commodore

Models

SR8120D
SR8140D
SR890D

Scientific Electronic Calculators

Owner's Manual

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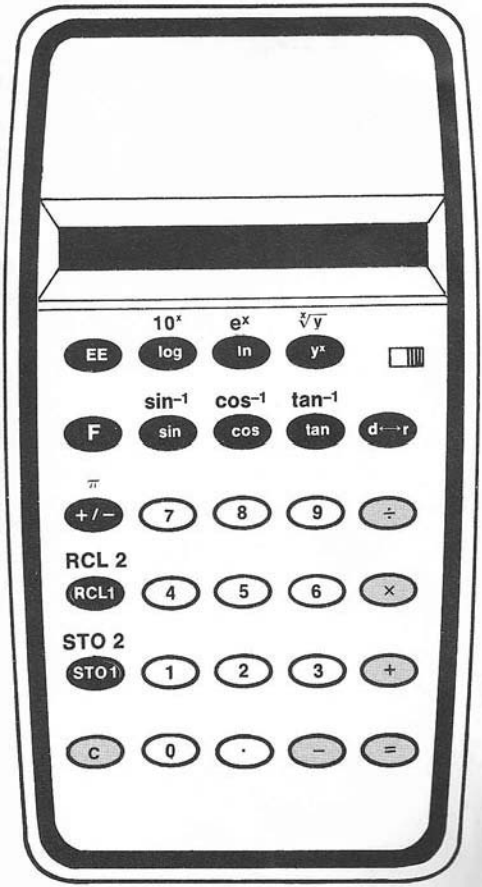
KEYBOARD



KEY INDEX

This index permits quick page location of the description and/or the first use of each function key.

INTRODUCTION

Thank you for selecting our new scientific calculator.

It represents the finest achievement in solid state large scale integrated/metal oxide silicon technology.

The commonsense logic of this scientific notation calculator is the key to your mastery of it. You are able to enter basic assignments just as you would write them down on paper. For example, 4 x 5 = , is entered just as you see it. Higher math arguments are accomplished on your mini-computer by again entering examples as they are commonly written. Thus, the Log of 9- the Log of 4 is indexed: 9 Log-4 Log = .

This emphasis on academic principles is a consistent theme which runs throughout the logic of your new mini-computer.

Students will appreciate the fact that most math concepts have been programmed into the logic system. Among these basic tenets are such principles as any number raised to the zero power equals one; and zero raised to any power (except zero) equals zero. As can be seen, results will be precisely displayed for immediate comprehension.

In short, our Scientific was designed by professionals for professionals and students alike. It has been developed as an easy-to-understand, easy-to-operate machine. Please read through the pages of this manual carefully. Become familiar with the keyboard and its characteristics. Work through the examples.

They have been designed to give you a thorough understanding of all functions. Proficiency is gained by practice. Once you discover how easy your mini-computer is to operate, it will become an essential, enjoyable aid to you in every area of computation.

A special note concerning display capacity and machine logic.

This book has been prepared to illustrate the operation of a 14-digit machine.

In the event you have selected a machine with a 12- or 9-digit capacity, you are of course restricted to an entry limited by the number of digits in the mantissa and results will be truncated in accordance with the capacity of the display. This in no way alters the accuracy of your machine as the extra digits are retained within the unit's logic for continued computation. Thus, you can work all of the problems in this manual.

The treatment of numbers between +1 and −1 differs among models. In all instances both entry and result are accurate. However, some models will express these values in scientific notation.

	Enter:	Read:
Example A.	.002 X	2. −03
Example B.	.002 X	0.002

Both results are identical.

NUMERICAL ENTRY

0 through 9 • +/− EE

sample display:

	Sign of Mantissa	Mantissa	Sign of Exponent	Exponent
(14 digits):	−	0.123456789		90
(12 digits):	−	102.34578	−	99
(9 digits):	−	123.45	−	99

- **sign mantissa:** − or + , blank on display implies a positive number
- **mantissa:** 10 digit maximum in 14-digit display

  8 digit maximum in 12-digit display.

  5-digit maximum in 9-digit display.

Special Case: A result between 1 and −1 which has an exponent −01 is displayed in floating notation with a leading zero. This affects the display only. The logic of the calculator realizes the true 10-digit result and the ten digit accuracy is retained in the machine.

