Texas Instruments

Slimline TI-50™

scientific calculator

KEY INDEX

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

IMPORTANT

Record the serial number from the bottom of the unit and purchase date in the space below. The serial number is identified by the words "SERIAL NO." on the bottom case. Always reference this information in any corresponsdence.

TI-50

Model No. **Serial No.** **Purchase Date**

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I. DESCRIPTION

Problem solving is an integral part of every field of study. It is through the solutions of problems that the critical decisions of business and science are tested and verified. Mastery of those mathematical techniques begins early in school and continues throughout life. This slide-rule calculator provides a convenient and accurate electronic means of obtaining answers to a wide range of problems beginning with elemental arithmetic and continuing through the most complicated situations. Use this calculator regularly and it will soon become an inseparable component of your problem solving system. Years of concentrated research in the calculator industry and the latest electronic advances have combined to produce this extremely versatile yet reasonably priced calculator. Here are a few of its features.

Features and Functions

- Easy to read Liquid Crystal Display (LCD).
- AOS™ Algebraic Operating System allows you to enter mathematical sequences in the same order that they are algebraically stated.
- Constant Memory™ feature holds numbers in statistics registers and user memories even while the calculator is turned off.
- APD™ Automatic Power Down provides for special power-saving features. The calculator turns itself off completely after typically 5 to 15 minutes of nonuse. You will never waste a set of batteries by forgetting to turn your calculator off or by having it turned on accidentally. This feature can increase the life of each set of batteries up to 50%.
- Battery indicator provides information on battery condition.
- Over 1000 hours of operation can normally be achieved from a fresh set of batteries.

• 60 Calculator Functions

Arithmetic	+, −, ×, ÷	4
Data Entry	+/−, π	2
Display	Scientific notation/ removal; mantissa expansion/ removal	4
Algebraic	x^2, $\sqrt{x}$, $1/x$, y^x, $\sqrt[x]{y}$, $x!$	6
Clearing	Clear and Clear Entry	2
Data Grouping	AOS algebraic operating system. Open and close parentheses (up to 15), and full algebraic hierarchy (up to 4 pending operations).	3
Memory	Two memories which can: Store, Recall, Exchange, Clear, Add, Subtract, Multiply and Divide	9
Percent	%, + %, − %, × %, ÷ %	5
Trigonometric	Sin, Cos, Tan, Sin^{-1}, Cos^{-1}, Tan^{-1}, and 3 angular modes (Degrees, Radians, Grads)	9
Logarithmic	ln x, log, e^x, 10^x	4
Constant	Operates with +, −, ×, ÷, y^x and $\sqrt[x]{y}$	6
Statistical	$\Sigma+$, $\Sigma-$, $\bar{x}$, σ_n, σ_{n-1}	5
Other	APD automatic power down mode select	1
		60

• Accuracy — The internal calculating capacity is 11 digits even though only 8 can be displayed. The 8-digit displayed number is generally rounded to within ± 1 in the 8th digit for all functions except where noted.

II. BASIC OPERATIONS

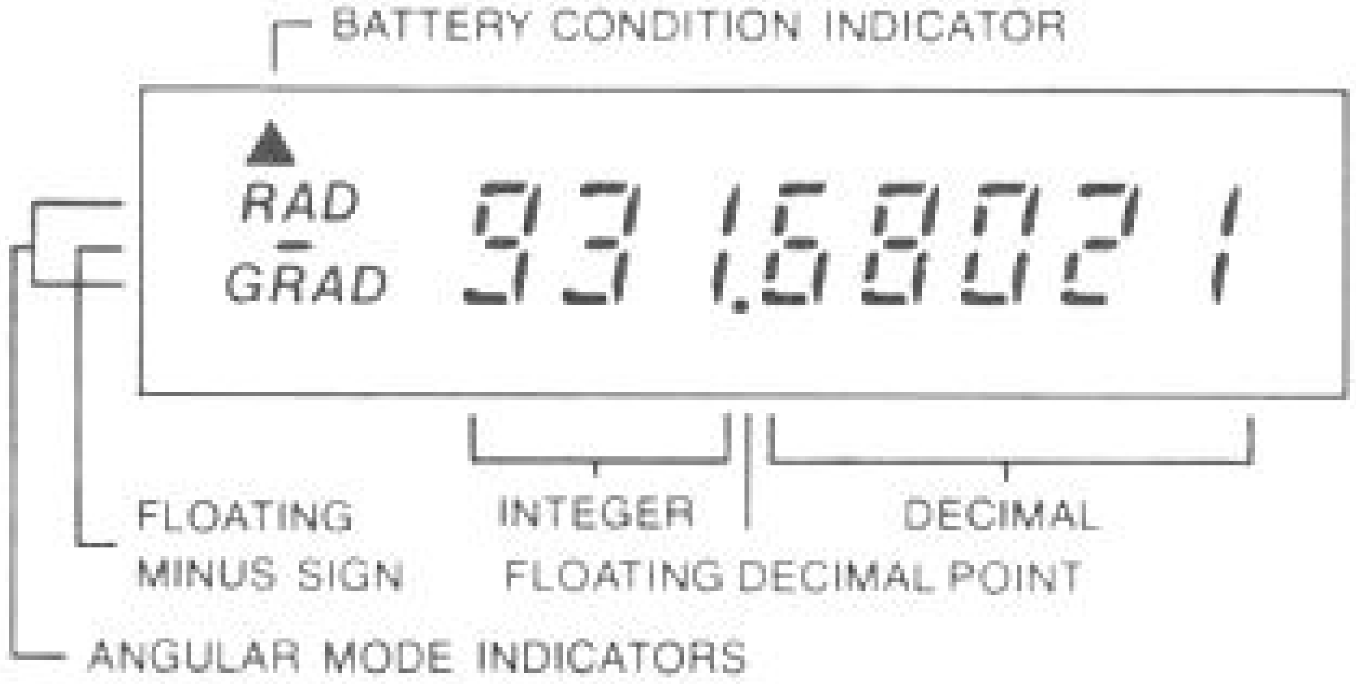
Your calculator is easy to operate because of its exclusive AOS™ Algebraic Operating System which allows entry of most problems just as they are stated. Although many operations may be obvious, the following instructions and examples will help you develop skill and confidence in problem solving.

Turning the Calculator On

Pressing ON/C, the upper right most key on the keyboard, applies power and clears the calculator. Power-on condition is indicated by the presence of a "▲" and a "0" in the display. The OFF key, of course, removes power from the calculator. When the calculator is turned off and then back on, the display and all pending operations and operands are cleared. However, the two user memories and any statistical data stored in the calculator are left intact, due to the calculator's Constant Memory™ feature.

