

Scientific Calculator

Technical Manual

Introduction

Do you really... I mean REALLY know how to use a calculator? Unfortunately, most people don't know how to use a calculator to its full potential. If you really think about it... Outside of **[0]-[9]**, **[.]**, **[+]**, **[-]**, **[x]**, **[÷]** keys, most of the other calculator's functions remain hidden deep in uncharted territory.



Now... Before we get started, you need to select the right calculator. After all, a calculator in its simplest terms is nothing more than a tool. As with every tool that's used in technology... You must use the right tool for the job.

For electronics and engineering work you need a scientific calculator that supports the following functions:

- Floating Point, Scientific Notation, and Engineering Notation: **[FD]** or **[Flo]**, **[Sci]**, and **[Eng]**
- Parenthesis: **[(]** and **[)]**
- Exponent: **[Exp]** or **[EE]**
- Reciprocal: **[1/x]**
- Memory Functions: **[STO]**, **[RCL]**, **[SUM]**
- Number Systems: **[DEC]**, **[BIN]**, **[OCT]**, and **[HEX]**

Logic Functions like **[AND]**, **[OR]**, **[NAND]**, **[NOR]**, **[XOR]**, and **[XNOR]** are not required but may be helpful.

Calculators that perform these functions aren't expensive. In fact, they're pretty cheap. You needn't spend \$80 on a graphing calculator when a \$10 scientific calculator will do just fine. In fact, the scientific calculator is superior to the graphing calculator for our purpose because most graphing calculators don't support engineering notation or multiple number systems. Remember to select the right tool for the job. You need a calculator that supports all of the functions listed above.

This lesson will introduce you to some new calculator functions and new methods of doing math. All of it applies to electronics technology and you'll apply the skills you've learned throughout this course. It's very important that you read the following section and apply these methods to the following exercises. You may feel that you can skip right to the exercises and commence with the cipherin'. Don't do it... Read through the examples and try to use these strategies to solve the problems.

Words and Terms You Should Know:

- Operators
- Operands
- 2nd Function
- Mode
- Memory Store
- Memory Recall
- Parenthetical Expression
- Number System
- Fixed Decimal
- Floating Point
- Exponent
- Mantissa
- Scientific Notation
- Engineering Notation
- Reciprocal
- Sum

Getting Started with the Scientific Calculator

You need to realize that not all calculators are equal. The instructions used in this section are general in nature and may not apply to the calculator that you're using. The key names and sequences may be different. You may need to refer to your calculator's user manual for instructions on how to perform these operations... so be prepared. Never... Never trust the output of a calculator based upon the punching of numbers into it. You need to know what's happening and recognize screwy results when you press the equal sign. You should always double-check your answers by working out a proof or solving the equation in reverse.

- The **[ON/C]** and **[OFF]** keys turn the calculator on and off. If you don't turn the calculator off, the Automatic Power Down feature turns it off for you. The **[ON/C]** key clears the calculator without affecting the memory register. To clear the display and all pending operations, press **[ON/C]** twice.
- The **[MODE]** key, used with the **[DEC]**, **[BIN]**, **[OCT]**, or **[HEX]** key, lets you select the number systems in which the calculator operates.
- The display shows entries and results with a maximum of 10 significant digits plus a two-digit exponent in scientific and engineering notation. To present additional information about the calculator, special indicators may also appear on the display.

<u>Indicator</u>	<u>Meaning</u>
M	The memory contains a value other than Zero.
E	An error has occurred . To clear the error condition, press [ON/C] .
2nd	You have pressed the [2nd] key. The calculator will access the second function of the next key pressed.
()	You have pressed the [()] key and have not yet completed the parenthetical expression.

Basic Operations of the Scientific Calculator

a. Entering Numbers

[0]-[9] The digit keys enter the digits 0-9 into the display. You may enter a maximum of 10 digits and a decimal point.

[.] The **[.]** key enters a decimal point.

