TEXAS INSTRUMENTS

TI-30 SLR LIGHT POWERED CALCULATOR

QUICK REFERENCE GUIDE

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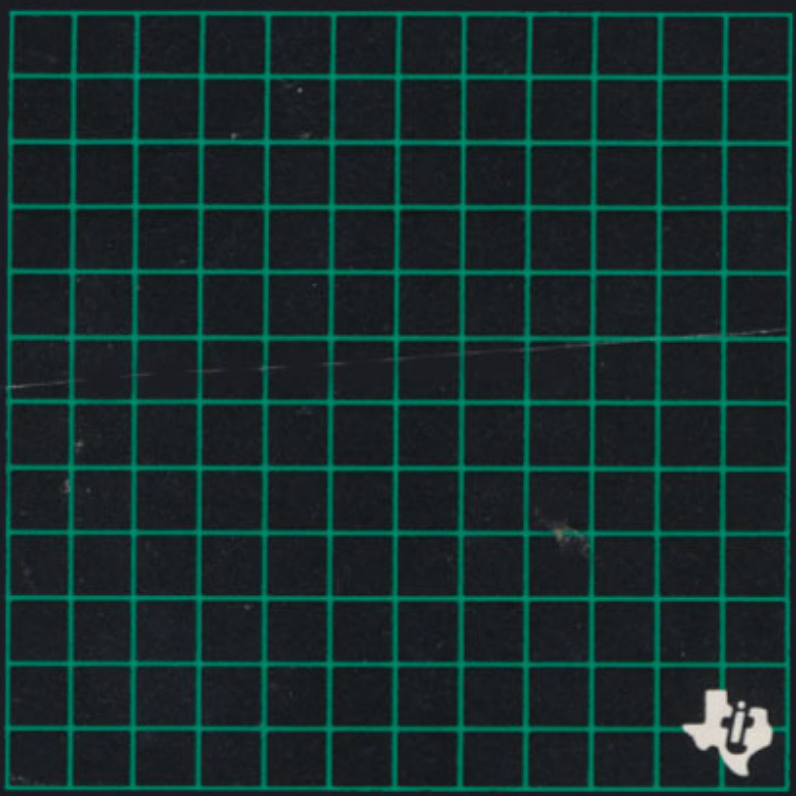

KEY INDEX

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

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IMPORTANT

Record the serial number from the bottom of the calculator and the purchase date in the space below. The serial number is identified by the words "SERIAL NO." on the bottom case. Always refer to this information in correspondence.

TI-30 SLR _____ _____

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

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I. DESCRIPTION

We live in a world of mathematics. It is a part of our daily lives. Our science, technology, and business are absolutely dependent on it. It is more important than ever that we understand how to make math work for us. But while math can be of great practical use, the often tedious and time consuming arithmetic has lead many people to believe that mathematics is beyond them. Adding, subtracting, multiplying, and dividing very cumbersome numbers can easily obscure the simplicity of the math itself. Your calculator is designed as a tool to remove most of the tedium and allow you to better understand the math behind the arithmetic. However, a calculator is "no more functional than the person who operates it". As with any tool, whether it's a pen, wrench, radio, or whatever, it's important to learn how to use it properly. This manual is designed to help you learn the capabilities of your calculator and how to use them. Here are a few of the calculator's features.

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Features and Functions

- Solar power cells located below the display operate your calculator wherever there is a source of light. Indoors or outdoors, direct or indirect lighting. Any normal reading light level is adequate.
- Never any batteries to replace. The solar power cells totally eliminate the need for batteries.
- Easy to read Liquid Crystal Display (LCD).
- AOS™ Algebraic Operating System provides a fixed set of rules for evaluating mathematical expressions. Even complicated problems may be entered simply and directly.

- 50 Calculator Functions

Arithmetic	+, −, x, ÷	4
Data Entry	+/−, π	2
Display	Scientific notation	1
Algebraic	x^2, $\sqrt{x}$, 1/x, y^x, $\sqrt[x]{y}$, x!	6
Clearing	Clear, Clear Entry, All Clear	3
Data Grouping	AOS algebraic operating system. Open and close parentheses (up to 15), and full algebraic hierarchy (up to 4 pending operations).	3
Memory	One memory with store, recall, sum, and exchange	4
Percent	%, + %, − %, x%, ÷ %	5
Trigonometric	Sin, Cos, Tan, Sin−1, Cos−1, Tan−1, and 3 angular modes (Degrees, Radians, Grads)	9
Angular Conversion	Degrees to Radians to Grads	3
Logarithmic	lnx, log, e^x, 10^x	4
Constant	Operates with +, −, x, ÷, y^x, and $\sqrt[x]{y}$	6
		50

- 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.