NOTICE: Depressing and holding down any key on the top row of your calculator will cause random segments to be displayed. These random segments do not affect normal operations of the calculator and will fade away or disappear when the key is released.

Display Indicators



NOTE: Eight digits may be entered into the display. Any digit keys pressed after the eighth are ignored.

Battery Condition Indicator — The small "▲" in the upper left-hand portion of the display indicates a "good battery" condition. When "▲" becomes very dim or disappears, it means that the batteries are becoming weak and should be replaced. However, the batteries may still operate the calculator for several more hours before it begins to operate erratically. See the *Service Information* Appendix for battery replacement instructions.

NOTE: The entire display, including the small "▲" battery condition indicator, is blanked during key entries and calculations.

Angular Mode Indicators

RAD — Indicates radian mode.

GRAD — Indicates grad mode.

If neither RAD nor GRAD is displayed, the calculator is operating in degree mode.

Floating Minus Sign

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

APD™ Automatic Power Down

Electronic control (as opposed to switch control) of ON and OFF allows the calculator to automatically power itself down if no key is pressed for a period of about 5 to 15 minutes. This feature provides a substantial increase in the operating life of your batteries.

Automatic Power Down Override

If the automatic power down feature is not desired, it may be defeated by pressing any keys in the second, fourth and fifth columns simultaneously (such as [0], [+/-] and [=]). The Automatic Power Down override command will then be in effect until the calculator is turned off with the [OFF] key.

Dual Function Keys

Many of your calculator keys have dual functions. Some are second functions and others are inverse functions, all of which are accessed by using the [INV] / [2nd] key. The dual function keys are described in the appropriate sections of this manual.

Data Entry

For maximum versatility, your calculator operates with a floating decimal point. When entering numbers, the decimal is assumed to the right of the mantissa until [•] is pressed. Then the fractional part of the number is entered and the decimal point floats with the entered number. A maximum of 7 digits may be entered to the right of the decimal.

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

[•] **Decimal Point Key** — Enters a decimal point. A decimal point is not displayed for integer numbers.

[+/-] **Change Sign Key** — When pressed after 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.

[2nd] [π] **PI Key Sequence** — Enters the value of pi correct to 11 digits. This value is rounded to 8 digits (3.1415927) for display.

Numbers up to 8 digits in length can be entered into the calculator directly from the keyboard. The calculator can hold and work with 11 digits. Numbers of this length can be entered as the sum of two numbers.

Example: Enter 389182.70636

Enter	Press	Display
389182	[+]	389182
.70636	[=]	389182.71

Clearing

[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, statistics registers, the constant and all pending operations. Pressing [ON/C] twice always clears the display, the statistics registers, the constant and pending operations.** The user memories are not affected by this key unless it is preceded by [M1] or [M2].

Scientific Notation

To enter very large or very small numbers you must use scientific notation where the number is entered as a mantissa multiplied by 10 raised to some power (exponent) such as -3.6089×10^{-32}.

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

[×] 1 [EE] [=] **Scientific Notation Key Sequence** — Converts a number in normal display format to scientific notation display format. The mantissa is normalized.

IMPORTANT: Pressing [EE] without [×] 1 will cause any non-displayed digits of a result or intermediate result to be discarded and only the rounded display value will be carried into the next problem.

[INV] [EE] [=] — **Scientific Notation Removal Key Sequence** — Removes displayed numbers from scientific notation if they are between $\pm 1 \times 10^{-7}$ and $\pm 9.9999999 \times 10^{7}$, and displays them in standard display format. If the displayed number is outside the range listed above, the scientific notation removal key sequence will be ignored and the number will remain in scientific notation format until the number is within the standard display range.

The entry procedure is to key in the mantissa (including its sign), then press [EE] and enter the power of ten. Any number smaller than $\pm 1 \times 10^{-7}$ or larger than ± 99999999 must be entered in scientific notation.

The number 320,000,000,000 can be written 3.2×10^{11} and can be entered into the calculator as:

Enter	Press	Display
	[ON/C]	
3.2	[EE]	3.2 00
11		3.2 11

The last two digits on the right side of the display are used to indicate the exponent of 10. Additional digits can be entered after pressing [EE], but only the last two numbers pressed are retained as the exponent.

In scientific notation, a positive exponent indicates how many places the decimal point should be shifted to the right. If the exponent is negative, the decimal should be moved to the left.

Regardless of how a mantissa is entered 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.

Enter	Press	Display
	[ON/C]	0
6025	[EE]	6025. 00
20		6025. 20
	[=]	6.025 23

The decimal point of the entered mantissa must not be beyond the 5th digit from the left because the mantissa for scientific notation is limited to 5 digits in the display. Eight digits can be entered, but only 5 are displayed when [EE] is pressed. The entire eight digit mantissa is used for calculations. The display does not go into scientific notation format if more than 5 numbers are entered to the left of the decimal point.

The change sign key can be used to attach a negative sign to the mantissa and to the power-of-ten exponent.

Example: Enter -4.818×10^{-10}

Enter	Press	Display
	[ON/C]	
4.818	[+/−] [EE]	−4.818 00
10	[+/−]	−4.818−10

Any displayed value can be easily converted from standard display format to scientific notation. To convert a result in standard display format to scientific notation, press [×] 1 [EE] [=].

Example: $89 \times 987 = 87843 = 8.7843 \times 10^4$

Enter	Press	Display
	[ON/C] [ON/C]	0
89	[×]	89
987	[=] [×]	87843
1	[EE] [=]	8.7843 04

Data in scientific notation form may be entered intermixed with data in standard form. The calculator converts the entered data for proper calculation.

Example: $3.2 \times 10^3 + 12575.321 = 15775.321$

Enter	Press	Display
	[ON/C]	0
3.2	[EE]	3.2 00
3	[+]	3.2 03
12575.321	[=]	1.5775 04
	[INV] [EE] [=]	15775.321

Notice that the complete answer to the problem is 15775.321 and this is the number used for further calculations. Actually, the calculator internally carries all intermediate calculations and final results to 11 places. These numbers are rounded to a maximum of 5 digits for a scientific notation mantissa or to 8 digits for standard display.

Mantissa Expansion and Mantissa Normalization

The normalized 5-digit mantissa in scientific notation format may be expanded to 8 digits by pressing [EXC]. The exponent will not be displayed. The display can be restored to scientific notation format by pressing the [STO] key. To continue calculations, simply press the desired function key. Numbers that are not in scientific notation can also be normalized by pressing the [EXC] key. Any key except [EXC] will restore the calculator to its original format as well as performing the function specified by that key.