[+/-] The **[+/-]** key changes the sign of the number in the display, making it easy to enter negative numbers. To enter a negative number, first enter the number as a positive value and press **[+/-]**.

b. Arithmetic Operations

[+], [-], [x], [÷] The **[+]**, **[-]**, **[x]**, and **[÷]** keys perform the arithmetic operations for addition, subtraction, multiplication, and division. The **[=]** key completes all pending operations and displays the result.

Example 1 Calculate $5.43 + 10.6 - 5$.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>
Clear, select mode and display format (floating decimal)	[ON/C] [ON/C] [MODE] [DEC]	
Enter the problem	[2nd] [FD] 5.43 [+] 10.6 [-] 5 [=]	0 5.43 16.03 11.03

Example 2 Calculate $5.43 \times 10.6 \div 5$.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>
Clear Display	[ON/C] [ON/C]	0
Enter Problem	5.43 [x] 10.6 [÷] 5 [=]	5.43 57.558 11.5116

c. Parentheses

[(,)] The **[(** key opens a parenthetical expression, and the **)]** key closes a parenthetical expression.

Example Calculate $7 \times (3 + 5)$.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>
Clear; select mode and display format	[ON/C] [ON/C] [MODE] [DEC] [2nd] [FD]	0
Enter pending multiplication	7 [x]	7
Begin parenthetical expression	[(3	3
Enter addition	[+] 5	5
Close parenthetical expression)]	8
Complete pending multiplication	[=]	56

d. Memory Operations

The memory can store any number within the range of the calculator. You can use the memory to compare a value with the result of a later calculation or to recall a number for use several times during a calculation.

[STO] The **[STO]** key clears the memory and then stores the number currently in the display.

[RCL] The **[RCL]** key displays (recalls) the number stored in memory without affecting the contents of memory.

[SUM] The **[SUM]** key adds the number in the display to the value in memory.

Example For practice with memory operation, perform the following steps.

1. Store 50 in memory and add 14.8.
2. Multiply the value in memory by itself.
3. Recall the number stored in memory.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>	<u>Memory</u>
Clear; select mode and display format	[ON/C] [ON/C] [MODE] [DEC] [2nd] [FD]	0	
Store 50 in memory	50 [STO]	50	50
Add 14.8 to memory	14.8 [SUM]	14.8	64.8
Multiply the value in memory by itself	[RCL] [x] [RCL] [=]	4199.04	64.8
Recall the value currently in memory	[RCL]	64.8	64.8

e. Entering Numbers in Scientific Notation

Scientific and Engineering notation are often used to represent numbers that are either very large or very small. It simplifies calculations by removing zeros from these numbers and representing them with powers of ten.

Terms and Definitions

- a. Exponent - The number of times a number is multiplied by itself is called the exponent of the number.
- b. Mantissa - The number which is multiplied by itself is called the mantissa.

Engineering notation is different from scientific notation in that the exponent in engineering notation is displayed in multiples of three. This makes it easier to convert to common terms in found electronics like mega, kilo, milli, micro, and pico.

The **[EXP]** key enables you to enter numbers in scientific notation.

To enter a number in scientific notation, the this procedure.

1. Enter the mantissa. If it is negative, press **[+/-]**.
2. Press **[EXP]**. 00 appears in the right side of the display.
3. Enter the exponent. If it is negative, press **[+/-]**. If you press an incorrect digit key, simply re-enter the correct digits.
4. Press **[=]** to enter the number. Then, if necessary, press **[2nd] [SCI]** or **[2nd] [Eng]** to place the display in the desired format.

