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commodore

Multi-Function Preprogrammed Rechargeable Scientific Notation Calculator

Model SR4190R

OWNER'S MANUAL

MR.
CALCULATOR
THANK YOU

BR 49.95 I

BR 03.25 IV

BR 53.20 BL DU

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Key	Description	See Sect.	Keystroke Sequence Reminder
HMS	Hour-minute-second mode	m	hours (or degrees) HMS minutes HMS seconds
n!	Factorial n	h	*number* n!
Γ(x)	Gamma function	h	*number* F Γ(x)
(and)	Left and right parenthesis	g	operator (computations)
%	Percent add-on/ discount	k	*number* F %
Δ%	Percent variation	k	*number* x↔y *number* F Δ%
(INV)	Generates inverse trigonometric or hyperbolic functions. Converts into the unit between ( ) on the keyboard	b	*number* (INV) then other keys
sin cos tan	Sine, cosine, tangent	h	*number* sine or cos or tan
sinh cosh tanh	Hyperbolic sine, cosine, tangent	h	*number* F sinh or F cosh or F tanh
F	Accesses functions symbolized above the keytop	a	F then key below legend function
→R →P	Coordinate conversion	k	*number* x↔y *number* →P or →R x↔y then store coordinates and clear C, or clear only
P^n_m	Permutation of n elements taken m at a time	k	n x↔y m P^n_m

Key	Description	See Sect.	Keystroke Sequence Reminder
$\underline{C^n_m}$	Combinations of n elements taken m at a time	k	n x↔y m F $\underline{C^n_m}$
ln log	Natural and common logarithm	h	*number* ln or log
$\underline{e^x}$ $\underline{10^x}$	Natural and common antilogarithm	h	*number* F $\underline{e^x}$ or F $\underline{10^x}$
y^x $\underline{\sqrt[x]{y}}$	Raises y to the xth or $\frac{1}{x}$th power	k	y y^x x = or y F $\underline{\sqrt[x]{y}}$ x=
d/r	Establishes an angular unit mode degree d or radian r. A dot will appear at the extreme right of the display when in radian mode. Will not convert the displayed number	o	press the key to change mode
$\underline{\text{d↔r}}$	Converts the displayed number into degrees or radians depending on if the radian indicator is lit or not. Will set the mode after conversion.	o	press the key to convert and change mode
STO1 RCL1 Σ1 $\underline{\text{STO2}}$ $\underline{\text{RCL2}}$ $\underline{\Sigma 2}$	Memory store, memory recall and add to memory keys	g	press STO1, RCL1, Σ1 or F $\underline{\text{STO2}}$ F $\underline{\text{RCL2}}$ F $\underline{\Sigma 2}$
x, ÷, −, +, =	Arithmetic operations	i	*number* key *number* key performs and chains the operation
$\underline{\text{jx}}$, $\underline{\text{j÷}}$, $\underline{\text{j−}}$, $\underline{\text{j+}}$	Complex numbers arithmetic operations	j	

Key	Description	See Sect.	Keystroke Sequence Reminder
$\underline{\text{(unit 1) unit 2}}$	(Legends above numeral keys) Converts a number displayed in unit 1 to the number expressing it in unit 2 Converts a number displayed in unit 2 to the *number* expressing it in unit 1	n	F $\underline{\text{(unit 1) unit 2}}$ (INV) F $\underline{\text{(unit 1) unit 2}}$
0, ., 1 9	Numeral entry keys	c	press keys to enter *number*
+/−	Change sign key	c	changes the sign of the displayed *number* after the *number* is entered
$\underline{\pi}$	Enter π = 3.141592654	c	F $\underline{\pi}$
EE	Sets exponent value entry mode	e	EE then exponent value
$\underline{\text{MANT}}$	Reverts to mantissa value entry mode	e	F $\underline{\text{MANT}}$ then mantissa value
EE↑	Increments exponent algebraically and moves decimal point accordingly	f	press as many times as required
$\underline{\text{EE↓}}$	decrements exponent algebraically and moves decimal point accordingly	f	press as many times as required. For both keys, depression of = key restores the full initial *number*
x^2 $\underline{\sqrt{x}}$	Square and square root	h	*number* x^2 or F $\underline{\sqrt{x}}$
C/CE	Clear key	d	one depression clears numerical entry. Two depressions clear arithmetic sequences
$\underline{\text{CA}}$	Clear all key	d	clears all registers including memories by F $\underline{\text{CA}}$

Calculator Description and Operation

a) **42 of the 49 keys have 2 key legends:** one written on the keytop and one written above the keytop. The function symbolized by the keytop legend is generated by depression of the key. The function symbolized by the legend above the keytop is generated by depression of the F key followed by depression of the key.

Example: if you depress keys marked 5 then sin you compute sine of 5. If you depress 5 then F then sin you compute sinh, hyperbolic sine of 5.

To clearly express the function we want to generate we will note F sinh the sequence by which we compute the hyperbolic sine. The underline is a reminder that we press the key immediately below the sinh legend.

b) **The key marked (INV) computes the inverse trigonometric and hyperbolic functions sometimes noted Arc or f^{-1}.**

Example: press . then 2 then (INV) then cos to compute Arc cos 0.2 (you do not need to enter the 0 before the decimal point).

Example: press . 3 then (INV) then F then tanh to compute $\tanh^{-1}$ or Arc tanh . 3. We note this sequence: . 3 (INV) F tanh.

You may also press . 3 then F then (INV) then tanh, the calculator accepts the F and (INV) key depressions in any order.

The (INV) key also computes the inverse unit conversions, converting into the unit marked between parenthesis on the keyboard.

Example: press 5 then F then (mi)km to convert 5 miles into kilometers. Press 5 then (INV) then F then (mi)km to convert 5 kilometers into miles.

As before, you may press F and (INV) keys in any order.

c) **Numeral entry keys:** 0, ., 1, 2, 3, 4, 5, 6, 7, 8, 9, +/– and F π keys. These keys directly enter positive or negative numbers (using the +/– key which changes the sign of the display after the entry has been made) by successive depressions.