Enter:	**See Displayed:**
2 ÷ 3 =	0.666666666

Subsequent chain calculations will be computed using the true result retained internally in scientific notation:

6.666666666 −01

- **sign of exponent:** − or +, blank implies positive
- **exponent field:** two digits maximum

Entry: A number (the mantissa) is entered just as written using the keys **0 through 9.** The sign of the mantissa can be entered at any time during a numerical entry by pressing the change sign key +/− . The sign of the exponent can be changed by pressing the change sign key after the EE key (enter exponent key) has been pressed. The exponent field is blank until EE is entered.

C

The clear entry/clear key. Pressing the C during or immediately after a numerical entry will clear the display. Only prior entries are retained intact. Pressing the C key in all other cases clears your calculator; Memories are not cleared.

Enter:

2 + 3 C 4 = 6 C

Clear Entry — Clear All

In the above example, we wished to add 2 and 4 but entered 3 by mistake. Pressing C and entering 4 corrects the error and allows further computation. The final C clears the calculator.

FOUR FUNCTION ARITHMETIC

[+] [−] [×] [÷]

Example:

Enter:	Read:	Explanation:
3 [+/−] [×]	3.	Enter −3 and multiply
1.2 [EE] [+/−] 2	1.2 − 02	Enter 1.2×10^{-2}
[=]	− 0.036	Perform multiplication and display result

CHAIN CALCULATIONS

Example:

Calculate $\frac{3 \times 4}{5} \div .3$

Enter:	Read:	Explanation:
3 [×]	3.	Enter 3 and multiply
4	4.	Enter 4
[÷]	12.	The multiplication 3 × 4 is performed, the result, 12, is displayed and divide is entered.
5	5.	Enter 5

Enter:	Read:	Explanation:
[÷]	2.4	The result of the division 12 ÷ 5 is displayed and divide is entered
.3	0.3	Enter .3
[=]	8.	The result of $\frac{3 \times 4}{5} \div .3$ which is 8 in display

CORRECTING OPERATIONS

Example: Calculate 3 × 4

Enter:	Read:	Explanation:
3 [+]	3.	Enter 3. We wish to multiply but entered + by mistake.
[×]	3.	Enter the correct function key
4	4.	Now enter 4
[=]	12.	The result of 3 × 4 is displayed

In this manner any of the "four function" keys (+ − × ÷) can be over written by another; the final entry will be executed. For example:

Enter:	Read:	Explanation:
3 [×] [+] [÷] [−] 4 [=]	− 1.	The last function pressed, (−) is executed.

Use of the F Function Key.

Your mini-computer has 29 keys, one of which is a special function key marked "F."
The application of this key enables you to increase the feature range of your machine by releasing twelve additional operations.

Nine of the 29 keys are inscribed with upper case functions. If any one of these keys is pressed the lower case function is executed. However, if the F key is indexed immediately prior to pressing one of the "double function" keys, the upper case function is performed.

Example:

Enter:	Read:	Explanation:
a. 2 y^x 3 =	8.	Raise 2 to the third power.
b. C 8 F $\sqrt[x]{y}$ 3 =	2.	Obtain the cube root of 8.

USING THE MEMORY

Store: STO 1 STO 2

The store keys refer to the two memory registers and they store data for future use. When STO 1 is pressed, the value currently on the display will be copied into Memory Register 1. Similarly, when the F key is entered as a prefix to the memory key STO 1, the displayed data is copied into Memory Register 2. Any data stored in the register prior to pressing the respective **STO** key will be lost. This is referred to as "writing over."

Recall: RCL 1 and **RCL 2**

These keys are used to recall data stored in their associated memory registers. The value stored in memory is copied onto the display; the value on display prior to recall is lost while the value stored in memory is unaltered. To recall data in **STO 2**, Press key sequence F **RCL 2**.

Example:

Enter:	Read:	Explanation:
5	5.	Enter 5
STO 1	5.	Copies 5 into memory register 1
6	6.	Enter 6
F STO 2	6.	Copies 6 into memory register 2

Enter:	Read:	Explanation:
RCL 1	5.	The content of Memory 1 (5) is copied onto the display. Five remains in Memory 1.
F RCL 2	6.	The content of Memory 2 (6) is copied onto the display. Six is retained in Memory 2.

Clear:

An individual memory register can be cleared by entering the key sequences:

C STO 1 Clears memory register 1.

C F STO 2 Clears memory register 2.

The C key need not be entered if 0. is on the display. However, you must still press the appropriate storage entry keys to replace the existing data with a zero value. Both memory registers are cleared at power on.

CHAIN CALCULATIONS USING MEMORY

Examples:

	Enter:	Read:
①	3 × 5 × 4 ÷ 6 = STO 1	10.