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II. BASIC OPERATIONS

Your calculator is easy to operate because of its exclusive AOS™ Algebraic Operating System which allows a simple straightforward entry of most problems. 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 and Off

Notice the absence of an ON or an OFF key. To turn the calculator on, simply expose the solar power cells to any adequate light source. "DEG" and "0." normally appear in the display. However, random segments and indicators may appear in the display. These do not affect normal operations of the calculator and are replaced with "DEG" and "0." when the calculator is cleared. The calculator will remain on as long as the solar cells are exposed to light. The length of time before the display appears depends on the intensity of the light source, but under normal lighting conditions this time is within a few seconds.

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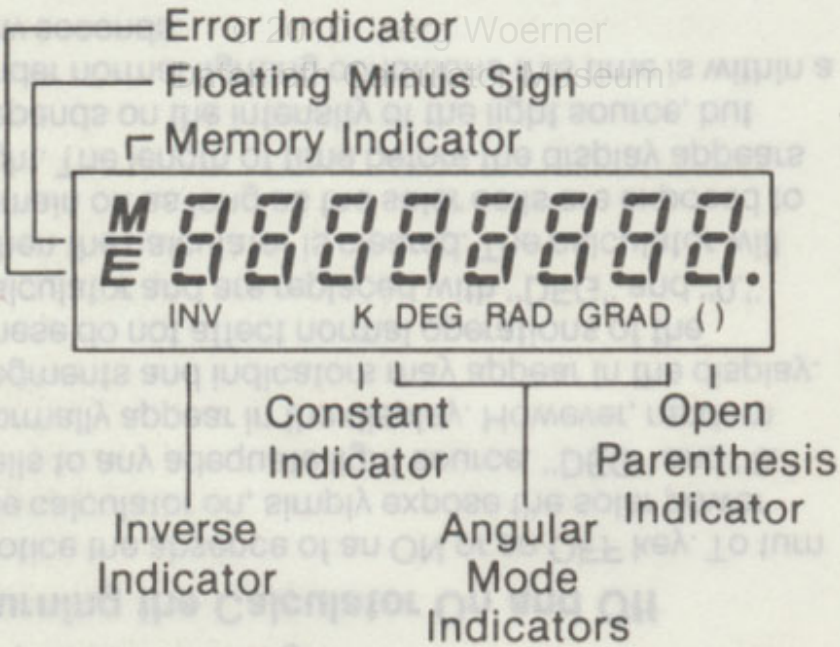
Under indirect or low-level lighting, covering even a portion of the solar cell panel may cause the display to disappear. Always be sure the entire panel is exposed to light.

When the calculator is first "turned on," be sure to completely clear the calculator by pressing [AC].

To turn the calculator off, simply remove the solar cells from the light source. This is most easily done by closing the flap of the calculator's carrying case. The calculator does not normally lose power until approximately 15 seconds after the light source is removed. If the solar cells are again exposed to light within 15 seconds, the previous display, any pending operations, and the memory are normally restored.

Even though there are no batteries to run down, leaving the calculator on for very extended durations may reduce the operating life of the calculator.Therefore, it is suggested that the calculator be "turned off" when not in use. Never leave your calculator in direct sunlight for long periods or store it where high temperatures are possible.

Display Indicators



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

Memory Indicator—

M—Indicates a non-zero number is stored in the memory.

Angular Mode Indicators—

DEG—Indicates degree mode.
RAD—Indicates radian mode.
GRAD—Indicates grad mode.

Inverse or Alternate Function Indicator—

INV—Indicates inverse is in effect.

Open Parenthesis Indicator—

( )—Indicates an unpaired open parenthesis.

Constant Indicator—

K—Indicates constant is in effect.

Error Indicator—

E—Indicates an error condition.