The F π key enters the constant π 3.141592654.

In this instruction manual we will note *"number"* any numeral key in the key sequence demonstrating a given function.

d) **Clear keys:** C/CE and F CA. The calculator has a display register noted x, a 2nd variable register noted y and various storage registers of which 2 are accessible as memories when not used for specialized function computations.

In arithmetic operations, a single depression of the C/CE key will clear the display register only, thus allowing correction of an erroneous entry.

Example: 2 + 3 C/CE 4 will replace 3 by 4 in the addition but will retain the sequence 2 + because the y register has not been cleared. Two consecutive depressions of the C/CE key will clear this register. The y register is also cleared by depression of the equal key = which retains only the display register contents.

In all other functions, a single depression of the C/CE key will clear both the x and y registers.

The C/CE key will also clear an error condition indicated by E in the display.

The F CA key clears all registers including memories.

When the calculator is turned "off" then "on", all registers including memories are also automatically cleared.

e) **Exponent and mantissa entry keys:** EE, F MANT

1) Display format

The display is a 14 digit light emitting diode array formatted in mantissa and exponent modes with Commodore's variable scientific notation.

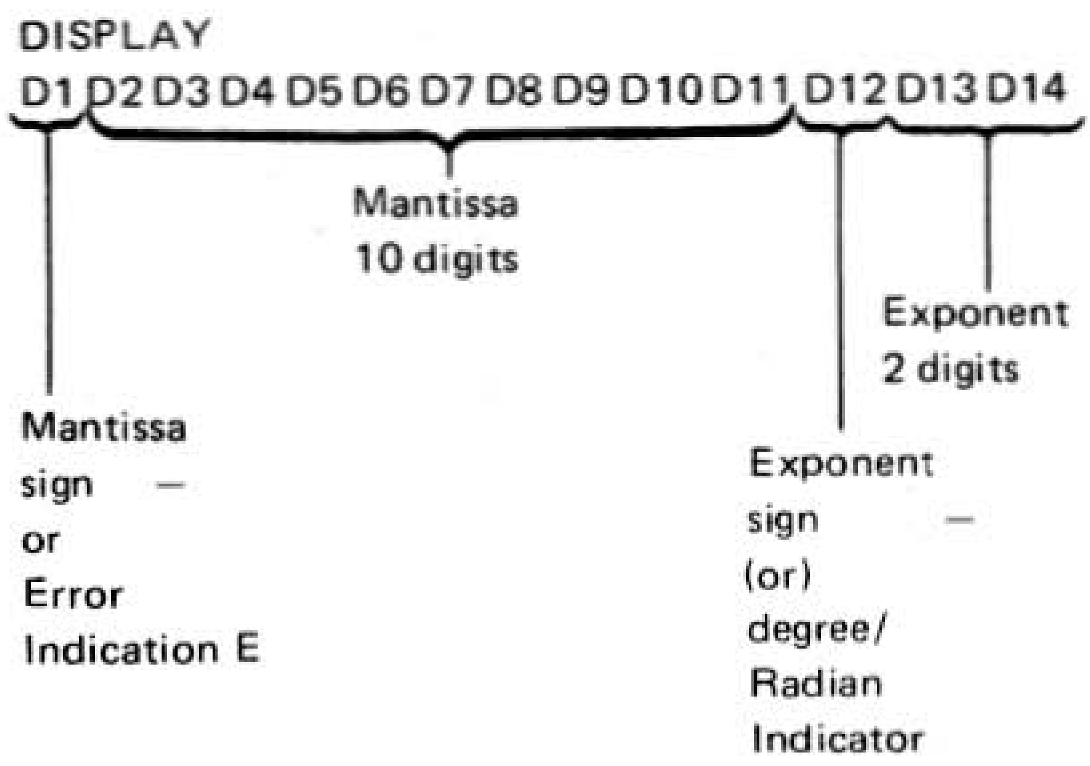
As an example, the negative *number* −123456.7 can be written as 1.234567 x 10,000. Since 10,000 = 10^5 we can imply the 10 and indicate only the exponent noted 05. We can write −123456.7 as −1.234567 05. We call −1.234567 the mantissa and 05 the exponent. The numeral by which the mantissa *number* begins (1 in the example) is called the "most significant digit". The numeral by which the mantissa ends (7 in the example) is called the "least significant digit".

We could also write:

$-1234.567 \doteq -123456.7 \times 0.01$. Since $0.01 = \frac{1}{100} = \frac{1}{10^2} = 10^{-2}$ we can note −1234.567 as: −123456.7 −02.

The exponent appears in the last 3 digits of the display and indicates the power of 10 by which the mantissa must be multiplied or, which is the same thing, the *number* of places its decimal point must be moved, to the right (if the exponent is positive) or to the left (if negative), filling the voids with 0's.

In the display, the absence of a – (minus sign) always indicates a positive *number*, both in the mantissa and the exponent. The exponent sign appears in the third digit from the right and the mantissa sign in the first digit from the left. This left digit is also used to indicate E, the error sign which appears when an operation cannot be performed or when the machine *number* capacity: 1×10^{-99} to $9.9....9 \times 10^{99}$ is exceeded. The complete display format is read as follows:



The decimal point of the last exponent digit indicates the angular unit mode selected by the d/r and F d↔r keys: degrees when off or radians when lit.

2) You may enter a *number* in decimal form or in exponent mode. The calculator will set itself to the exponent mode in order to display its results with as many significant digits as possible in the mantissa if the exponent is positive and with a maximum exponent of −02 if negative. The mantissa decimal point will be automatically set after the most significant digit.

Depression of the EE key displays an exponent value 00 and sets the exponent entry mode which must follow the mantissa entry normal mode to which the calculator returns after depression of any function key. In the event the mantissa needs to be changed after the exponent entry and before depression of a function key, the key F MANT will return the entries to the mantissa and clear the exponent.

