalls the contents of the memory into the display without affecting the content of the memory.

Example: Store and recall 45.68

Enter	Press	Display
45.68	[STO]	45.68
	[OFF] [ON/C]	0.
	[RCL]	45.68

By using these keys, you can store a long number you want to use several times. Notice that you can turn off the calculator without losing the contents of the memory registers.

Example: Evaluate $2.4x^4 - 3x^2 + x - 10.25$ when $x = 3.1478963$

Enter	Press	Display	Comments
2.4	[×]	2.4	
3.1478963	[STO] [y^x]	3.1478963	Store x
4	[−]	235.66382	$2.4x^4$
3	[×]	3	
	[RCL]	3.1478963	Recall x
	[x^2]	9.9092511	x^2
	[+]	205.93607	$2.4x^4 - 3x^2$
	[RCL]	3.1478963	Recall x
	[−]	209.08396	$2.4x^4 - 3x^2 + x$
10.25	[=]	198.83396	Answer

You can see that storing x the first time it is entered saves you from having to spend 15 more keystrokes to key in x the other two times it is needed. A single press of the [RCL] key brings the eight digit x to the display each time. Notice also that using the [STO] and [RCL] did not interfere with calculator operations.

Sum to Memory

[SUM] **Sum to Memory Key**—Algebraically adds the display value to the memory content. This key does not affect the displayed number or calculations in progress.

Important: Because of your calculator's Constant Memory™ feature, the memory is not automatically cleared when the calculator is turned off. To prevent adding a new number to the existing contents of the memory, be sure to first clear the memory registers by pressing [ON/C] [STO] before pressing [SUM].

Example:

$28.3 \times 7 = 198.1$
$173 + 16 = 189$
$312 - 42 + 7.8 = 277.8$
Total 664.9

Enter	Press	Display	Memory
28.3	[×]	28.3	0.
7	[=] [STO]	198.1	198.1
173	[+]	173.	198.1
16	[=] [SUM]	189.	387.1
312	[−]	312.	387.1
42	[+]	270.	387.1
7.8	[=] [SUM]	277.8	664.9
	[RCL]	664.9	664.9

This example is performed using the memory but, if the expression had been more complicated, solving the entire problem sequentially could be risky. A mistake would mean starting over. By placing the sum in memory, each completed expression is independent of the previous calculations.

Memory Exchange

[EXC] **Exchange Key**—Swaps the content of the memory with the display value. The display 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	Memory
.258963	[STO] [x^2] [+]	0.0670618	Store A, 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

When A is recalled from memory the last time it is needed, pressing [EXC] instantly stores B in its place.

Algebraic Functions

The special function keys described in this section are single-variable functions except for y^x and $\sqrt[x]{y}$, which are two-variable functions.

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

Two-variable functions can be isolated within a calculation by parentheses or used with the order of calculations.

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.

Roots and Powers

[x²] **Square Key**—Calculates the square of the number x in the display.

Example: $(4.235)^2 = 17.935225$

Enter	Press	Display
4.235	[x²]	17.935225

[2nd] [$\sqrt{x}$] **Square Root Key Sequence**—Calculates the square root of the number x in the display. The x value cannot be negative.

Example: $\sqrt{6.25} = 2.5$

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

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

Enter	Press	Display
3.1452	[2nd] [$\sqrt{x}$] [−]	1.7734712
7	[+]	−5.226528
3.2	[x²]	10.24
	[=]	5.0134712
	[2nd] [$\sqrt{x}$]	2.2390782

Y to the xth power and the xth root of y are the only special functions that do not act immediately on the displayed value. Both require a second value before the function can be realized. The procedure for using these two keys is identical as illustrated on the next page.

$\boxed{y^x}$ **y to the xth Power Key**—Raises the displayed value y to the xth power. The order of entry is y $\boxed{y^x}$ x. The y value cannot be negative, but both x and y can be fractional.

Example: $2.86^{-.42} = 0.643171$

Enter	Press	Display
2.86	$\boxed{y^x}$	2.86
.42	$\boxed{+/-}$	−0.42
	$\boxed{=}$	0.6431707

$\boxed{2nd}$ [$\sqrt[x]{y}$] (= $\sqrt[x]{y}$ **xth Root of y Key Sequence**—Takes the xth root of the displayed value y. The order of entry is y $\boxed{2nd}$ [$\sqrt[x]{y}$] x. The y value cannot be negative, but both x and y can be fractional.

Example: $\sqrt[3.12]{1460} = 10.3327$

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

There is a restriction on these functions—the variable y must be non-negative. When y is negative, the **Error** message appears in the display after x and an operation key are pressed.