Enter	Press	Display
1	[÷]	1
777	[EE]	777. 00
50	[=]	1.287 -53
	[EXC]	1,2870013
	[STO]	1.287 -53

Error Indication

The display shows "Error" whenever overflow or underflow occurs or when an improper mathematical operation is requested. When this occurs, no entry from the keyboard will be accepted until [ON/C] is pressed. This clears the error condition and all pending operations. You must now return to the first of your problem and begin again. "Error" appears for the following reasons.

1. Number entry or calculation result (including memory arithmetic) outside the range of the calculator, $\pm 1.0 \times 10^{-99}$ to $\pm 9.9999 \times 10^{99}$.
2. Dividing a number by zero.
3. Calculating [log], [lnx] or [1/x] of zero or calculating the 0th root of any number.
4. Calculating [log], [lnx], a power or a root of a negative number.

5. Inverse of sine or cosine (arcsine, arccosine) when the absolute value is greater than 1.
6. Tangent of 90°, 270° $\pi/2$ radians, $3\pi/2$ radians, 100 grads, 300 grads or their rotation multiples like 450°, etc.
7. Having more than 15 open levels of parentheses with each pending operation or more than four pending operations.
8. Factorial of any number except a non-negative integer ≤ 69.
9. Calculating standard deviation ($n-1$ weighting) with only one data point.
10. Calculating any statistics function with no data points.
11. Multiplying a number greater than 1×10^{99} by another number (decimal or integer) may cause an error condition.
12. Entering a statistical data point x, such that $x \leq \pm 1 \times 10^{-50}$ or $x \geq \pm 1 \times 10^{50}$.
13. Entering a series of statistical data points (x_i) such that $\Sigma (x_i)^2$ exceeds the upper or lower limit of the calculator.

Accuracy and Rounding

Each calculation produces an 11-digit result. These 11 digits are more than can be displayed. The result is therefore rounded to an 8-digit standard display or to a 5-digit mantissa and 2-digit exponent for scientific notation. The 5/4 rounding technique built into this calculator adds 1 to the least significant digit of the display if the next, non-displayed digit is five or more. If this digit is less than five, no rounding is applied. In the absence of these extra digits, inaccurate results would frequently be displayed, such as

$$1/3 \times 3 = 0.9999999$$

The example shows $1 \div 3 = 0.3333333$ when multiplied by 3 produces this answer. The internal 11-digit string of nines in your calculator is rounded to 1.

The higher order mathematical functions use iterative calculations. The cumulative error from these calculations in most cases is maintained beyond the eight-digit display so that no inaccuracy is displayed. Most calculations are accurate to ± 1 in the last displayed digit. There are a few instances in the solution of high-order functions where display accuracy begins to deteriorate as the function approaches a discontinuous or undefined point. For example, the tangent of 89 degrees is accurate for all displayed digits. However, the tangent of 89.99999 is accurate to only four places. Another example is when the y^x function has a y value that approaches 1 and the x value is very large. The displayed result for 1.005^{-160} is accurate for all displayed digits where 1.0000005^{-160} is accurate to only four places.

III. ARITHMETIC FUNCTIONS

To perform simple addition, subtraction, multiplication or division, the calculator with its algebraic type of entry allows you to key in the problem just as it is stated.

This calculator is specially equipped with AOS™ (Algebraic Operating System). This advanced system allows key sequences to be interpreted correctly by storing certain quantities and operations until the algebraic principles say they can be completed. A more complete discussion of this system occurs later in this section.

Basic Keys

[+] **Add Key** — Completes any previously entered arithmetic, 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 arithmetic, 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 divide or multiply, 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. This displayed value must be less than 1×10^{99} or an error condition may result.

[÷] **Divide Key** — Completes any previously entered divide or multiply, 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: 23.79 + 0.54 − 6 = 18.33

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

Again note that the numbers and functions are entered in the same order as they are mathematically stated.

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

Input Error Correction

At any point in a calculation, ON/C can be pressed twice to clear all calculations and statistics registers, including any errors and start over. This drastic action is seldom necessary.

If an incorrect number entry is made, pressing the ON/C key before any non-number key clears the incorrect number without affecting any calculation in progress.

Special circuitry has been provided to facilitate the correction of a wrong operation entered while keying in your problem.

When there are no stored operations, as when the first operation is keyed in, and an unwanted operation key is entered, simply press the correct operation and continue. This applies to +, −, ÷, ×, y^x and INV y^x.

Correction of an incorrect operation entry while there are stored operations in the calculator is dependent on the table below.

INCORRECT ENTRY	DESIRED OPERATION			
	+, −	×, ÷	y^x	$\sqrt[x]{y}$
+, −	CK*	ON/C	ON/C	ON/C
×, ÷	CK	CK	ON/C	ON/C
y^x	CK	CK		ON/C
$\sqrt[x]{y}$	CK	CK	CK	

*CK means to press the correct key and continue.

Locate the incorrect entry you have just made in the column on the left, then follow that row over to the desired operation and apply whatever instruction occurs at that junction.

The ON/C key in the table indicates that the incorrect entry cannot safely be corrected to the desired operation for all conditions so the problem must be restarted.

Example: 6 ~~+~~ × 7 ~~−~~ + ~~4~~3 = 45

Enter	Press	Display	Comments
6	+ ×	6	First operation wrong
7	− +	42	6 × 7 Completed
4	ON/C	0	Clears 4 (entry)
3	=	45	Answer

A full understanding of the calculator hierarchy discussed in the next few pages will make the input error correction methods obvious.

Combining Operations

After a result is obtained in one calculation it may be directly used as the first number in a second calculation. There is no need to reenter the number from the keyboard.

Example:
1.84 + 0.39 = 2.23 then (1.84 + 0.39)/365 = 0.0061096

Enter	Press	Display	Comments
1.84	[+]	1.84	
.39	[=]	2.23	1.84 + 0.39
	[÷]	2.23	
365	[=]	0.0061096	2.23 ÷ 365

Calculator Hierarchy

In order to efficiently combine operations, you need to understand the standard algebraic rules that have been specifically programmed into the calculator. These algebraic rules assign priorities to the various mathematical operations. Without a fixed set of rules, expressions such as 5 × 4 + 3 × 2 could have several meanings:

5 × (4 + 3) × 2 = 70
or (5 × 4) + (3 × 2) = 26
or ((5 × 4) + 3) × 2 = 46
or 5 × (4 + (3 × 2)) = 50

Algebraic rules state that multiplication is to be performed before addition. So, algebraically, the correct answer is (5 × 4) + (3 × 2) = 26. The complete list of priorities for interpreting expressions is:

1) Single-variable Functions
2) Exponentiation (y^x), Roots ($\sqrt[x]{y}$)
3) Multiplication, Division
4) Addition, Subtraction
5) Equals

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) Multiplication 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 only after all operations through multiplication and division as well as other addition and subtraction are completed.