Example: we enter 523.7 10^{-24} and then want to change the mantissa to –523.756

Key	Display
523.7	523.7
EE	523.7 00
+/–	523.7 –00
24	523.7 –24
F MANT	523.7
56	523.756
+/–	–523.756
EE	–523.756 00
24	–523.756 24
+/–	–523.756 –24
+	–5.23756 –22

Depression of a function key such as + has set the decimal point after the most significant mantissa digit and changed the exponent accordingly. This would have happened in the same way without exponent entry, for example:

Key	Display
.000000006	0.000000006
=	6 –09

f) **Variable Scientific notation keys:** EE↑, F EE↓
Commodore scientific calculators offer the possibility of changing the exponent at will, therefore allowing the full choice of the unit in which the display may be read.

The EE↑ and EE↓ will algebraically increment or decrement the value of the exponent by one for each depression, moving accordingly the decimal point of the mantissa.

Example: The mantissa value is .12 and you want to express the results in cents, reading –02 (divide by 100) in the exponent. Press F EE↓ twice to read 12. –02 meaning 12 cents.

Example: The display reads 123. –13 and you want to express the result in micrometers, exponent: –06. Press EE↑ to algebraically increment the exponent (since it is negative its absolute value decreases) Read: 0.0000123 –06.

Note: When the decimal point moves to the right with the variable scientific notation, the exponent will stop changing when the display has reached maximum capacity. When the decimal point moves to the left, the mantissa will become 0. (In both cases, the original mantissa may be recalled by single depression of the = key. If there is a pending operation, = would carry out the operation. So the safest way to recall the original mantissa is by depressing the d/r key twice.)

Example: 1230 in mantissa. Press EE↑ 12 times and read 0.000000001 12
Press = key and read: 1230

g) **Register keys:** STO1, RCL1, Σ1, F STO2, F RCL2, F Σ2, x↔y, x_n, x_i, y_i, α, β, γ, (,)

Keys	Function
STO1 F STO2	Memory store keys. Depression of key erase previous content of memory 1 or 2. Ex: 5 STO1 2 STO1 will initially store 5 in memory 1 then erase 5 and store 2.

To clear memories: Memories are cleared by pressing F CA key or by the sequence: C/CE STO1 or C/CE F STO2 which stores 0 in memory 1 or memory 2.

Keys	Function
RCL1 F RCL2	Memory recall keys. Display memory content without changing it.
Σ1 F Σ2	Memory accumulation keys. Add the displayed *number* to the memory content without changing the display. Ex: 5 Σ1 2 x 3 = Σ1 stores 5 then adds the result of 2 x 3 = 6, for a total of 11 in memory. Note that the sequence 5 Σ1 2 x 3 Σ1 will store 5 + 3 = 8 since the multiplication result has not been displayed.
x↔y	Exchange key. Successive depressions will display alternatively the x register content and the y register content. This key allows to exchange the factors of addition, multiplication, division, subtraction with their signs. Ex: 2 ÷ 3 x↔y = will execute 3 ÷ 2 Ex: 2 – 5 +/– x↔y = will execute –5 –2 = –7 Its main use is to enter the parameters of a 2 variable function or to get a 2 variable result. Note: Single variable functions can be performed on one register without altering the other, but 2 variable functions will operate on both registers.

Keys	Function

Ex:

Key	Display
30	30
x↔y	0
60	60
cos	0.5 (cosine of 60°)
x↔y	30
cos	0.866025403 (cosine of 30°)

Keys	Function
x_n	Enter successive sample values for mean and standard deviation computation and count their *number*. Memory 2 must be cleared for execution of this function. Ex: If samples are: 5, 10, 15, 3, 2 press: C/CE F STO2 5 x_n, 10 x_n, 15 x_n, 3 x_n, 2 x_n. Then display samples *number*: 5 by pressing x↔y key. Then press x↔y again to return to mean and standard deviation computation.
x_i, y_i	Enter linear regression sample values (least squares method for linear trend analysis). Ex: 2 x_i 3 y_i 4 x_i 9 y_i etc. up to 99 data points.
α, β, γ	Enter 3 variable statistical function parameters. Ex: 4 α 6 β 10 γ, then press the key function.
(	Left parenthesis. Puts on hold the execution of prior arithmetic function until new functions inside the parenthesis are executed.

Key	Function
)	Right parenthesis. Executes last arithmetic function inside parenthesis. Ex: to compute $5 \times 6 + 3 \times 2 = 36$ Press: 5 x 6 + (3 x 2) = Ex: to compute $(4\,e^{-3} + e^{3})^{3} \times 3 =$ Press: 3 x (4 x 3 +/− e^X + 3 e^X) y^X3 = 25039.52414 will be displayed. Note 1: y^X and $\sqrt[X]{y}$ will be executed on left parenthesis with the displayed *number* as exponent. Note 2: Factorial function n!, Gamma function Γ(x) and functions where registers x↔y, α, β, γ, x_i, y_i are used in entry cannot be placed between parenthesis.

h) **One real variable function keys**

Key Sequence	Function
number ln	logarithm base e of entry
number log	logarithm base 10 of entry
number F $\underline{e^X}$	antilog base e (exponential function) of entry
number F $\underline{10^X}$	antilog base 10
number 1/x	reciprocal of entry
number F $\underline{\sqrt{x}}$	square root of entry
number x^2	square of entry
number sin *number* cos *number* tan	trigonometric functions with entry as argument
number (INV) sin *number* (INV) cos *number* (INV) tan	inverse trigonometric functions Arc sin, Arc cos, Arc tan with entry as argument