Accuracy for roots and powers 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

[1/x] **Reciprocal 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

Factorial

[x!] **Factorial Key**—Calculates the factorial (x) $(x-1)(x-2)\ldots(2)(1)$ of the value x in the display for integers $0 \leq x \leq 69$. $0! = 1$ by definition.

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

Enter	Press	Display
36	[x!]	3.719941

Natural Logarithm and Natural Antilogarithm

[LN] **Natural Logarithm Key**—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]	0.1823216

[2nd] [e^x] **Natural Antilogarithm (e to the xth power) Key Sequence**—Calculates the natural antilogarithm of the disp]ayed 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
	[ON/C] [(]	0.	
7.5	[+]	7.5	Enter 7.5
1.4	[LN]	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 Common Antilogarithm

[LOG] **Common Logarithm Key**—Calculates the common logarithm (base 10) of the number x in the display. When $x > 0$.

Example: log 32.01 = 1.5052857

Enter	Press	Display
32.01	[LOG]	1.5052857

[2nd] [10^x] **Common Antilogarithm (10 to the xth power) Key Sequence**—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 $(303 + 10^{1.36}) = 2.5130959$

Enter	Press	Display	Comments
	[ON/C] [(]	0.	
303	[+]	303.	Enter 303
1.36	[2nd] [10^x]	22.908676	$10^{1.36}$
	[)]	325.90868	$303 + 10^{1.36}$
	[LOG]	2.5130959	Answer

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

Trigonometric Functions

[DRG] **Degree, Radian, Grad Key**—Selects the units for angular measurement.

When you first turn the calculator on, it is in the degree mode. Pressing the [DRG] key once places the calculator in the radian mode. Press this key again and your angles are measured in grads (right angle = 100 grads). The mode changes in a rotary fashion each time you push the key. Another key push, for instance, returns the calculator to the degree mode.

The display indicates the current angle mode of the calculator. **DEG** is displayed for degree mode. **RAD** is displayed for radian mode. **GRAD** is displayed for grad mode.

The angle mode has absolutely no effect on calculations unless the trigonometric functions are being used. Selecting the angle mode is an easy step to perform—**and to forget!** Neglecting this step is responsible for a large portion of errors when using trigonometric functions.

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

When you activate the trig functions (sine, cosine, and tangent), they compute their respective functions of the displayed angle. The inverse trig functions find the smallest angle whose function value is in the display.

[SIN] **Sine Key**—Instructs the calculator to find the sine of the displayed value.

[2nd] [SIN^{-1}] **Arcsin Key Sequence**—Calculates the smallest angle whose sine is in the display (first or fourth quadrant).

[COS] **Cosine Key**—Instructs the calculator to find the cosine of the displayed value.

[2nd] [COS^{-1}] **Arccosine Key Sequence**—Calculates the smallest angle whose cosine is in the display (first or second quadrant).

[TAN] **Tangent Key**—Instructs the calculator to find the tangent of the displayed value.

[2nd] [TAN^{-1}] **Arctangent Key Sequence**—Calculates the smallest angle whose tangent is in the display (first or fourth quadrant).

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

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

Example: sin 30° = 0.5 = sin 390°

Enter	Press	Display
(select degree mode **DEG**)		
30	SIN	0.5
390	SIN	0.5

Example: $[\sin(.3012\pi)]^{-\tan(16.2°)} = 1.06267$

Enter	Press	Display	Comments
(select radian mode **RAD**)			
	ON/C (	0.	
.3012	×	0.3012	
	2nd [π]	3.1415927	
	)	0.9462477	
	SIN	0.8112271	
	y^x	0.8112271	
16.2	DRG DRG TAN	0.2905269	Tan 16.2°
	+/− =	1.0626654	Answer

The largest angle resulting from an arc function is 180 degrees (π radians or 200 grads). Because certain angles have identical function values within one revolution. The angle returned by each function is restricted as indicated on the next page.

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

Examples:

$\sin^{-1} .712 = 45.397874$ degrees $= 0.7923424$ radians $= 50.442082$ grads

Enter	Press	Display
(select degree mode **DEG**)		
.712	2nd [SIN^{-1}]	45.397875
(select radian mode **RAD**)		
.712	2nd [SIN^{-1}]	0.7923424
(select grad mode **GRAD**)		
.712	2nd [SIN^{-1}]	50.442083

$$\sqrt{\arctan 9.72^\circ} + \frac{1}{\arcsin .808^\circ} = 9.1905773^\circ$$

Enter	Press	Display	Comments
(select degree mode **DEG**)			
9.72	2nd [TAN^{-1}]	84.126039	arctan 9.72
	2nd [$\sqrt{x}$] [+]	9.1720248	$\sqrt{\arctan 9.72}$
.808	2nd [SIN^{-1}]	53.900984	arcsin .808
	1/x	0.0185525	1 / arcsin .808
	=	9.1905773	Answer

Degree, Radian, Grad Conversions

It is frequently necessary to convert angular values from one unit system to another. While there are no special conversion keys for this purpose, the key sequences to convert angular units are relatively simple and can be used without affecting the statistical registers, the memory registers, or calculations in progress.