5) Equals completes all operations.

To illustrate, consider the interpretative order of the following example:

Example: $4 \div 5^2 \times 7 + 3 \times .5^{\cos 60°} = 3.2413203$

Enter	Press	Display	Comments
4	[÷]	4	(4÷) is stored.
5	[x^2]	25	(5^2) single-variable function [x^2] evaluated immediately.
	[×]	0.16	($4 \div 5^2$) evaluated because × is same priority as ÷.
7	[+]	1.12	× higher priority than + so ($4 \div 5^2 \times 7$) evaluated, + stored
3	[×]	3	(3×) stored.
.5	[y^x]	0.5	.5 y^x stored.
60	[cos]	0.5	Cos 60° evaluated immediately.
	[=]	3.2413203	Completes all operations: $.5^{\cos 60°}$ evaluated, then $3 \times .5^{\cos 60°}$ next, then this is added to 1.12.

Thus, by entering the expression just as it is written, the calculator correctly interprets it.

The important thing to remember here is that operations are enacted 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 exactly the correct time and place. Once familiar with the order of these operations, you will find most problems are extremely 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 your calculator are positioned in such a way as to help you remember the AOS™ hierarchy.

[y^x] — Exponentiation and roots

[÷] [×] — Multiplication and Division

[−] [+] — Addition and Subtraction

[=] — "Equals" which completes all operations

(All single variable functions are performed on the displayed number immediately when pressed.)

Parentheses

[(] [)] **Parentheses Keys** — Used to isolate particular numerical expressions for separate mathematical interpretation.

There are sequences of operations for which you must 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 as written using only the calculator hierarchy, many independent steps would be required. Also, intermediate results would have to be stored and the sequence certainly could not be input in the same order in which it is written. Parentheses should be used here and whenever a mathematical sequence cannot be directly entered using the previously mentioned algebraic rules or when there is doubt in your mind as to how the calculator is going to reduce an expression.

To illustrate the benefit of parentheses, try the following experiment: press [(] 5 [+] 9 [)], and you will see the value 14 displayed. The calculator has evaluated 5 + 9 and replaced it with 14 even though the [=] key was not pressed. Because of this function of parentheses, the algebraic rules now apply their hierarchy of operations within each set of parentheses. Use of parentheses insures that your problem can be keyed in 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. When a closed parenthesis is encountered, all operations included within the parenthesis pair are completed.

Parentheses have the additional capability of supplying a missing operand, as shown by the following example:

Example: 4 − (4 + 2) = −2

Enter	Press	Display
4	[−] [(] [+]	4
2	[)]	6
	[=]	−2

If no value is entered after a [(], the calculator uses the value in the display register. In the example a 4 was automatically inserted before the +.

A closed parenthesis can also supply a missing operand. For instance, 3 [+] [)] gives 6. The [)] uses the display value 3 for the missing operand.

Example: $4 \times (5 + 9) \div (7 - 4)^{(2 + 3)} = 0.2304527$

Key in this expression and follow the path to completion.

Enter	Press	Display	Comments
4	[×] [(]	4	(4×) stored pending evaluation of parentheses.
5	[+]	5	(5+) stored.
9	[)]	14	(5 + 9) evaluated.
	[÷]	56	Hierarchy evaluates 4 × 14.
	[(]	56	(56 ÷) stored pending evaluation of parentheses.
7	[−]	7	(7 −) stored.
4	[)]	3	(7 − 4) evaluated.
	[y^x] [(]	3	Prepares for exponent.
2	[+]	2	
3	[)]	5	(2 + 3) evaluated.
	[=]	0.2304527	$(7 - 4)^{(2 + 3)}$ evaluated then divided into 4 × (5 + 9).

There are limits on how many operations and associated numbers can be stored. Actually, as many as fifteen parentheses can be open at any one time and four operations can be pending, but only in the most complex situations would these limits be approached. If you do attempt to open more than 15 parentheses or if the calculator tries to store more than four operations, "Error" 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	Comment
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 has the capability to complete all incomplete 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 closed 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 may want. Specifically, you can check intermediate results.

Example: $3 \times (4^{(2 - (\sqrt[4]{7}))}) = 4.7000434$

Enter	Press	Display	Comments
	[ON/C]	0	
3	[×] [(]	3	
4	[y^x] [(]	4	
2	[y^x] [(]	2	
7	[INV] [y^x]	7	
4	[)]	1.6265766	$\sqrt[4]{7}$
	[+/−]	−1.6265766	$-(\sqrt[4]{7})$
	[)]	0.3238558	$2 - (\sqrt[4]{7})$
	[)]	1.5666811	$4^{.323\ldots}$
	[=]	4.7000434	$3 \times 4^{.323\ldots}$

Note that in all these examples, the expressions are entered in a straight left to right sequence.

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].

Repetitive calculations have been simplified through use of the constant feature of the calculator. Entry of a recurring sequence such as +3, × (−17.3) or y^7 can be stored and used by the calculator to operate on any displayed number. To use the constant feature, enter the repetitive number, m, then enter the desired operation, then 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 power.
m [INV] [y^x] [K]	takes the mth root of each subsequent entry.

After storing the constant, each calculation is completed by entering the new number and pressing [=]. Clearing the calculator or entering any of the above arithmetic functions eliminates the constant that is currently stored.

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	3.2 00
2	+/− =	1.8346 00

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

IV. SPECIAL 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. The single-variable functions operate only on the displayed value without interfering with calculations in progress. The two-variable functions may be isolated within a calculation by parentheses or used with the calculator hierarchy.

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

Roots and Powers

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

Example: $(4.235)^2 = 17.935225$

Enter	Press	Display
4.235	[x^2]	17.935225

[$\sqrt{x}$] **Square Root Key** — Calculates the square root of the number x in the display.

Example: $\sqrt{6.25} = 2.5$

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

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

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

[y^x] **y to the xth Power Key** — Raises the displayed value y to the xth power. Order of entry is y [y^x] x. The y value cannot be negative but both x and y can be fractional.

INV y^x (= $\sqrt[x]{y}$) xth Root of y Key Sequence — Takes the xth root of the displayed value y. Order of entry is y INV y^x x. The y value cannot be negative but both x and y can be fractional.