Key Sequence	Function
	hyperbolic functions with entry as argument:
number F <u>sinh</u>	$\sinh u = \frac{e^u - e^{-u}}{2}$,
number F <u>cosh</u>	$\cosh u = \frac{e^u + e^{-u}}{2}$,
number F <u>tanh</u>	$\tanh u = \frac{e^u - e^{-u}}{e^u + e^{-u}}$
	inverse hyperbolic functions Arc sinh, Arc cosh, Arc tanh.
number (INV) F <u>sinh</u>	Arc sinh = $\ln (x + \sqrt{x^2 - 1})$
number (INV) F <u>cosh</u>	Arc cosh x = $\ln (x + \sqrt{x^2 - 1})$
number (INV) F <u>tanh</u>	Arc tanh x = $1/2 \ln \frac{1 + x}{1 - x}$
number n!	factorial of integer entry $n! = 1 \times 2 \times 3 \times \ldots \times (n-1) \times n$
STO1 (optional)	store result if chaining with another factorial function is required
number F <u>Γ(x)</u>	Gamma function of entry $\Gamma(x) = \int_0^\infty y^{x-1} e^{-y}\, dy$
STO1	store result if chaining with another Gamma function is required

Note: n! and Γ(x) computations chain only as the first term in the chain sequence.

i) **2 real variables arithmetic function keys:**
+, –, ÷, x, =
The +, –, x, ÷ keys execute any pending 2 variable operation with the displayed number as second variable and begin a new one with the result as first variable (chained operations). The = key terminates any key sequence by clearing the chaining registers.

The calculator arithmetic key sequence follows the normal algebraic logic.

Example: to perform (2 x 3 + 4) ÷ 5 = 2 the key sequence is: 2 x 3 + 4 ÷ 5 = and the result 2 will be displayed.

j) **2 complex variables arithmetic function keys:**
Fj+, Fj–, Fjx, Fj÷
These keys initiate the addition, subtraction, multiplication and division of 2 complex numbers of the form a + j b where $j = \sqrt{-1}$. a is the real part, b the imaginary part. Depression of the = key terminates the operation.

Complex numbers are entered as follows:

Key Sequence	Function
number	enter real part a in x register
x↔y	go to y register
number	enter imaginary part b in y register

Note that a or b can be entered as the result of a one variable function with the exception of n! factorial and Γ(x) gamma function.

Once the real and imaginary parts are entered, depression of the appropriate arithmetic function key followed by entry of the 2nd complex operand and depression of the = key will execute the operation. After the = key is depressed, the display will show the real part of the result. Depression of the x↔y key will display the imaginary part. Successive depressions of the x↔y will alternate the display of real and imaginary parts. The key sequence is as follows:

Key Sequence	Function
first *number* real part	
x↔y	first complex *number* entry
first *number* imaginary part	
Fj+ or Fjx or Fj– or Fj÷	
second *number* real part	
x↔y	second complex *number* entry
second number imaginary part	
=	display real part of the result
ST01 (optional)	store real part of the result in memory 1
x↔y	display imaginary part of the result
FST02 (optional)	store imaginary part of the result in memory 2
C/CE	clears x and y registers for further operations

The formulas are:

$$(a \pm jb) \pm c \pm jd) = (a \pm c) \pm j(b \pm d)$$
$$(a + jb) \times (c + jd) = (ac - bd) + j(ad + cb)$$
$$(a + jb) \div (c + jd) = \frac{ac + bd}{c^2 + d^2} + \frac{bc - ad}{c^2 + d^2}$$

Note: Complex *number* operation clears memory 2 of its previous contents.

Complex numbers under the form $a + jb = re^{j\theta} = r(\cos\theta + j\sin\theta)$.

Key Sequence	**Function**
	Conversion to the form $r\,e^{j\theta}$ from the form $a + jb$
number	enter a in x register
x↔y	go to y register
number	enter b in y register
→P	display r
ST01 (optional)	store r in memory 1 for further use
x↔y	display θ
FST02 (optional)	store θ in memory 2 for further use
C/CE	clear x and y registers for further operations

Note: when the complex number $a + jb$ has been obtained as the result of a complex numbers arithmetic operation, the key →P may be pressed directly.

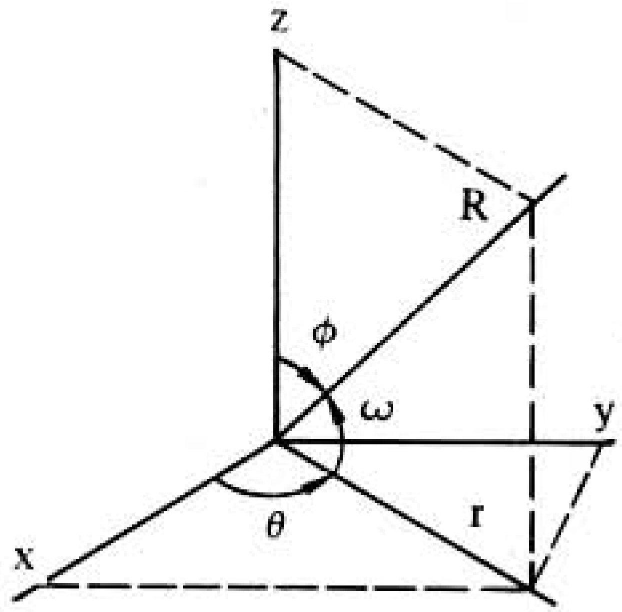
Key Sequence	**Function**
	Conversion to the form $a + jb$ from the form $r\,e^{j\theta}$
number	enter r in x register
x↔y	go to y register
number	enter θ in y register
→R	display a
ST01 (optional)	store a in memory 1 for further use
x↔y	display b
FST02 (optional)	store b in memory 2 for further use

Key Sequence	**Function**
C/CE	clear x and y registers
	Operations under the form $r\,e^{j\theta}$ after above conversion or by direct entry
	Ex 1: $(r\,e^{j\theta})^k = r^k e^{jk\theta}$
RCL1 (or *number*)	recall r (or enter r value)
y^x	
number	enter *number* k
=	display r to the k power
ST01	store r to the k power
FRCL2 (or *number*)	recall θ (or enter θ value)
x	
number	enter same *number* k
=	display k x θ
FST02	store k x θ
	By recalling the memories and converting to the form $a + jb$ as above, the real and imaginary part of $(c + jd)^k$ are found, where $c + jd = r\,e^{j\theta}$ with the entered values of r and θ
	Ex 2: $\ln(r\,e^{j\theta}) = \ln r + j\theta$
RCL1	recall r
ln	display logarithm base e of r
ST01	