Example 1 Enter 12345.6789 x 10³ and set the display format to scientific notation.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>
Clear; select mode and display format	[ON/C] [ON/C] [MODE] [DEC] [2nd] [FD]	0
Enter the mantissa	12345.6789	12345.6789
Enter the exponent	[EXP] 3	12345.6789 03
Enter the value as a calculated result	[=]	12345678.9
Set format to scientific notation	[2nd][Sci]	1.23456789 07

Example 2 Enter 60.23 x 10⁻¹⁴ in scientific notation, but accidentally enter the wrong exponent.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>
Clear display	[ON/C] [ON/C]	0
Enter value with incorrect exponent	60.23 [EXP] 26	60.23 26
Correct the exponent	14 [+/-]	60.23-14
Normalize	[=]	6.023-13
Set the format to scientific notation	[2nd] [Sci]	6.023-13

Example 3 Convert .001 to engineering notation.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>
Clear display	[ON/C] [ON/C]	0. 00
Set the format to engineering notation	[MODE] [DEC] [2nd] [Eng]	
Enter value	.001	0.001
Normalize	[=]	1. ⁻⁰³



Scientific Calculator

Exercise 1 – Arithmetic Operations

Exercise Objective:

In this exercise, you will practice solving some basic math problems.

Name:	
Period:	
Date:	

Discussion of Fundamentals:

The important thing to remember when solving these equations is to pay attention to the order in which you perform the calculations. There's a certain hierarchy to mathematical operators when they're mixed into a single equation. Perform all operations in this order:

1. Clear all parenthesis by solving for the contents.
2. Multiplication
3. Division
4. Addition
5. Subtraction

Example 1 Calculate $5.43 + 10.6 - 5$.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>
Clear, select mode and display format (floating decimal)	[ON/C] [ON/C] [MODE] [DEC]	
Enter the problem	[2nd] [FD] 5.43 [+] 10.6 [-] 5 [=]	0 5.43 16.03 11.03

Example 2 Calculate $5.43 \times 10.6 \div 5$.

<u>Procedure</u>	<u>Press</u>	<u>Display</u>
Clear Display	[ON/C] [ON/C]	0
Enter Problem	5.43 [x] 10.6 [÷] 5 [=]	5.43 57.558 11.5116

Research Resources:

Company	Web Site	Description
calculator.com	http://www.calculator.com/calcs/calc_sci.html	On-line Scientific Calculator
scientificcalculator.com	http://www.scientificcalculator.com/	On-line Scientific Calculator
calculator.org	http://www.calculator.org/	On-line Scientific Calculator and Resources
math.com	http://www.math.com/students/calculators/source/scientific.htm	On-line Scientific Calculator and Resources
vintagecalculators.com	http://www.vintagecalculators.com/	On-line Calculator Museum

Required Materials:

Scientific Calculator Pencil

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Procedure:

Using a scientific calculator, solve the following problems. Write your solutions on this worksheet and have your instructor compare them against the answer key. Correct all of the problems you answered incorrectly.

a. $682 + 17 = \underline{699}$

k. $(4)(8) = \underline{\hspace{2cm}}$

b. $0.523 + 0.234 = \underline{\hspace{2cm}}$

l. $400 \times 0.2 = \underline{\hspace{2cm}}$

c. $5,463,832 + 7,000,000 = \underline{\hspace{2cm}}$

m. $180 \div 12 = \underline{\hspace{2cm}}$

d. $98 + 84 + 77 = \underline{\hspace{2cm}}$

n. $165.6 \div 3.6 = \underline{\hspace{2cm}}$

e. $74 - 43 = \underline{\hspace{2cm}}$

o. $0.175 \div 0.25 = \underline{\hspace{2cm}}$

f. $888 - 999 = \underline{\hspace{2cm}}$

p. $24.72 \div 12 = \underline{\hspace{2cm}}$

g. $0.0054 - 0.0022 = \underline{\hspace{2cm}}$

q. $6 \times 2 + 4 = \underline{\hspace{2cm}}$

h. $1575 - 800 = \underline{\hspace{2cm}}$

r. $9 \times 2 + 4 - 2 = \underline{\hspace{2cm}}$

i. $3.2 \times 3 = \underline{\hspace{2cm}}$

s. $5 \div 3 \div 2 = \underline{\hspace{2cm}}$

j. $4 \times 4 \times 4 = \underline{\hspace{2cm}}$

t. $9 \times 32 \times 2 = \underline{\hspace{2cm}}$



Scientific Calculator

Exercise 2 – Parentheses

Exercise Objective:

In this exercise, you will practice solving some basic math problems using the parentheses function on the calculator.