Your calculator also provides two universal roots and powers functions that allow you to vary the value of the exponent as well as the value of the base. One is accessed by the y^x key. The other is accessed by the INV y^x key sequence providing $\sqrt[x]{y}$. These functions are the only special functions that do not act on the displayed value immediately. They require a second value before the function can be realized. Use of these two keys is identical. Enter y, press y^x or INV y^x enter x, and press = or an arithmetic function key to yield the answer. A closed parenthesis also completes these functions as well as other stored operations back to the nearest open parenthesis.

Example: $2.86^{-.42} = 0.6431707$

Enter	Press	Display
2.86	y^x	2.86
.42	+/-	-0.42
	=	0.6431707

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

Enter	Press	Display
1460	INV y^x	1460
3.12	=	10.332744

There is a restriction on these functions — the variable y must be non-negative. When y is negative "Error" appears in the display after x and an operation key are pressed. The y value cannot be negative because logarithms are used to perform these functions. The 0th root of a number is not a natural mathematical operation and consequently results in an error condition. Any non-negative number taken to the zero power is 1.

Accuracy for these roots and powers is within ±1 in the 8th significant digit over all ranges except for values of y very near 1 and very large exponents or very small roots. For example 1.00008^{436700} has an error of 4 in the 6th digit. These errors increase as y approaches 1 and the exponent becomes extremely large or when roots become extremely 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

[2nd] [x!] **Factorial Key Sequence** — Calculates the factorial (x) (x−1) (x−2)...(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	[2nd] [x!]	3.7199 41

Percent

[%] **Percent Key** — Converts the displayed number from a percentage to a decimal.

Example; 43.9% = .439

Enter	Press	Display
43.9	[%]	0.439

When [%] is pressed after an arithmetic operation, add on, discount, and percentage can be computed as follows;

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

Example: What is the total cost of a $15 item when there is a 5% sales tax?

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

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

Example: How much is paid for a $5 item that has been discounted 2%?

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

[×] n [%] [=] multiplies the number in the display by n%.

Example: What is 2.5% of 15?

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

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

Example: 25 is 15% of what number?

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

Natural Logarithm and Natural Antilogarithm

[lnx] **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	[lnx]	0.1823216

[INV] [lnx] **Natural Antilogarithm (e to the xth power) key sequence** — Calculates the natural antilogarithm of the number in the display. This sequence raises the constant e to the displayed power.

Example: $e^{3.81} = 45.150439$

Enter	Press	Display
3.81	[INV] [lnx]	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	[lnx]	0.3364722	ln 1.4
	[)]	7.8364722	(7.5 + ln 1.4)
	[INV] [lnx]	2531.2594	Answer

Note that the [=] key is not needed as the special 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. $x > 0$.

Example: log 32.01 = 1.5052857

Enter	Press	Display
32.01	[log]	1.5052857

[INV] [log] **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	[+/−] [INV] [log]	7.5858−08

Example: log $(303 + 10^{1.36}) = 2.5130959$

Enter	Press	Display	Comments
	ON/C (	0	
303	+	303	Enter 303
1.36	INV log	22.908677	$10^{1.36}$
	)	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 round off.

Trigonometric Functions

DRG **Degree, Radian, Grad Key** — Selects the units for angular measurement. When the calculator is first turned 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 the key is pushed. Another key push, for instance, returns the calculator to the degree mode.

The display indicates the current angular mode of the calculator. "RAD" is displayed for radian mode, and "GRAD" is displayed for grad mode. Degree mode has no indicator.

The angular mode has absolutely no effect on calculations unless the trigonometric functions are being used. Selecting the angular mode is an easy step to perform —*and to forget!* Neglecting this step is responsible for a large portion of errors in operating any calculating machine that offers a choice of angular units.

When the trig functions (sine, cosine, and tangent) are activated, they compute their respective functions of the angle in the display. 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.

[INV] [sin] **Arcsine ($\sin^{-1}$) 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.

[INV] [cos] **Arccosine ($\cos^{-1}$) 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.

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

Trigonometric values can be calculated for angles greater than one revolution. As long as the trigonometric function result is displayed in normal form rather than in scientific notation, all display digits are accurate for any angle from: −36000° to 36000°, −200 π to 200 π radians and −40,000 to 40,000 grads. In general, the accuracy decreases one digit for each decade outside this range.

Example: sin 30° = 0.5 = sin 390°

Enter	Press	Display
(Select degree mode)		
30	[sin]	0.5
390	[sin]	0.5

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

Enter	Press	Display	Comments
(Select radian mode "RAD")			
	ON/C (	RAD 0	
.3012	×	RAD 0.3012	
	2nd π	RAD 3.1415927	
	)	RAD 0.9462477	(.3012π)
	sin	RAD 0.8112271	Sin (.3012π)
	y^x	RAD 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, i.e. arcsin = .5 for 30° and 150°, the angle returned by each function is restricted as follows:

Arc Function for x ⩾ 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)

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

Example:
$\sin^{-1}$ .712 = 45.397875 degrees = 0.7923424 radians = 50.442082 grads

Enter	Press	Display
	(Select degree mode)	
.712	INV sin	45.397875
	(Select radian mode "RAD")	
.712	INV sin	RAD 0.7923424
	(Select grad mode "GRAD")	
.712	INV sin	GRAD 50.442083

Example:

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

Enter	Press	Display	Comments
(Select degree mode)			
9.72	INV tan	84.126039	arctan 9.72
	$\sqrt{x}$ +	9.1720248	$\sqrt{\arctan 9.72}$
.808	INV sin	53.900984	arcsin .808
	1/x	0.0185525	1/arcsin .808
	=	9.1905773	Answer

Sine and cosine functions are accurate throughout all displayed digits when displayed in standard form. The tangent of $\pm 90^\circ$ $\pm\pi/2$ radians, or ± 100 grads results in an error condition because the function is undefined at these points. As the tangent approaches these undefined limits the accuracy is restricted. For example, the tangent of 89 degrees (1.5533 radians or 98.888889 grads) is accurate throughout the 8 displayed digits whereas the tangent of 89.99999° is accurate to 3 places.

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. First, be sure the calculator is in the correct angular mode for entry of the angle to be converted.