The result of the calculation (10) is displayed and stored in Memory 1 for future recall.

	Enter:	Read:
②	3 + 5 + RCL 1 =	18.

The value in Memory 1 (10) is added to 8 and the result is displayed. Memory 1 is unaffected.

③	3 × 5 × 4 ÷ 6 = F STO 2	10.

The result of the calculation is displayed and stored in Memory 2 for future recall.

①	3 × 4 ÷ F RCL 2 =	1.2

The value stored in Memory 2 (10) is included in the calculation and the result is displayed. Memory 2 is unaltered.

EXPONENT KEY

EE Enables entry of exponent values.

Enter:	Read:	Explanation:
5.5 EE 46	5.5 46	We have entered 5.5×10^{46}

y^x With the power key, a number raised to any power (or root) can be calculated. The base is entered first, then the power key, and finally the power (or root) to which the base is to be raised. Powers are calculated using the formula $y^x = e^{(x \ln y)}$, $\sqrt[x]{y} = e^{\left(\frac{\ln y}{x}\right)}$. Therefore, negative bases are not permitted. Any attempt to raise a negative base to a power will result in an error condition. In addition to performing all commonly encountered powers and roots accurately and quickly, your calculator will correctly perform these calculations:

$0^0 = 1$, $x^0 = 1$, $0^x = 0$ for $x \neq 0$.

① **Chain calculation involving y^x key**

Calculate $3x^5 - x^3 + 4$ for $x = 4$

Enter:	Read:	Explanation:
3 ×	3.	Enter 3 and multiply
4 y^x	4.	Enter 4 as the base
5	5.	Enter 5 as the power
−	3072.	Calculate and display $3(4)^5$ and enter subtract
4 y^x	4.	Enter 4, the base

Enter:	Read:	Explanation:
3	3.	Enter 3, the power
+	3008.	Calculate and display $3(4)^5 - (4)^3$ enter add
4 =	3012.	$3(4)^5 - (4)^3 + 4 = 3012$.

② **Binary to decimal conversion:**

Convert the binary number 11011 to decimal. 11011 in base 2 is equal to $2^4 + 2^3 + 2^1 + 2^0$ in decimal.

Enter:	Read:	Explanation:
2 y^x	2.	Enter 2, the base
0 +	1.	Calculate & display 2^0 and add
2 y^x	2.	Enter 2, the base
1 +	3.	Calculate & display $2^0 + 2^1$ and add
2 y^x	2.	Enter 2, the base
3 +	11.	Calculate and display $2 + 2 + 2$ and add
2 y^x		
4 =	27.	Terminate calculation & display result

11011 base 2 = 27 base 10

③ **What are the monthly payments on a $20,000 mortgage at 9% annually extending over 20 years?**

formula: $$PMT = \frac{PV\ I}{1 - (1 + I)^{-n}}$$

Where PV is the Principal (present value) of the mortgage
I is the monthly interest expressed as a decimal
n is the number of months
PMT is the monthly payment

Enter:	Read:
.09 ÷ 12 +	0.0075

Calculate the monthly interest (9% for 12 months)

1 = y^x	1.0075

Calculate (1 + I) and enter it as the base

240 +/−	− 240.

Enter the number of months, change the sign, calculate $(1 + I)^{-n}$ and subtract 1

= +/− + 1 =	0.833587156
STO 1	

Store $1 - (1 + I)^{-n}$ in memory

Enter:	Read:
.09 ÷ 12 ×	0.0075

Calculate the monthly interest and multiply

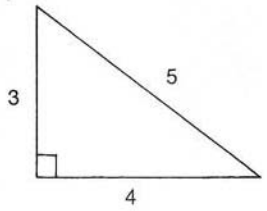
20000 ÷	150.

Calculate PV Enter divide

RCL 1 =	179.945191

The dollar amount necessary to amortize a $20,000 mortgage in 20 years at 9% annual interest

④ **Hypotenuse Calculations**



Given a right triangle, three meters on one side and four on the other, find the hypotenuse. The equation is:

$R = \sqrt{A^2 + B^2}$ A = side 1 B = side 2

Find R, if A = 3 and B = 4

Enter:	Read:	Explanation:
3 y^x	3.	Enter 3, the base
2 +	9.	Calculate & display 3^2
4 y^x	4.	Enter 4, the base
2 =	25.	Calculate and display $3^2 + 4^2$
F $\sqrt[x]{y}$	25.	Enter 25 as the base
2 =	5.	Calculate and display the second root of 25.