Name:	
Period:	
Date:	

Discussion of Fundamentals:

In this exercise, you'll use the parentheses keys to functionally group parts of an equation together to perform the mathematics necessary to solve the problem.

Here's how to use the parentheses function:

[(,)] The **[(** key opens a parenthetical expression, and the **[)]** key closes a parenthetical expression.

Example Calculate $7 \times (3 + 5)$.

Procedure

Clear; select mode and display format

Enter pending multiplication

Begin parenthetical expression

Enter addition

Close parenthetical expression

Complete pending multiplication

Press

[ON/C] **[ON/C]**

[MODE] **[DEC]**

[2nd] **[FD]**

7**[x]**

[(]**3**

[+]**5**

[)]

[=]

Display

0

7

3

5

8

56

Research Resources:

Company

calculator.com

scientificcalculator.com

calculator.org

math.com

vintagecalculators.com

Web Site

http://www.calculator.com/calcs/calc_sci.html

<http://www.scientificcalculator.com/>

<http://www.calculator.org/>

<http://www.math.com/students/calculators/source/scientific.htm>

<http://www.vintagecalculators.com/>

Description

On-line Scientific Calculator

On-line Scientific Calculator

On-line Scientific Calculator and Resources

On-line Scientific Calculator and Resources

On-line Calculator Museum

Required Materials:

Scientific Calculator

Pencil

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Procedure:

Using the parenthesis keys ([**()**] and [**)]**) on a scientific calculator, fill in the blanks with the correct answers. Write your solutions on this worksheet and have your instructor compare them against the answer key. Correct all of the problems you answered incorrectly.

a. $4 + (4 \times 2) = \mathbf{12}$

f. $(3 \times 8) - 9 = \underline{\hspace{2cm}}$

b. $(2 + 3) \times 4 = \underline{\hspace{2cm}}$

g. $((4+8)\div 6) \times 3 = \underline{\hspace{2cm}}$

c. $6 + (2 \times 3) = \underline{\hspace{2cm}}$

h. $8(3 + 6) + 7 = \underline{\hspace{2cm}}$

d. $3(2 + 2 - 1) = \underline{\hspace{2cm}}$

i. $4 + (8 - 3) = \underline{\hspace{2cm}}$

e. $6 + (2 \div 3) = \underline{\hspace{2cm}}$

j. $(12 + 48)\div(12 \times 48) = \underline{\hspace{2cm}}$



Scientific Calculator

Exercise 3 – Scientific and Engineering Notation

Exercise Objective:

In this exercise, you will learn how to use a calculator to work with some very large numbers as well as some very small numbers. You will use a calculator to convert numbers between fixed decimal (floating point), scientific notation, and engineering notation.

Name:	
Period:	
Date:	

Discussion of Fundamentals:

When you use scientific or engineering notation, you can keep better track of the large number of zeros typically used in electronics formulas. In fact, you don't use many zeros at all. Engineering notation is particularly powerful because the exponents directly correlate to metrics like mega, kilo, milli, and micro to represent quantities.

You're probably thinking to yourself, "What on Earth is he talking about?" Don't worry about it. You'll do more of that stuff later in the course. For right now, it's very important that you know how to convert between the three different ways of representing numbers using the calculator and not cerebral manipulation of decimal points.

Here's an example showing how to convert between floating point and engineering notation:

Example	Convert .001 to engineering notation.	Press	Display
<u>Procedure</u>			
Clear display		[ON/C] [ON/C]	0. 00
Set the format to engineering notation		[MODE] [DEC] [2nd] [Eng]	
Enter value		.001	0.001
Normalize		[=]	1. ⁻⁰³

Converting to scientific notation is very similar.