Conversion	Key Sequence
Degrees to Radians	[sin] [DRG] [INV] [sin]
Degrees to Grads	[sin] [DRG] [DRG] [INV] [sin]
Grads to Degrees	[sin] [DRG] [INV] [sin]
Grads to Radians	[sin] [DRG] [DRG] [INV] [sin]
Radians to Degrees	[sin] [DRG] [DRG] [INV] [sin]
Radians to Grads	[sin] [DRG] [INV] [sin]

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

Enter	Press	Display	Comments
(Select degree mode)			
50	[sin] [DRG] [INV] [sin]	RAD 0.8726646	radians
	[sin] [DRG] [INV] [sin]	GRAD 55.555556	grads
	[sin] [DRG] [INV] [sin]	50	degrees

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

0 ± 90 degrees
0 ± 100 grads
$0 \pm \pi/2$ radians

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

For converting angles in any quadrant from one system to another, the following table of conversion factors can be used.

FROM \ TO	degrees	radians	grads
degrees		$\times \frac{\pi}{180}$	$\div .9$
radians	$\times \frac{180}{\pi}$		$\times \frac{200}{\pi}$
grads	$\times .9$	$\times \frac{\pi}{200}$	

These operations can be performed in any angular mode setting of the calculator.

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

Because of the independence of these conversions from the angular mode of the calculator, you must be extremely careful when using the results for further calculations. *The angular mode must be adjusted to match the units of the results.*

V. MEMORY USAGE

Your calculator has two "constant memories" that are able to store data 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.

The memory keys, [M1] & [M2] can be used in conjunction with eight other keys ([+], [−], [×], [÷], [=], [EXC], [STO], [ON/C]) to perform any common memory task. In the following sections, [Mn] is used to denote either [M1] or [M2]. (n=1 or 2)

Memory Store

[Mn] [STO] **Memory Store Key Sequence** — Stores the displayed quantity in the desired memory (1 or 2) without removing it from the display. Any previous value stored in the memory is replaced by the new entry.

Memory Recall

[Mn] [=] **Memory Recall Key Sequence** — Recalls the contents of the desired memory into the display without affecting the content of the memory.

Example: Store and recall 45.68

Enter	Press	Display
45.68	[M1] [STO]	45.68
	[OFF] [ON/C]	0
	[M1] [=]	45.68

Use of these keys allows you to store a long number that is to be used several times. Notice that the calculator can even be turned off without losing the contents of the memory registers.

Example:

Evaluate $2.4x^4 - 3x^2 + x - 10.25$ for x = 2.1478963

Enter	Press	Display	Comments
2.4	[×]	2.4	
2.1478963	[M1] [STO] [y^x]	2.1478963	Store x
4	[−]	51.081599	$2.4x^4$
3	[×]	3	
	[M1] [=]	2.1478963	Recall x
	[x^2]	4.6134585	x^2
	[+]	37.241223	$2.4x^4 - 3x^2$
	[M1] [=]	2.1478963	Recall x
	[−]	39.389119	$2.4x^4 - 3x^2 + x$
10.25	[=]	29.139119	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 next two times it is needed. Pressing [Mn] [=] brings the 8-digit x to the display each time. Notice also that the use of [Mn] [STO] and [Mn] [=] does not interfere with calculator operations.

Memory Exchange

[Mn] [EXC] **Memory Exchange Key Sequence —** Swaps the contents of the memory with the displayed value. The displayed value is stored and the previously stored value is displayed.

This key sequence combines the store and recall operations sequence. Use of this key sequence like the other memory key sequences, does not disturb a series of calculations and can consequently be used anywhere in the solution of a problem.

The [Mn] [EXC] key sequence permits you to solve a problem and store the result, then solve another problem and compare the results of the two problems while retaining both answers. Also, numbers can be temporarily stored and used as needed.

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

Enter	Press	Display	Comments
.258963	[M1] [STO] [x^2] [+]	0.0670618	Store A, A^2 displayed
1.25632	[×]	1.25632	Enter B
	[M1] [EXC]	0.258963	Store B, recall A
	[×]	0.3253404	A × B displayed
2	[+]	0.7177426	$A^2 + 2AB$ displayed
	[M1] [=]	1.25632	Recall B
	[x^2]	1.5783399	B^2
	[=]	2.2960826	Answer

When A is recalled from memory for the last time it is needed, B is instantly stored in its place by pressing [M1] [EXC] .

Memory Clear

[Mn] [ON/C] **Memory Clear Key Sequence** — Clears the desired memory. This key sequence should always be used prior to memory use to insure that the desired memory is clear of unwanted numbers.

Sum to Memory

[Mn] [+] **Sum to Memory Key Sequence** — Algebraically adds the displayed value to the contents of the desired memory. This key sequence does not affect the displayed number or calculations in progress.

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

These keys are used to accumulate the results from a series of independent calculations. The [Mn] [+] key sequence replaces the arithmetic sequence [+] [Mn] [=] [=] [Mn] [STO].

Example: 28.3 × 7 = 198.1
173 + 16 = 189
312 − 42 + 7.8 = 277.8
Total 664.9

Enter	Press	Display	Memory 2
	[ON/C] [M2] [ON/C]	0	0
28.3	[×]	28.3	0
7	[=] [M2] [STO]	198.1	198.1
173	[+]	173	198.1
16	[=] [M2] [+]	189	387.1
312	[−]	312	387.1
42	[+]	270	387.1
7.8	[=] [M2] [+]	277.8	664.9
	[M2] [=]	664.9	664.9

This example could have been performed simply by linking each expression together with a [+] and not using the memory. But if each of the three expressions had been far more complicated, then solving the entire problem sequentially could be risky. An uncorrectable mistake during calculations would necessitate starting over from the beginning. Summing to memory saves each completed expression making the calculation of each new series of terms independent of previous calculations.

Subtract from Memory

[Mn] [−] **Subtract from Memory Key Sequence** — Algebraically subtracts the displayed value from the contents of the desired memory. This key sequence does not affect the displayed number or calculations in progress.

Example: 645.50 + 63.25 = 708.75
− 125.00
− 73.50
− 15.75

Total 494.50

Enter	Press	Display	Memory 1
	[ON/C] [M1] [ON/C]	0	0
645.5	[+]	645.5	0
63.25	[=] [M1] [STO]	708.75	708.75
125	[M1] [−]	125	583.75
73.5	[M1] [−]	73.5	510.25
15.75	[M1] [−]	15.75	494.5
	[M1] [=]	494.5	494.5

Multiply by Memory

[Mn] [×] **Multiply by Memory Key Sequence** — Algebraically multiplies the displayed value by the contents of the desired memory and stores the result in that memory. This key sequence does not affect the displayed number or calculations in progress.