Key Sequence	Function
	The memories hold now respectively the real and imaginary parts of ln (r e$^{j\theta}$) = ln r + jθ
	Ex 3: log (r e$^{j\theta}$) = log r + jθ log e
RCL1 (or *number*)	recall r (or enter r values)
log	display logarithm base 10 or r
ST01	store log r
1	enter 1
e^{x}	display e = 2.718281828
log	display logarithm base 10 of e, 0.434294481
x	
FRCL2 (or *number*)	recall θ (or enter θ value)
=	display θ x log e
FST02	store θ x log e
	The memories hold now respectively the real and imaginary parts of log (r e$^{j\theta}$). By recalling the memories and converting to the form (a + jb) as above, the real and imaginary parts of log (c + jd) are found, where c + jd = r e$^{j\theta}$ with the entered values of r and θ

k) **2 real variable analytical function keys:** →P, →R, P^n_m, F C^n_m, y^x, F $\sqrt[x]{y}$, F %, F Δ%,

Key Sequence	Function



Coordinate conversions

Formulas: $x = r\cos\theta$

$r = \sqrt{x^2 + y^2}$

$y = r\sin\theta$

$R = \sqrt{x^2 + y^2 + z^2}$

$z = r/\tan\phi$

$\theta = \text{Arc tan}\,\frac{y}{x}$

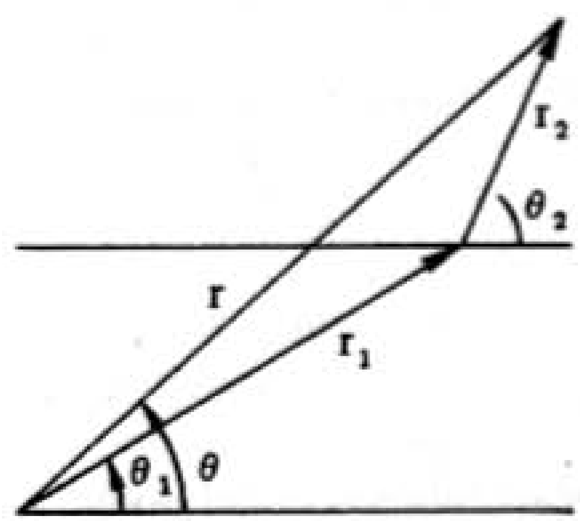
$R = r/\sin\phi$

$\phi = \text{Arc tan}\,\frac{r}{z}$

Key Sequence	Function
	Conversion to rectangular coordinates in 2 dimensions
number	enter radius r value in x register
x↔y	go to y register
number	enter angle θ value in y register
→R	displays the x rectangular coordinate value
ST01 (optional)	store x for further use
x↔y	displays the y rectangular coordinate value
FST02 (optional)	store y for further use
C/CE	clear x and y registers
	Conversion to Polar coordinates in 2 dimensions

Key	Example	Function
number		enter x – coordinate in x register
x↔y		go to y register
number		enter y – coordinate in y register
→P		displays radius r value
ST01 (optional)		store r for further use
x↔y		displays angle θ value
FST02 (optional)		store θ for further use
C/CE		clear x and y registers
		Conversion to Polar coordinates in 3 dimensions (spherical coordinates)
number		enter x – coordinate value in x register
x↔y		go to y register
number		enter y – coordinate value in y register
→P		display r value
x↔y		displays θ value
number		enter z value
x↔y		automatic re-enter of r value
→P		displays Polar radius R .
x↔y		displays ϕ value
		Note: If the key depression x↔y which automatically re-enters r is skipped, the last result will be the angle ω value (latitude).

Key	Example	Function
		Conversion to Rectangular coordinates in 3 dimensions
number		enter polar radius value R in x register
x↔y		go to y register
number		enter angle ϕ value or 90° – ω value
→R		display value of z coordinate
number		enter angle θ value
→R		display value of x – coordinate
x↔y		display value of y – coordinate
C/CE		clear x and y registers before further operations
Vector addition		2 vectors $r_1\angle\theta_1 + r_2\angle\theta_2$ result in the vector $r\angle\theta$



Ex: $r_1 = 6, \theta_1 = 20°$,
$r_2 = 4, \theta_2 = 30°$

Key	Example	Function
FCA		clear both memories
number	6	enter first vector radius r_1 in x register
x↔y		go to y register
number	20	enter first vector angle θ_1 in y register (degrees)
→R	5.638155725	display x - coordinate of first vector
Σ1		add x - coordinate to memory 1
x↔y	2.05212086	display y coordinate of first vector
FΣ2		add y - coordinate to memory 2
number	4	enter second vector radius r_2 in x register
x↔y		go to y register
number	30	enter second vector angle θ_2 in y register
→R	3.464101615	display x - coordinate of second vector
Σ1		add x - coordinate to memory 1
x↔y	2	display y - coordinate of second vector
FΣ2		add y - coordinate in memory 2
CE		clear x and y register for third entry
RCL1	9.10225734	recall x - coordinate sum in x register
x↔y		go to y register
FRCL2	4.05212086	recall y - coordinate sum in y register
→P	9.963471892	display radius r of resultant vector
ST01 (optional)		store r in memory 1 for further use

Key	Example	Function
x↔y	23.99755606	display angle θ of resultant vector
F STO2 (optional)		store θ in memory 2 for further use
C/CE		clear x and y register before further operation

Permutations: computes the *number* of ways in which m distinct elements can be selected from a total of n elements.

Key Sequence	Function
number	enter total *number* of elements n in x register
x↔y	go to y register
number	enter the *number* of selected elements m in y register
P_m^n	displays $P_m^n = \frac{n!}{(n-m)!}$ value
STO1 (optional)	store result

Combinations: computes the *number* of groups of m distinct elements selected from a total of n elements.