Before you begin, be sure the calculator is in the correct angle mode for entering the angle to be converted.

Conversion	Key Sequence
Degrees to Radians	SIN DRG 2nd [SIN^{-1}]
Degrees to Grads	SIN DRG DRG 2nd [SIN^{-1}]
Grads to Degrees	SIN DRG 2nd [SIN^{-1}]
Grads to Radians	SIN DRG DRG 2nd [SIN^{-1}]
Radians to Degrees	SIN DRG DRG 2nd [SIN^{-1}]
Radians to Grads	SIN DRG 2nd [SIN^{-1}]

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

Enter	Press	Display	Comments
(select degree mode **DEG**)			
50	SIN DRG 2nd [SIN^{-1}]	0.8726646	Radians
	SIN DRG 2nd [SIN^{-1}]	55.555556	Grads
	SIN DRG 2nd [SIN^{-1}]	50.	Degrees

The angular range of the previous conversions must be limited to the first and fourth quadrants:

0 ± 90 degrees 0 ± 100 grads 0 ± π/2 radians

Larger angles used in the conversion sequences are returned in the first or fourth quadrants as governed by the calculator arcsine function.

You can use the following table for converting angles in any quadrant from one system to another.

FROM \ TO	Degrees	Radians	Grads
degrees		× π/180	÷ .9
radians	× 180/π		× 200/π
grads	× .9	× π/200	

These operations can be performed in any angle mode setting of the calculator. Therefore, you should be careful when using the results for further calculations. **The angle mode must be adjusted to match the units of the results.**

Example: Convert 120 degrees to radians and grads.

Enter	Press	Display	Comments
120	× 2nd		
	[π] ÷	376.99112	
180	=	2.0943951	radians
	×	2.0943951	
200	÷ 2nd		
	[π] =	133.33333	grads
	×	133.33333	
.9	=	120	degrees

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. You can effectively evaluate this data using statistical methods. The most commonly used statistical calculations are the mean (x), standard deviation (σ_n or σ_{n-1}), and variance (σ^2_n or σ_{n-1}^2).

The mean (or average value) is the most common "central" tendency in your data. The standard deviation and variance give you a feel for how variable the data are—a feel for how far the data differs from the mean.

Statistical Data Entry and Removal

[Σ+] **Sigma Plus Key**—Enters data points x_i for calculation of mean, variance, and standard deviation. After you enter x_i, the current number of data points (n) is displayed. The first entry with this key sets the calculator in the statistical mode and **STAT** appears in the display.

[2nd] [Σ−] **Sigma Minus Key Sequence**—Removes unwanted data points x_i. After you remove x_i, the current number of data points (n) is displayed.

Using the Statistical Mode

[Σ+] sets the calculator in the statistical mode. The arithmetic functions, [+], [−], [×] and [÷], powers and roots with [y^x], parenthesis [(] [)], constant [K] and [=] are all invalid in the statistical mode and will cause an **Error** message.

[2nd] [CSR] clears the statistical registers and resets the calculator for normal calculations.

Mean

[2nd] [$\bar{x}$] **Mean Key Sequence**—Calculates the mean of the data entered.

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}, i = 1, 2, 3 \ldots n$$

Standard Deviation

[2nd] [σn] **Population Standard Deviation Key Sequence**—Calculates standard deviation using n weighting (for population data).

$$\sigma_n = \sqrt{\frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{N}}$$

[2nd] [$\sigma n-1$] **Sample Standard Deviation Key Sequence**—Calculated standard deviation using n – 1 weighting (for sample data).

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

Note: A population is usually a large set of items and a sample is a smaller portion selected from the population. The difference between the Sample Standard Deviation and the Population Standard Deviation calculations becomes very small for over 30 data points.

Variance

[2nd] [σn] [x^2] **Population Variance Key Sequence**— Calculates variance using n weighting (for population data).

$$VAR_{(n)} = \frac{i = \sum_{i}^{N}(x_i - \overline{x})^2}{N}$$

[2nd] [$\sigma n-1$] [x^2] **Sample Variance Key Sequence**— Calculates variance using n – 1 weighting (for sample data).

$$VAR_{(n-1)} = \frac{i = \sum_{i}^{N}(x_i - \overline{x})^2}{N-1}$$

Entering and Removing Data Entries

Enter data points by pressing [Σ+] after each entry and remove them by pressing [2nd] [Σ−] after entry of an incorrect point. The number of each entry is displayed after each entry.