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.

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 automatically displayed to the right of an integer.

[+/−] **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.

[π] **PI Key**—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 123456.78943

Enter	Press	Display
123456	[+]	123456.
.78943	[=]	123456.79

Notice the rounding of the eighth digit in the display.

Clearing

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

[AC] **All Clear Key**—Clears the display, the constant, and pending operations as does [CE/C] [CE/C]. However, [AC] also clears the memory and sets the angular mode of the calculator to degrees.

NOTICE: It is a good practice to clear the calculator with [CE/C] or [CE/C] [CE/C] whenever possible. [AC] should be used only to clear the calculator when it is first "turned on" and before beginning any calculation which requires a clear memory. During a memory calculation, this practice will prevent you from inadvertently clearing the memory.

Inverse and Alternate Functions

[INV] **Inverse Key**—Selects the inverse or the alternate function of the next key pressed. The display shows "INV" while inverse is in effect. Inverse has no effect and is cancelled if the next key pressed has no inverse or alternate function, or if [INV] is pressed again. Keys affected by inverse are those on the second and third rows (except [K]) and [EXC]. Factorial and angular conversions are alternate functions of [EXC] and [DRG].

Scientific Notation

Scientific notation allows you to enter very large or very small numbers, 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 standard display format to scientific display format.

IMPORTANT: Pressing [EE] [=] without pressing [×] 1 may result in the calculator using only the eight displayed digits for subsequent calculations and discarding the internally carried guard digits.

[INV] [EE] **Scientific Notation Removal Key Sequence**—When pressed after a function key, 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 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), 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 as 3.2×10^{11} and can be entered into the calculator as

Enter	Press	Display
	[CE/C] [CE/C]	0.
3.2	[EE]	3.2 00
11		3.2 11

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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 of the mantissa should be shifted to the right. If the exponent is negative, the decimal should be shifted 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
	[CE/C] [CE/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. However, 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.

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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
	[CE/C] [CE/C]	0.
4.818	[+/-] [EE]	– 4.818 00
10	[+/-]	– 4.818-10

Any displayed value can be easily converted from standard display format to scientific notation by pressing [X] 1 [EE] [=].

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

Enter	Press	Display
	[CE/C] [CE/C]	0.
89	[X]	89.
987	[=] [X]	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
	CE/C CE/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.

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Error Indication

The display shows "E" and "0." whenever overflow or underflow occurs or when an improper mathematical operation is requested. When this occurs, no entry from the keyboard is accepted until CE/C or AC is pressed. Pressing CE/C clears the error condition and all pending operations. Pressing AC clears the error condition, all pending operations, and the memory. You must now return to the beginning of your problem and start again.

"E" appears for the following reasons.

1. Number entry or calculation result (including memory sum) outside the range of the calculator, $\pm 1.0 \times 10^{-99}$ to $\pm 9.9999 \times 10^{99}$.
2. Dividing a number by zero.
3. Calculating [log], [ln x], or [1/x] of zero.
4. Calculating the 0th root of any number or the 0th power of zero.
5. Calculating [log], [ln x], a power, or a root of a negative number.
6. Inverse of sine or cosine (arcsine, arccosine) when the absolute value is greater than 1.
7. Tangent of 90°, 270°, $\pi/2$ radians, $3\pi/2$ radians, 100 grads, 300 grads, or their rotation multiples like 450°.
8. Having more than 15 open levels of parentheses with each pending operation or more than four pending operations.
9. Factorial of any number except a non-negative integer ≤ 69.
10. Multiplying numbers with negative exponents when the sum of those exponents (as displayed in *normalized* scientific notation format) exceeds -99.

    Example:

    $$4 \times 10^{-45} \times 5 \times 10^{-55} = 20 \times 10^{-100}$$
    $$= 2 \times 10^{-99}$$

    This example produces an error because of the -100 exponent in the intermediate result, even though the final result is within the range of the calculator.

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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

$$1 \div 3 \times 3 = 0.9999999$$

However, because of rounding, the internal 11-digit string of nines in your calculator is rounded to 1 in the display.

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. These particular instances are noted where appropriate.

III. 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 ×, ÷, 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 ×, ÷, 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
	CE/C CE/C	0.
23.79	+	23.79
.54	–	24.33
6	=	18.33

Notice the straightforward manner in which the numbers and functions are entered.