Key Sequence	Function
number	enter total *number* of elements n in x register
x↔y	go to y register
number	enter m value in y register
FC_m^n	displays $C_m^n = \frac{n!}{m!(n-m)!}$ value
STO1 (optional)	store result

Note: Permutations and Combinations computations clear memory 2 of its previous contents and chain only as the first term of the chain sequence.

Key Sequence	Function
	Raising to a power
number	enter the value of the base y
y^x	(negative entries are not allowed)
number	enter the value of the exponent x
=	display the result of the base raised to the exponent power
number	enter the base y
F $\sqrt[x]{y}$	
number	enter the root value x
=	displays the xth root of y
	Alternate method:
	$\sqrt[x]{y} = y^{\frac{1}{x}}$ therefore:
number	enter the base y
y^x	
number	enter the root value x
1/x	displays the reciprocal of x
=	displays the xth root of y

Note: y^x and $\sqrt[x]{y}$ keys will operate for any number, positive, rational, irrational or transcendant. The function will not accept a power or root value resulting from a level of parenthesis operation, but may be computed inside a level of parenthesis. The function will not execute prior operation in order to compute $a + b^c + d$ and not $(a + b)^c + d$.

Key Sequence	Function
	Percent key: computes mark up and mark down: $a + b\% = a + a \times b/100$ $a - b\% = a - a \times b/100$ Ex: 100 + 6% = 106 100 − 6% = 94
100	enter a = 100
+	
6	enter b = 6
F %	display percentage amount $\frac{a \times b}{100} = 6$
=	display total amount $a + a \times b/100 = 106$
100	enter 100
−	
6	enter 6
F %	display percentage amount 6
=	display total amount $a - a \times b/100 = 94$
	Percent margin: computes the percentage $\frac{b - a}{b}$ (profit) by which to decrease a higher *number* b to get a lower a or the percentage $\frac{a - b}{a}$ (mark up) by which to increase a lower *number* to get a higher. The first *number* entered is taken as reference.
	Ex: a product is bought at 100 and sold at 125. What are the profit and the mark up?
125	enter b = 125 in x register
x↔y	go to y register
100	enter a = 100 in y register
FΔ%	display profit % − 20 (maximum discount)

Key Sequence	Function
100	enter a = 100 in x register
x↔y	go to y register
125	enter b = 125 in y register
F <u>Δ%</u>	display mark up 25%

I) **Statistical function keys:** x↔s, F <u>SLOPE</u>, F <u>INTCP</u> F <u>GAUSS</u>, F <u>BINOM</u>, F <u>POISS</u>,

Key Sequence	Function
	Mean and Standard deviation
0 F <u>STO2</u>	clear memory 2
number x_n *number* x_n etc.	enter sample values "entry" to compute the mean and standard deviation of their distribution (any number of samples)
x↔y	display number of samples entered
x↔y	return to mean and standard deviation computation
F <u>x↔s</u>	display mean value: $x = \frac{\text{sum of sample values}}{\text{number of samples}} = \frac{\Sigma x_n}{N}$
STO1 (optional)	store x for further use
x↔y	displays standard deviation value: $s = \sqrt{\frac{\Sigma (x_n - \overline{x})^2}{N - 1}}$

Key Sequence	Function
F <u>STO2</u> (optional)	store σ for further use
C/CE	clear x and y registers before further operations
	Linear regression (trend line): finds the equation of the closest line to the points representing an estimated linear distribution.
F <u>CA</u>	clear all registers
number x_i *number* y_i *number* x_i *number* y_i etc. . . .	these points have x_i and y_i for coordinates. Up to 99 points may be entered.
F <u>SLOPE</u>	displays slope m of the line
F <u>INTCP</u>	displays y-intercept value b of the line
Then to find a point on the line given one of its coordinates X_s or Y_s:	the equation is: $y = mx + b$ the formulas are:

$$m = \frac{N\Sigma x_i y_i - \Sigma x_i \Sigma y_i}{N\Sigma x_i^2 - (\Sigma x_i)^2}$$

$$b = \frac{\Sigma y_i \Sigma x_i^2 - \Sigma x_i \Sigma x_i y_i}{N\Sigma x_i^2 - (\Sigma x_i)^2}$$

Key Sequence	Function
number F <u>Y_s</u>	displays Y_s for a given X_s entry
or	
number F <u>X_s</u>	displays X_s for a given Y_s entry

Key Sequence	Function
C/CE	clear x and y registers before further operations
	Gaussian (Normal) distribution: computes the distribution value Q for a given value of the random variable, knowing the mean and standard deviation of the distribution.

$$Q = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Key Sequence	Function
in any order:	
number α	enter random variable value x in α register
number β	enter standard deviation value σ in β register
number γ	enter mean value μ in γ register
followed by:	
F <u>GAUSS</u>	displays Q value
STO1 (optional)	store result for further use
	Binomial distribution: computes the probability B for k successes out of n trials when one success has a probability p:
in any order:	
number α	enter number of trials n in α register
number β	enter probability p in β register
number γ	enter number of successes k in γ register
followed by:	

Key Sequence	Function
F BINOM	displays B value

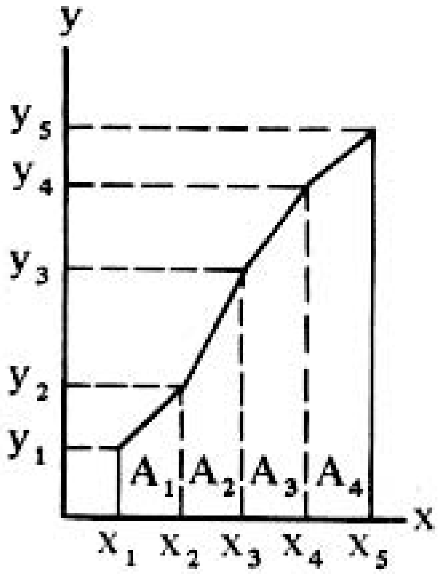
$$B = C_k^n \times p^k \times (1-p)^{n-k}$$

$$\text{with } C_k^n = \frac{n!}{k!(n-k)!}$$

Note: Binomial computations clear memory 2 of its previous contents and chain only as the first term in the chain sequence.