Once you have entered the data, you can calculate the mean, variance, and standard deviation by simply pressing the necessary keys.

Example: Analyze the following test scores: 96, 81, 87, 70, 93, 77, assuming that the six students are the entire population.

Enter	Press	Display	Comments
	[ON/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)
70	[Σ+]	4	4th Entry
93	[Σ+]	5	5th Entry
77	[Σ+]	6	6th Entry
	[2nd] [$\bar{x}$]	84	Mean (class average)
	[2nd] [σn]	9.0184995	Standard Deviation
	[x^2]	81.333333	Variance

Important: Remember to press [2nd] [CSR] to perform arithmetic calculations.

Appendix A: Hyperbolic Functions

Hyperbolic Functions

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	[×]	2.99
2	[=]	5.98
	[2nd] [e^x] [STO] [−]	395.44037
1	[=] [÷]	394.44037
	[(] [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 $x \geq 1$

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

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

Enter	Press	Display
86.213	[+] [(]	86.213
	[x^2] [+]	7432.6814
1	[)]	7433.6814
	[2nd] [$\sqrt{x}$]	86.218799
	[=]	172.4318
	[LN]	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

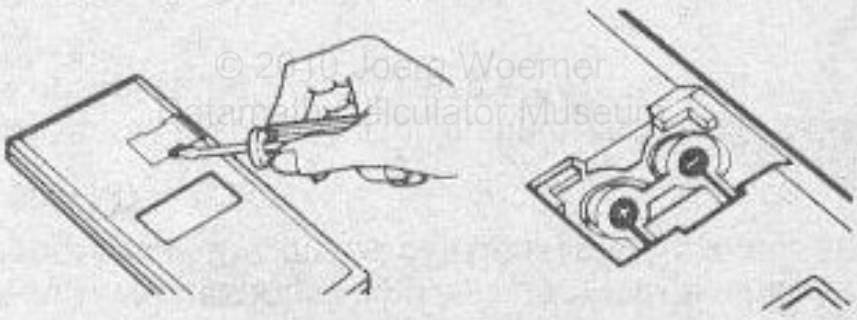
Battery Replacement

Note: Your calculator cannot hold data if the batteries are removed or become discharged.

Replace the batteries with one of these two types:

- For up to 1000 hours operation, you can use two Panasonic LR-44, Union Carbide (Eveready) A-76, or Ray-O-Vac RW-82 alkaline batteries (equivalent supplied with calculator).
- For up to 2500 hours operation, you can use two Mallory 10L14, Union Carbide (Eveready) 357, Panasonic WL-14, Ray-O-Vac RW-42, or Toshiba G-13 silver-oxide batteries.

1. Turn the calculator off. Place a small screwdriver, paper clip, or other similar instrument into the slot, and gently lift the battery cover.



2. Remove the discharged batteries and install new ones as shown. Be careful not to crease the film contacts while installing the new batteries. Be sure the film contacts are positioned to lie on top of the batteries after the batteries are installed.
3. Replace the battery cover, top edge first. Press until the bottom of the cover snaps into place.
4. Press [OFF], [ON/C] [ON/C], [2nd] [CSR], and [STO]. The display then shows 0 and DEG and the calculator is ready to be used.

Caution: The old batteries should be disposed of properly. Do not incinerate the batteries or leave them where a child can find them. Swallowing a battery may lead to an injury.

In Case of Difficulty

1. If the digits fail to appear on the display, check for improperly inserted or discharged batteries. See Battery Replacement on the previous page.
2. Press [OFF] then [ON/C] and try the calculation again. Review the operating instructions to be certain the calculations were performed properly.
3. When batteries are inserted into the calculator and the display does not reset, pressing [OFF], [ON/C] [ON/C] [2nd] [CSR] and [STO] should reset the display and prepare the calculator for use.

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 or adapters) 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

A flat-rate charge by model is made for out-of-warranty service. To obtain the service charge for a particular model, call Consumer Relations before returning the product for service. (We cannot hold products in the Service Facility while providing charge information.)

Texas Instruments Service Facilities

U. S. Residents
(U.S. Postal Service)
Texas Instruments
P.O. Box 2500
Lubbock, Texas 79408

U. S. Residents
(other carriers)
Texas Instruments
2305 N. University
Lubbock, Texas 79415

Canadian Residents Only
Texas Instruments
41 Shelley Road
Richmond Hill, Ontario, Canada L4C5G4

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 (1) 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. Texas Instruments strongly recommends that you insure the product for value, prior to mailing.

FCC Information Concerning Radio Frequency Interference

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference with radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you can try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Caution: Any changes or modifications to this equipment not expressly approved by Texas Instruments may void your authority to operate the equipment.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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