Example: Use memory 2 to solve the parentheses part of this problem.
$2.95 + (.8 \times 46)^2 = 1357.19$

Enter	Press	Display	Memory 2
	[ON/C] [M2] [ON/C]	0	0
2.95	[+]	2.95	0
.8	[M2] [STO]	0.8	0.8
46	[M2] [×]	46	36.8
	[M2] [=]	36.8	36.8
	[x^2]	1354.24	36.8
	[=]	1357.19	36.8

Divide into Memory

[Mn] [÷] **Divide into Memory Key Sequence** — Algebraically takes the contents of the desired memory, divides it by the number in the display, and stores the result in that memory. This key sequence does not affect the displayed number or calculations in progress.

Example: Use memory 1 to work the division part of this problem.
(.274 × 396) ÷ 5 = 21.7008

Enter	Press	Display	Memory 1
	[ON/C] [M1] [ON/C]	0	0
.274	[×]	0.274	0
396	[=]	108.504	0
	[M1] [STO]	108.504	108.504
5	[M1] [÷]	5	21.7008
	[M1] [=]	21.7008	21.7008

VI. STATISTICAL FUNCTIONS

In many situations in your business (and everyday) life, you may find yourself making decisions based on a set of data points. This data could be test scores, sales figures, weights of an incoming shipment, etc. An effective way to evaluate this data is to use statistical methods. The most commonly used statistical calculations are the mean ($\bar{x}$) standard deviation (σ_n or σ_{n-1}), and variance (σ^2_n or σ^2_{n-1}).

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 is — a feel for how far the data differs from the mean. Because of your calculator's Constant Memory™ feature, the statistics registers retain all entered data even after the calculator is turned off. This feature allows you to enter additional data to a previously entered data array without having to re-enter the old data. This time-saving feature is especially useful whenever you're working with a large data array.

Caution: To retain data in the statistics registers, you must use the [ON/C] key very carefully because it can clear the statistics registers. If you want to retain statistical data, the [ON/C] key can only be used to do the following:

- Turn the calculator on.
- Clear numerical entry (1 key push).

If [ON/C] is pressed once after a non-numerical entry, or if the [ON/C] key is pressed twice in succession, the statistics registers will be cleared.

Statistical Data Entry and Removal

[Σ+] **Sum Plus Key** — Enters data points x_i for calculation of mean, variance, and standard deviation. After x_i is entered, the current number of data points, n is displayed.

[2nd] [Σ-] **Sum Minus Key Sequence** — Removes unwanted data points x_i. After x_i is removed, the current number of data points, n is displayed.

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).

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

2nd $\sigma n\text{-}1$ Sample Standard Deviation Key Sequence — 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 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)

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

2nd $\sigma n\text{-}1$ x^2 Sample Variance Key Sequence — Calculates variance using n-1 weighting (for sample data)

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

Important: Since this calculator can hold statistical data in its memory registers even when turned off, always clear the calculator by pressing [ON/C] twice before entering a new set of statistical data.

Data points are entered by pressing [Σ+] after each data-point entry and removed by pressing [2nd] [Σ-] after reentry of an incorrect point. The entry number n is displayed after each entry. n = 0, 1, 2 . . .

Once entered, the data can be used to 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] [ON/C]	0	Clear
96	[Σ+]	1	1st Entry
81	[Σ+]	2	2nd Entry
97	[Σ+]	3	3rd Entry (Incorrect)
97	[2nd] [Σ-]	2	Remove 3rd Entry
87	[Σ+]	3	Correct 3rd Entry
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

APPENDIX A
HYPERBOLIC FUNCTIONS

Hyperbolic Functions

Solving problems involving hyperbolic functions uses the exponential ([INV] [lnx]) capability of your calculator.

Hyperbolic Sine (sinh) x $= \frac{1}{2}(e^x - e^{-x}) = \dfrac{e^{2x} - 1}{2e^x}$

Hyperbolic Cosine (cosh) x $= \frac{1}{2}(e^x + e^{-x}) = \dfrac{e^{2x} + 1}{2e^x}$

Hyperbolic Tangent (tanh) x $= \dfrac{e^x - e^{-x}}{e^x + e^{-x}} = \dfrac{e^{2x} - 1}{e^{2x} + 1}$

Example: tanh 2.99 = 0.9949551

Enter	Press	Display
2.99	[×]	2.99
2	[=]	5.98
	[INV] [lnx] [M1] [STO] [−]	395.44037
1	[=] [÷]	394.44037
	[(] [M1] [=] [+]	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 $x \geq 1$

$\tanh^{-1}x = \frac{1}{2}\ln\left(\dfrac{1 + x}{1 - x}\right)$ 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
	[$\sqrt{x}$]	86.218799
	[=]	172.4318
	[lnx]	5.1500018

APPENDIX B
CONVERSION FACTORS

English to Metric

To Find	Multiply	By
microns	mils	**25.4**
centimetres	inches	**2.54**
metres	feet	**0.3048**
metres	yards	**0.9144**
kilometres	miles	**1.609344**
gramme	ounces	28.349523
kilogramme	pounds	**4.5359237×10^{-1}**
litres	gallons (U.S.)	3.7854118
litres	gallons (Imp.)	4.546090
millilitres (cc)	fl. ounces	29.573530
sq. centimetres	sq. inches	**6.4516**
sq. metres	sq. feet	**9.290304×10^{-2}**
sq. metres	sq. yards	**8.3612736×10^{-1}**
millilitres (cc)	cu. inches	**16.387064**
cu. metres	cu. feet	2.8316847×10^{-2}
cu. metres	cu. yards	7.6455486×10^{-1}

Temperature Conversions

$$°F = \frac{9}{5}(°C) + 32$$

$$°C = \frac{5}{9}(°F - 32)$$

Boldface numbers are exact; others are rounded.

APPENDIX C
SERVICE INFORMATION

In Case Of Difficulty

1. If the battery indicator fails to appear on the display, check for improperly inserted or discharged batteries. See Battery replacement instructions on the following page.
2. Review operating instructions to be certain that calculations were performed correctly.
3. When batteries are inserted into the calculator and the display does not reset, pressing [OFF] then [ON/C] should reset the display and prepare the calculator for use.

If none of the above procedures corrects the difficulty, return the calculator PREPAID and INSURED to the applicable SERVICE FACILITY listed on the back cover

NOTE: The P.O. box number listed for the Lubbock Service Facility is for United States parcel post shipments only. If you desire to use another carrier, the street address is:

Texas Instruments Incorporated
2305 University Ave.
Lubbock, Texas 79415

For your protection, the calculator must be sent insured; Texas Instruments cannot assume any responsibility for loss of or damage to uninsured shipments.