Key Sequence	Function
	Poisson distribution: computes the probability P for k successes out of an almost infinite number of trials when one success has a probability of almost 0 and when the product of the number of trials by the probability of one success is a constant noted λ. (λ is also expressed as frequency of successes x time period during which successes occur).
in any order:	
number α	enter number of successes k in α register
number β	enter constant λ in β register
F POISS	displays P value

$$P = \frac{e^{-\lambda}\lambda^k}{k!}$$



Numerical integration: A curve F(x) may be approximated to a straight line between close enough coordinates (x_1y_1), (x_2y_2) etc. . . .

The area between the curve, the x-axis and two parallels to the y-axis may then be approximated to:

$A = A_1 + A_2 + \ldots$

We may write:

$$A = \int_{x_1}^{x_n} F(x)dx = \frac{1}{2}\sum_{i=1}^{n}(x_{i+1} - x_i)(y_{i+1} + y_i)$$

Key Sequence	Function
	The calculator computes A as follows:
C/CE F STO2	clear memory 2 (which will be used)
number	enter x_1 in x register
x↔y	go to y register
number	enter y_1 in y register
∫	start integration (display reads 0)
number	enter x_2 in x register
x↔y	go to y register
number	enter y_2 in y register
∫	display A_1
number	enter x_3 in x register
x↔y	go to y register
number	enter y_3 in y register
∫	display $A_1 + A_2$
number	enter x_4 in x register
x↔y	go to y register
number	enter y_4 in x register
∫	display $A_1 + A_2 + A_3$
etc. . . .	until total area A is computed

Note: Numerical integration computations clear memory 2 of its previous contents and chain only as the first term in the chain sequence.

m) **Hours-minutes-seconds (or degrees-minutes-seconds) mode key HMS.** This key allows entries in hours/degrees-minutes-seconds format. Conversion to this format is also automatically accomplished by depression of the F (d)dms keys from decimal hours or degrees. Conversion from this format to decimal is accomplished by depression of the (INV) F(d)ms keys.

The HMS mode is entered as follows:

Key Sequence	Example	Display	Comments
number	55 hours	55	integer, up to 9999
HMS		55-	sets hours
number	5 minutes	55- 5	integer, up to 99
HMS		55- 5-	sets minutes
number	32 seconds	55- 5- 32	integer, up to 99

Addition and subtraction will not change the mode. Arithmetic operations where the first factor is expressed in the HMS mode and the second in decimal will give results in the HMS mode.

If the second factor in multiplication or division is also expressed in HMS mode, the result will appear in decimal.

n) **Unit conversion keys.** These key legends appear above the numeral entry keys and are noted (unit 1) unit 2. The key sequences are as follows:

	Converts number expressed in	To number expressed in	Conversion factor
number F(°F)C	degrees Fahrenheit	degrees Centigrade	(°F−32) ÷ 1.8
number F(d)dms	decimal	HMS format	60 mn/sec = 1 hr/mn
number F(d)gra	degrees	grads	1.11111111111
number F(gal)l	gallons	liters	3.785411784

	Converts number expressed in	To number expressed in	Conversion factor
number F(oz)g	ounces	grams	28.34952313
number F(lb)kg	pounds	kilograms	0.45359237
number F(ft)m	feet	meters	0.3048
number F(mi)km	miles	kilometers	1.609344
number F(f oz)l	flour ounces	liters	0.0295735296
number F(in)cm	inches	centimeters	2.54
number F(BTU)J	British Thermal Unit (international table)	Joules	0.00105505585262

To convert into the unit indicated between parentheses, the key sequence is: *number* (INV) F (unit 1)unit 2

o) **Degree/radian conversion and mode keys.** These keys light up the last display decimal point on the right to indicate a displayed number expressed in radians.

Key	Function
d/r	depression of this key does not change the displayed number and sets all trigonometric computations to the radian unit mode or the degree unit mode

Key	Function
F d↔r	depression of these keys converts the displayed number to its value expressed in degrees or radians and sets all trigonometric computations to the degree or radian unit mode

Operating Accuracy

Addition, Subtraction, Multiplication, Division, Reciprocal, Square, Conversions, Complex Number Manipulations. Δ %, % Give Results with Max. Errors of ± 1 Count In the 10th Digit.

Function	Argument	Max Mantissa Error
$\sqrt{X}$	Positive	1 Count In 10th digit
lN X	Positive	1 Count In 10th digit
log X	Positive	1 Count In 10th digit
e^X		1 Count In 10th digit
10_X		1 Count In 10th digit
y^X	y Positive	4 Counts In 10th digit
sin ϕ	Between 0 and 2π	1 Count In 9th digit
cos ϕ	Between 0 and 2π	1 Count In 9th digit
tan ϕ	Between 0 and 89°	4 Counts In 10th digit
	Between 89° and 89.95°	1 Count In 6th digit

Function	Argument	Max. Mantissa Error
$\sin^{-1} X$		$E < 5 \times 10^{-10}$
$\cos^{-1} x$		$E < 5 \times 10^{-10}$
$\tan^{-1} x$		$E < 5 \times 10^{-10}$
sinh X		1 Count In 10th digit
cosh X		1 Count In 10th digit
tanh X		1 Count In 10th digit
$\sinh^{-1} x$	Negative or 0	$E < 2 \times 10^{-10}$
	Positive	6 Counts In 10th digit
$\cosh^{-1} x$		6 Counts In 10th digit
$\tanh^{-1} x$		$E < 2 \times 10^{-10}$
Factorial		6 Counts In 10th digit
Gamma Function	Positive	6 Counts In 10th digit
P_m^n	n ≥ m	1 Count In 9th digit
C_m^n	n ≥ m	1 Count In 9th digit

Linear Regression, Binomial Density, Poisson Density, Gaussian Density, Mean and Standard Deviation, Integration. Give Results with Maximum error of 1 Count in 9th digit.