In the following examples, notice that CE/C CE/C need not be pressed 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

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Input Error Correction

At any point in a calculation, CE/C can be pressed twice to clear all calculations, including any errors, and start over.

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

Press AC only if you wish to clear all calculations, including any errors, *and the memory*.

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].

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

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 $(1.84 + 0.39) \div 365 = 0.0061096$

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

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Calculator Hierarchy

In order to efficiently combine operations, the AOS™ Algebraic Operating System provides the calculator with a fixed set of standard algebraic rules. These rules assign priorities to the various mathematical operations. Without a fixed set of rules, expressions such as $5 \times 4 + 3 \times 2$ could have several meanings:

$$5 \times (4 + 3) \times 2 = 70$$
$$\text{or } (5 \times 4) + (3 \times 2) = 26$$
$$\text{or } ((5 \times 4) + 3) \times 2 = 46$$
$$\text{or } 5 \times (4 + (3 \times 2)) = 50$$

Algebraic rules state that multiplication is to be performed before addition. So, algebraically, the correct answer is $(5 \times 4) + (3 \times 2) = 26$. 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. 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 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: $4 \div 5^2 \times 7 + 3 \times .5^{\cos 60^\circ} = 3.241321$

Enter	Press	Display	Comments
	AC	0.	Clears calculator and sets angular mode to degrees
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: ($.5^{\cos 60^\circ}$) evaluated, then ($3 \times .5^{\cos 60^\circ}$) next, then this is added to 1.12.

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The important thing to remember here is that 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 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
- [÷] Division and
- [×] Multiplication
- [−] Subtraction and
- [+] Addition
- [=] "Equals" which completes all operations.

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

Parentheses

( ) **Parentheses Keys**—Isolates particular numerical expressions for separate mathematical interpretation. When (is pressed after a pending operation, "( )" appears in the display until all parenthesis pairs are completed.

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 using only the calculator hierarchy, many independent steps would be required. Also, intermediate results would have to be stored and the sequence certainly would be more difficult to enter.

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.

NOTICE: You may see equations or expressions with parenthesis indicating implied multiplication: $(2 + 1)(3 + 2) = 15$. *Your calculator will not perform implied multiplications.* An operation must be entered between parentheses: $(2 + 1) \times (3 + 2) = 15$.

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 simply and directly. 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.

Open 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.

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

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 $4 \times (5 + 9)$.

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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, "E" 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: $5 + (8 \div (9 - (2 \div 3))) = 5.96$

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

Because the [=] key completes all operations 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 [)].

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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: $3 \times (4^{(2-(\sqrt[4]{5}))}) = 4.9053384$

Enter	Press	Display	Comments
	[CE/C] [CE/C]	0.	
3	[×] [(]	3.	
4	[y^x] [(]	4.	
2	[y^x] [(]	2.	
5	[INV] [y^x]	5.	
4	[)]	1.4953488	$(\sqrt[4]{5})$
	[+/−]	−1.4953488	$-(\sqrt[4]{5})$
	[)]	0.3546951	$2-(\sqrt[4]{5})$
	[)]	1.6351128	4.354...
	[=]	4.9053384	3 × 4.354...

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Note that in all these examples the expressions are entered in a simple and direct 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]. "K" appears in the display until the constant is cleared.

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

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After storing the constant, each calculation is completed by entering the new number and pressing [=]. The constant is cleared by pressing [=] [CE/C], [)], or any of the above arithmetic keys.

Using [K] in any other sequence than described above may affect entered numbers.

Example:

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

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

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

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

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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 presssing 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

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[$\sqrt{x}$] **Square Root Key**—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	[$\sqrt{x}$]	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.

These two universal roots and powers 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: $2.86^{-.42} = 0.6431707$

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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, "E" appears in the display after x and an operation key are pressed. The value y 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 conditiion. Any non-negative number taken to the zero power is 1.