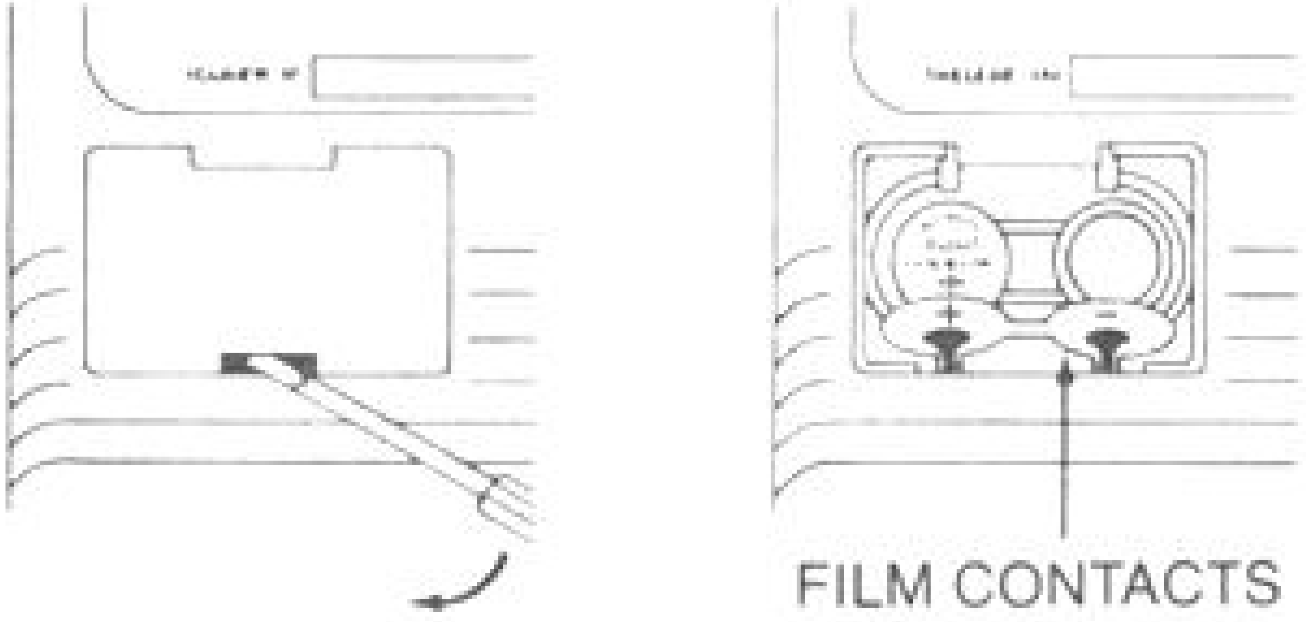
Please include information on the difficulty experienced with the calculator, as well as return address information including name, address, city, state and zip code. The shipment should be carefully packaged and adequately protected against shock and rough handling.

Battery Replacement

NOTE: Your calculator cannot hold data in its user memories or statistics registers if the batteries are removed or become discharged.

There are two types of batteries that can be used with your calculator. For up to 1000 hours operation, you can use two Panasonic LR-44 or Ray-O-Vac RW-82 alkaline batteries (equivalent supplied with calculator). You can also use two Mallory 10L14 Union Carbide (Eveready) 357, Panasonic WL-14 or Toshiba G-13 silver-oxide batteries for up to 2500 hours operation.

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



FILM CONTACTS

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 lay on top of the batteries after the batteries are installed.
3. Replace the cover top edge first, then gently press until the bottom of the cover snaps into place.

Caution: Do not incinerate old batteries.

Out-of-Warranty Service.

Because our Service Facility serves the entire United States, it is not feasible to hold units while providing repair estimates. For simplicity of operation, we have established flat-rate charges for all out-of-warranty repairs. To obtain the correct charges for a particular model, call our toll-free number listed in this section.

Calculator Exchange Centers

If your calculator requires service, instead of returning the unit to a service facility for repair, you may elect to exchange the calculator for a factory-rebuilt calculator of the SAME MODEL at one of the exchange centers which have been established across the United States. A $3.00 charge will be made by the exchange center for in-warranty exchanges. Out-of-warranty exchanges will be charged at the rates in effect at the time of the exchange. Please call the Consumer Relations Department for further details and the location of the nearest exchange center.

If You Need Service Information

If you need service information for your calculator, write Consumer Relations at:

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

or call Consumer Relations at 800-858-1802 (toll-free within all contiguous United States except Texas) or 800-692-1353 (toll-free within Texas). If outside contiguous United States call 806-747-3841. (We regret that we cannot accept collect calls at this number.)

ONE-YEAR LIMITED WARRANTY

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

WARRANTY DURATION

This Texas Instruments electronic calculator is warranted to the original purchaser for a period of one (1) year from the original purchase date.

WARRANTY COVERAGE

This Texas Instruments electronic calculator is warranted against defective materials or workmanship. **THIS WARRANTY DOES NOT COVER BATTERIES AND IS VOID IF: (i) THE CALCULATOR HAS BEEN DAMAGED BY ACCIDENT OR UNREASONABLE USE, NEGLECT, IMPROPER SERVICE OR OTHER CAUSES NOT ARISING OUT OF DEFECTS IN MATERIAL OR WORKMANSHIP, (ii) THE SERIAL NUMBER HAS BEEN ALTERED OR DEFACED.**

WARRANTY PERFORMANCE

During the above one (1) year warranty period your calculator will either be repaired or replaced with a reconditioned model of an equivalent quality (at TI's option) when the calculator is returned, postage prepaid and insured, to a Texas Instruments Service facility listed below. In the event of replacement with a reconditioned model, the replacement unit will continue the warranty of the original calculator or 6 months, whichever is longer. Other than the postage and insurance requirement, no charge will be made for such repair, adjustment, and/or replacement.

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 (1) 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 PURCHASER.

Some states do not allow the exclusion or limitation 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.

TEXAS INSTRUMENTS CONSUMER SERVICE FACILITIES

Texas Instruments Service Facility
P.O. Box 2500
Lubbock, Texas 79408

Texas Instruments Service Facility
41 Shelley Road
Richmond Hill, Ontario, Canada

Consumers in California and Oregon may contact the following Texas Instruments offices for additional assistance or information:

Texas Instruments Consumer Service
3186 Airway Drive Bldg. K
Costa Mesa, California 92626
(714) 540-7190

Texas Instruments Consumer Service
10700 Southwest Beaverton Highway
Park Plaza West, Suite 565
Beaverton, Oregon 97005
(503) 643-6758

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