Example:

⑤ **Find the radius of a sphere whose volume is 2144 cubic meters.**

Equation: $R = \sqrt[3]{\frac{3V}{4\pi}}$ R = radius V = Volume

Enter:	Read:	Explanation:
2144 ×	2144.	Enter the Volume - multiply
3 ÷	6432.	By 3 divide
4 ÷	1608.	By 4 divide
F π =	511.842297	By π

Enter:	Read:	Explanation:
F $\sqrt[x]{y}$	511.842297	Enter $\frac{3V}{4\pi}$ as the base
3 =	7.999178546	Calculate the cubic root of $\frac{3V}{4\pi}$ and display result

The sphere has a radius of approximately 8 meters.

TRANSCENDENTAL FUNCTIONS

Your scientific calculator will perform common and natural (Naperian) logarithmic and inverse logarithmic functions. It also calculates the three trigonometric functions and their inverses. Each of these keys operates on the value currently on display.

Logarithmic Functions

log Calculates the common logarithm ($\log_{10}$) of x.

10^x Calculates the common antilogarithm of x.

ln Calculates the natural logarithm ($\log_e$) of x.

e^x Calculates the natural antilogarithm of x.

Examples:

① Natural logarithm ln and inverse natural logarithm function, e^x
Calculates $e^{\ln 2 + \ln 3}$

Enter:	Read:	Explanation:
2 **ln** +	0.69314718	Calculate ln 2 and enter +
3 **ln**	1.098612289	Calculate ln 3
=	1.791759469	Display result of $\ln^2 + \ln^3$
F e^x	6.	Calculate the inverse function.

The above calculation demonstrates the equation ln (a) + ln (b) = ln (ab)
To calculate the hyperbolic arc tan of .5:

② Equation: $\text{arctanh } X = \frac{1}{2} \ln \left(\frac{1 + x}{1 - x}\right)$

Enter:	Read:	Explanation:
1 − .5 = **STO 1**	0.5	Store (1 − .5) in Memory 1
1 + .5 = ÷	1.5	Calculate (1 + .5), enter divide

Enter:	Read:	Explanation:
RCL 1 =	3.	Calculate (1 + .5)
ln	1.098612289	Calculate ln [(1 + .5)/(1 − .5)]
÷ 2 =	0.549306144	Calculate ln $\left[\frac{(1+.5)}{(1-.5)}\right]$ arc tan = 2

③ Calculate the hyperbolic sine of .5

Equation: $\sinh x = \frac{e^x - e^{-x}}{2}$

Enter:	Read:	Explanation:
.5 **F** e^x −	1.648721271	Calculate and display the exponential function of .5, $e^{.5}$ and enter −
.5 +/− **F** e^x	0.606530659	Calculate and display the exponential of −.5
÷	1.042190611	Perform subtraction, display result, and enter ÷
2 =	0.521095305	Divide by 2 and display the result, the sinh of .5

Trigonometric Functions

sin	Calculates sine of x.
sin⁻¹	Calculates inverse sine of x.
cos	Calculates cosine of x.
cos⁻¹	Calculates inverse cosine of x.
tan	Calculates tangent of x.
tan⁻¹	Calculates inverse tangent of x.

Your calculator will find the sine, cosine, tangent, arc sine, arc cosine and arc tangent of any number on display in either degrees or radians. The calculator is in degree mode when turned on. Pressing the **d/r** key shifts your calculator to radian mode, lights a decimal point in the exponent field, and converts the value on display from degrees to radians. Pressing **d/r** again shifts the calculator back to degree mode and converts the display in degrees.

Input range for sine, cosine and tangent is ± *0-360°*

Example: Degree Mode

Enter:	Read:
30	30.
sin	0.5
F **sin⁻¹**	30

Enter:	Read:
120	120
cos	− 0.5
F **cos⁻¹**	120
45	45.
tan	1.
F **tan⁻¹**	45

Example: Radian Mode

Enter:	Read:	Explanation:
C **d/r** **F** **÷** **6** **=**	0.523598775 •	
sin **π**	0.5 •	
F **sin⁻¹**	.523598775 • (Radian Indicator)	enter $\frac{\pi}{6}$ radian

Conversion to radian

①

Enter:	Read:	Explanation:
C	0.	
120	120.	
d/r	2.094395102 •	120° converted to $\frac{2\pi}{3}$ rad. Radian mode initiated
cos	− 0.5 •	
F cos⁻¹	2.094395102 •	
d/r	120.	Convert back to degrees. Initial degree mode

②

Enter:	Read:	Explanation:
45	45. •	
d/r	0.785398163 •	45° converted to $\frac{\pi}{4}$ rad. Radian mode initiated
tan	1. •	
F tan⁻¹	0.785398163 •	
d/r	45.	Convert back to degrees and initiate degree mode

APPENDIX A

Error Condition

An error condition results when an improper operation is performed or when the result of an operation overflows or under flows the absolute range of the calculator.