For roots and powers, the calculator only carries its calculations to nine significant digits. 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, 1.05^{-160} is accurate for all displayed digits where $1.0000005^{-1{,}600{,}000}$ is accurate to only six digits. The error increases 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

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[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	[INV] [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

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

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[×] 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

[ln x] **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 x]	0.1823216

[INV] [ln x] **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] [ln x]	45.150439

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

Enter	Press	Display	Comments
	[CE/C] [CE/C] [(]	0.	
7.5	[+]	7.5	Enter 7.5
1.4	[ln x]	0.3364722	ln 1.4
	[)]	7.8364722	(7.5 + ln 1.4)
	[INV] [ln x]	2531.2594	Answer

Note that the [=] key is not needed since 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: $\log (303 + 101.36) = 2.5130959$

Enter	Press	Display	Comments
	[CE/c] [CE/c] [(]	0.	
303	[+]	303.	Enter 303
1.36	[INV] [log]	22.908677	101.36
	[)]	325.90868	303 + 101.36
	[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.

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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. "DEG" is displayed for degree mode. "RAD" is displayed for radian mode. "GRAD" is displayed for grad mode.

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.

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

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

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[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. However, in the radian mode, the rounded value of π may limit accuracy at very large rotational multiples of π and $\pi/2$.

Sine and cosine functions are accurate throughout all displayed digits, except where noted above for the radian mode. The tangent of $\pm 90°$, $\pm \pi/2$ radians, or $\pm$ 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: $(\sin(.3012\pi)) - \tan(16.2°) = 1.0626654$

Enter	Press	Display	Comments
(select radian mode "RAD")			
	CE/C CE/C (	0.	
.3012	×	0.3012	
	π	3.1415927	
	)	0.9462477	(.3012π)
	sin	0.8112271	sin (.3012π)
	y^x	0.8112271	
16.2	DRG DRG tan	0.2905269	tan (16.2°)
	+/- =	1.0626654	Answer

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

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

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

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

Example: $\sqrt{\arctan 9.72°} + \frac{1}{\arcsin .808} =$ 9.1905773 degrees

Enter	Press	Display	Comments
(select degree mode "DEG")			
9.72	INV tan	84.126038	arctan 9.72
	√x +	9.1720248	$\sqrt{\arctan 9.72}$
.808	INV sin	53.900984	arcsin .808
	1/x	0.0185525	1 / arcsin .808
	=	9.1905773	Answer

Degree, Radian, Grad Conversions

INV DRG► Conversion Key Sequence—Instructs the calculator to change angular mode and convert the displayed value to its equivalent angular value in the new mode. The key sequences to make this conversion are simple, involving the INV and DRG► keys. The memory and calculations in progress are not affected by changing angular values. Be sure that the calculator is in the correct angular mode for entry of the angle to be converted.

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Conversion	Key Sequence
Degrees to Radians	INV DRG►
Degrees to Grads	INV DRG► INV DRG►
Grads to Degrees	INV DRG►
Grads to Radians	INV DRG► INV DRG►
Radians to Degrees	INV DRG► INV DRG►
Radians to Grads	INV DRG►

Each calculation should be completed before pressing the next key.

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

Enter	Press	Display	Comments
(select degree mode "DEG")			
50	INV DRG▸	0.8726646	Radians
	INV DRG▸	55.555556	Grads
	INV DRG▸	50.	Degrees

Example: Convert 100 grads to degrees and radians.

Enter	Press	Display	Comments
(select grad mode "GRAD")			
100	INV DRG▸	90.	Degrees
	INV DRG▸	1.5707963	Radians

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V. MEMORY USAGE

Your calculator has one memory that is able to store data as long as the calculator's solar cells are exposed to light. 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 they are needed.

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

Memory Clearing

Be very careful when clearing your calculator while working with data in memory. Use [AC] only before beginning any calculation which requires a clear memory. Use [CE/C][CE/C] at all other times.

Memory Store

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[STO] **Memory Store Key**—Stores the displayed quantity in the memory without removing it from the display. Any previous value stored in the memory is replaced by the new entry. "M" appears in the display when a non-zero value is stored in memory.

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]	M 45.68
	[CE/C][CE/C]	M 0.
	[RCL]	M 45.68

Use of these keys allows you to store a long number that is to be used several times. Notice that the calculator is cleared with [CE/C][CE/C] without losing the contents of the memory register.

Example: Evaluate $2.4x^4 - 3x^2 + \ . - 10.25$ for $x = 3.1478963$

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

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You can see that storing x the first time it is entered saved 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 the use of [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.