Research Resources:

Company	Web Site	Description
brazosport	http://www.brazosport.cc.tx.us/~et/EngNot.htm	Engineering Notation Lesson
purplemath.com	http://www.purplemath.com/modules/exponent.htm	Notation and Powers Lesson
calculator.com	http://www.calculator.com/calcs/calc_sci.html	On-line Scientific Calculator
scientificcalculator.com	http://www.scientificcalculator.com/	On-line Scientific Calculator
calculator.org	http://www.calculator.org/	On-line Scientific Calculator and Resources

Required Materials:

Scientific Calculator Pencil

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Procedure:

Using the **[Sci]**, **[Eng]**, and **[EXP]** keys on a scientific calculator, fill in the blanks with the correct answers. Write your solutions on this worksheet and have your instructor compare them against the answer key. Correct all of the problems you answered incorrectly.

Hint: Answers for Scientific Notation will have only 1 digit to the left of the decimal point.
Answers for Engineering Notation will have 12, 9, 6, 3, 0, -3, -6, -9, or -12 for an exponent.

1. Convert the following numbers to scientific notation and then to engineering notation.

	<u>Scientific Notation</u>	<u>Engineering Notation</u>
a. 481,000	4.81×10^5	481×10^3
b. 29,000	_____	_____
c. 610,000	_____	_____
d. .0034	_____	_____
e. .000006	_____	_____
f. 47.50	_____	_____
g. 10	_____	_____
h. 4,700	_____	_____
i. .001	_____	_____
j. .0022	_____	_____

2. Change the following numbers that are in notation to ordinary form (fixed decimal).

- | | | | | | |
|----|-----------------------|-----------------------------|----|--------------------|-----------------------------|
| a. | 23×10^2 | <u>2300</u> | f. | 4.7×10^3 | <u> </u> |
| b. | 1×10^{-3} | <u> </u> | g. | 1×10^6 | <u> </u> |
| c. | 1.456×10^7 | <u> </u> | h. | 22×10^4 | <u> </u> |
| d. | 4.7×10^{-6} | <u> </u> | i. | 1.5×10^3 | <u> </u> |
| e. | 2.2×10^{-12} | <u> </u> | j. | 4000×10^3 | <u> </u> |

3. Perform the following calculations using the exponent key [EXP] on a scientific calculator.

<u>Notation</u>	<u>Scientific Form</u>	<u>Floating Decimal</u>
a. $(1 \times 10^3) \times (1 \times 10^3)$	1×10^6	1,000,000
b. $7 \times (1 \times 10^3) \times (1 \times 10^3)$	<u> </u>	<u> </u>
c. $(1 \times 10^7) \times (1 \times 10^{12}) \times (1 \times 10^{-3})$	<u> </u>	<u> </u>
d. $(25 \times 10^3) \times (12 \times 10^9)$	<u> </u>	<u> </u>
e. $(470 \times 10^{-6}) \times (1 \times 10^3)$	<u> </u>	<u> </u>



Scientific Calculator

Exercise 4 – Test

1. Using a scientific calculator, solve the following basic operation problems.

a. $6 + (2 \times 4)$ = _____

b. $(14 \times 2) - 20$ = _____

c. $((8 + 12) \div 5) + 3$ = _____

d. $\frac{1}{\frac{1}{4} + \frac{1}{3} + \frac{1}{2}}$ = _____

e. $(3 \times 8) - 9$ = _____

2. Using a scientific calculator, solve the following scientific notation problems. Answers should be in scientific notation.

a. $(4 \times 10^4) \times (2 \times 10^2)$ = _____

b. $4,000,000 \times 2,000,000$ = _____

c. $(7 \times 10^4) + 200$ = _____

d. $(4 \times 10^{-12}) \times (3 \times 10^6)$ = _____

e. $(2 \times 10^2) \div (2 \times 10^4)$ = _____

3. Convert the following numbers to engineering notation using a scientific calculator.

a. .0000001 = _____

b. 1,100,000 = _____

c. 3,300 = _____

d. .047 = _____

e. .000000005 = _____