When an error condition occurs the letter "E" is displayed.

Press the clear key C to clear the error condition.

Improper Operation:

X ÷ Y	where Y = 0
Y^x	where y < 0
$\sqrt[x]{y}$	where X < 0
ln X	where X ≤ 0
log X	where X ≤ 0
$\sin^{-1}$ X	where | X | >1
$\cos^{-1}$ X	where | X | >1

Overflow

Occurs when a computed result is greater than the display capacity of your machine.

Underflow

Occurs when a computed result is less than 1.0×10^{-99}

APPENDIX B

OPERATING ACCURACY

The precision of your calculator depends upon the operation being performed. Basic addition, subtraction, multiplication, division and reciprocal assignments have a maximum error of ± one count in the tenth or least significant digit.

While countless computations may be performed with complete accuracy, the accuracy limits of particular operations depend upon the input argument as shown below.

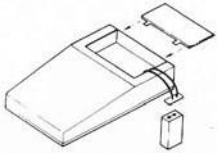
Function	Input Argument	Mantissa Error (Max.)
ln x		1 count in D_{10}
log x		1 count in D_{10}
e^x		3 counts in D_{10}
y^x		1 count in D_9
sin ϕ	$0° \leq \lvert\phi\rvert \leq 360°$ or $0 \leq \lvert\phi\rvert \leq 2\pi$	8 counts in D_{10}
cos ϕ	$0° \leq \lvert\phi\rvert \leq 360°$ or $0 \leq \lvert\phi\rvert \leq 2\pi$	8 counts in D_{10}
tan ϕ	$0 \leq \lvert\phi\rvert < 89°$ $89° \leq \lvert\phi\rvert \leq 89.95°$	4 counts in D_9 1 count in D_8
$\sin^{-1}$ x	$10^{-10} \leq \lvert x\rvert \leq 1$	$E < 5 \times 10^{-8}$
$\cos^{-1}$ x	$10^{-10} \leq \lvert x\rvert \leq 1$	$E < 5 \times 10^{-8}$
$\tan^{-1}$ x		$E < 5 \times 10^{-8}$

Dn = Nth display digit assuming a left justified 10 digit result.

APPENDIX C

Disposable Battery Model (D)

Your calculator uses a standard nine-volt battery type 006P available at most drug, department and camera stores. To operate, disconnect the adaptor cord and turn power switch "ON" (an interlocking switch in the AC socket will prevent battery use if the plug remains connected). When the battery weakens, display will dim.



Experience has proven that batteries packed with machines age considerably. To protect your calculator, we have omitted the battery from the package. Please ask your dealer for a fresh, new power cell. In the event your brand new machine does not function, please check the battery first.

Please note, machines with disposable batteries will not recharge. See battery replacement details above.

AC Adapter Operation

It is recommended that you unsnap and remove the battery from your machine before inserting the adapter jack.

APPENDIX C

Use proper Commodore/CBM adapter for AC operation.

Adapter 640 or 707 North America

Adapter 708 England

Adapter 709 West Germany

APPENDIX E

Guarantee

Your new electronic calculator carries a parts and labor guarantee for one year from date of purchase.

We reserve the right to repair a damaged component, replace it entirely, or, if necessary, exchange your machine.

If you own a portable calculator which uses an AC adapter, the adapter must be returned with your machine when service is required.

In order to receive free service under this guarantee at a Commodore Service Center, you are required to pay all postage, shipping and insurance charges when returning your calculator to the Commodore Service Center and enclose a check or money order for $2.50 to cover handling charge, return postage and insurance.

This guarantee is valid only when a copy of your original sales slip or similar proof of purchase accompanies your defective machine.

This guarantee applies only to the original owner. It does not cover damage or malfunctions resulting from fire, accident, neglect, abuse or other causes beyond our control.

The guarantee does not cover the repair or replacement of plastic housings or transformers damaged by the use of improper voltage. Nor does it cover the replacement of expendable accessories and disposable batteries.

The guarantee will also be automatically voided if your machine is repaired or tampered with by any unauthorized person or agency.

This guarantee supersedes, and is in lieu of, all other guarantees whether expressed, or implied.

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