[SUM] is used to accumulate the results from a series of independent calculations. [SUM] replaces the arithmetic sequence [+][EXC][=][EXC].

Important: The memory is not cleared if the calculator is cleared with the [CE/C][CE/C] key sequence. If your first memory operation involves summing to a clear memory, press [AC] before beginning any calculations. However, it is a good practice to add the first number to memory using [STO], as shown in the following example.

Example:

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

Enter	Press		Display	Memory
28.3	[×]		28.3	0.
7	[=][STO]	M	198.1	198.1
173	[+]	M	173.	198.1
16	[=][SUM]	M	189.	387.1
312	[−]	M	312.	387.1
42	[+]	M	270.	387.1
7.8	[=][SUM]	M	277.8	664.9
	[RCL]	M	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 mean starting over from the first. Summing to memory saves each completed expression, making the calculation of each new series of terms 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.

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

The EXC key permits you to solve problem 1 and store the result. Then solve problem 2 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	Memory
.258963	STO x^2 +	M 0.0670618	Store A, A^2 displayed
1.25632	×	M 1.25632	Enter B
	EXC	M 0.258963	Store B, recall A
	×	M 0.3253404	A × B displayed
2	+	M 0.7177426	$A^2 + 2AB$ displayed
	RCL	M 1.25632	Recall B
	x^2	M 1.5783399	B^2
	=	M 2.2960826	Answer

When A is recalled from memory for the last time it is needed, B is instantly stored in its place by the single keystroke EXC.

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APPENDIX A

Hyperbolic Functions

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

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

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

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

Example: tanh 2.99 = 0.9949551

Enter	Press	Display
2.99	[X]	2.99
2	[=]	5.98
	[INV] [ln x] [STO] [−]	M 395.44037
1	[=] [÷]	M 394.44037
	[(] [RCL] [+]	M 395.44037
1	[=]	M 0.9949551

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Inverse Hyperbolic Functions

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

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

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

Example: sinh⁻¹ 86.213 = 5.1500018

Enter	Press	Display
86.213	[+] [(]	86.213
	[x²] [+]	7432.6814
1	[)]	7433.6814
	[√x]	86.218799
	[=]	172.4318
	[ln x]	5.1500018

APPENDIX B
Conversion Factors

English to Metric

To Find	Multiply	By
microns	mils	**25.4**
centimeters	inches	**2.54**
meters	feet	**0.3048**
meters	yards	**0.9144**
kilometers	miles	**1.609344**
gram	ounces	28.349523
kilogram	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}

Boldface numbers are exact; others are rounded.

Temperature Conversions

$$°F = \frac{9}{5}(°C) + 32$$

$$°C = \frac{5}{9}(°F - 32)$$

APPENDIX C
Service Information

In Case of Difficulty

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

If none of the above procedures corrects the difficulty, return the calculator PREPAID to the applicable CUSTOMER SERVICE FACILITY listed on the inside 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:

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

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Customer Service Centers

If your calculator requires service, instead of returning the unit to your dealer or to a service facility for repair, you may elect to exchange the calculator for a factory-reconditioned calculator of the SAME MODEL (or equivalent model specified by TI) by bringing the calculator in person to one of the customer service centers which have been established across the United States. No charge will be made for the exchange with proof-of-purchase during the first 90 days. The exchanged unit will be in warranty for the remainder of the original warranty period or for 6 months, whichever is longer. A HANDLING FEE WILL BE CHARGED FOR EXCHANGE AFTER 90 DAYS FROM THE DATE OF PURCHASE. Out-of-warranty exchanges will be charged at the rates in effect at the time of the exchange.

To determine if there is a customer service center in your locality, look for Texas Instruments Incorporated Customer Service Center in the white pages of your telephone directory or look under one of the following two headings in the yellow pages: "Calculating & Adding Machines & Supplies" or "Computers — Service & Repair". Please call the customer service center to check for the availability of your model, or write the Consumer Relations Department for further details and the location of the nearest customer service center.

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The repaired or replacement calculator will continue the warranty of the original unit or six months, whichever is longer. Other than the postage requirement, no charge will be made for such repair or replacement of in-warranty calculators.

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