*Algorithm for Evaluation of $\sinh^{-1} X$ Will Not Accept Argument Smaller than 1×10^{-50}. For These Arguments, $\sinh^{-1} = x$

Computation Times for Combinatorial and Statistical Functions

Depending on the argument certain computations will take from 1 to 12 seconds. The display will be blanked during this time. All key entries during computations are ignored by the calculator.

USEFUL FORMULAS

Hyperbolic Functions

$\cosh u \pm \sinh u = e^{\pm u}$

$\cosh^2 u - \sinh^2 u = 1$

$\sinh (a + jb) = \sinh a . \cos b + j (\cosh a . \sin b)$

$\cosh (a + jb) = \cosh a . \cos b + j (\sinh a . \sin b)$

hyperbolic (jb) = j trigonometric (b)

$$\text{Arc tanh } (a + jb) = \frac{1}{2} \text{Arc tanh } \frac{2a}{1 + a^2 + b^2} + \frac{j}{2} \text{ Arc tan } \frac{2b}{1 - a^2 - b^2}$$

Factorial of Even Numbers

$(2n)!! = 2.4.6 \ldots 2n = 2^n \, n!$

Factorial of Odd Numbers

$$(2n - 1)!! = 1.3.5 \ldots (2n-1) = \frac{1}{\sqrt{\pi}} 2^n \, \Gamma (n + \tfrac{1}{2})$$

Gamma and Beta Functions

$\Gamma (n + 1) = n \, \Gamma (n) = n!$

$$B (x,y) = \frac{\Gamma (x) \, \Gamma (y)}{\Gamma (x + y)}$$

Fourier Series

$$\int_0^{\frac{\pi}{2}} \sin^n u \, du = \frac{\sqrt{\pi}}{2} \frac{\Gamma (\frac{n+1}{2})}{\Gamma (\frac{n+2}{2})} \quad n > -1$$

Binomial Coefficients

$$(1 + x)^n = \sum_{r=o}^{n} C_r^n x^r \quad . \; n \geqslant o$$

Combinations with Repetitions

The number of ways in which r indistinguishable particles can be distributed among n cells with no restrictions as to the number of particles permitted in any one cell is: $C_r^{n + r - 1}$

Multinomial coefficients

The number of ways in which a set of r elements can be partitioned into an ordered set of k subsets having $r_1, r_2 \ldots r_k$ elements respectively with $\Sigma_1^k r_i = n$ is:

$$\frac{n!}{r_1 ! \, r_2 ! \ldots r_k!} = C_{r_1}^n \times C_{r_2}^{n-r_1} \times C_{r_3}^{n - r_1 - r_2} \times \ldots C_{rk}^{rk}$$

Matching

The number of ways in which n numbered elements can go into n numbered cells so that no element goes into a cell having the same number as the element is:

$$\frac{n!}{2!} - \frac{n!}{3!} + \frac{n!}{4!} - \ldots \frac{\pm n!}{n!} = (-1)^n (1 - P_1^n + P_2^n - P_3^n + \ldots + (-1)^n P_{n-2}^n)$$

Negative Binomial Distribution

The probability of getting an mth success on the nth trial, each success having the probability p, is:

$$C_{m-1}^{n-1} \times p^m \times (1 - p)^{n - m}$$

Hypergeometric Distribution (Sampling Without Replacement)

The probability of getting m success out of n trials out of a set containing a successes and b failures, each with an equal probability of being selected is:

$$\frac{C_m^a \times C_{n-m}^b}{C_n^{a+b}}$$

Poisson Probability

$$P(n) = \frac{e^{-ft}(ft)^n}{n!}$$

Where f is the rate of occurrences, t the time interval and n the number of occurrences.

Mixed Functions Application Examples

Note: All examples assume an all cleared calculator at start.

Example 1: What is the probability that 30 persons have a different birthday?

We apply the formula giving the probability of no repetition in a sample of r elements from a population of n elements:

$$P = \frac{n(n-1) \ldots (n-r+1)}{n^r} = P^n_r \frac{1}{n^r} \text{ with } r = 30$$

and n = 365.

We have to compute:

$P^{365}_{30} \times 365^{-30}$

Key	Display
365	
x↔y	
30	
P^n_m	2.171030232ee76 = P^{365}_{30}
x	
365	
y^x	
30	
+/−	

= 0.293683763 probability

Since 1 − 0.29 = .71 there are over 70% chances that at least 2 persons out of 30 have the same birthday.

Example 2: What is the probability of having a 10 card suit in a bridge hand? Bridge is played with a standard 52 card deck having 4 suits of 13 cards and a bridge hand has 13 cards. The probability is:

$$P = \frac{\text{number of 10 card suit hands}}{\text{total number of hands}}$$ There are C^{52}_{13} bridge hands. There are C^4_1 ways to choose a suit, C^{13}_{10} ways to select 10 cards from the suit, and of the remaining 42 cards, C^{39}_3 ways to get 3 other cards.

Therefore: $$P = \frac{C^4_1 \times C^{13}_{10} \times C^{39}_3}{C^{52}_{13}}$$

We will have to store intermediate results since combination computations don't chain with each other.

The key sequence is:

Key	Display
4	
x↔y	
1	
FC^n_m	4 = C^4_1
STO1	
13	
x↔y	
10	
FC^n_m	286 = C^{13}_{10}
x	
RCL1	
=	1144 = $C^{13}_{10} \times C^4_1$

Key	Display
STO1	
39	
x↔y	
3	
FC^n_m	$9,139 = C_3^{39}$
x	
RCL1	
=	10,455,016 = number of hands with 10 card suit.
STO1	
52	
x↔y	
13	
FC^n_m	6.350135609 ee 11 = C_{13}^{52}
$\frac{1}{x}$	
x	
RCL1	
=	1.646424052 ee − 05
EE↑	
EE↑	
EE↑	0.001646424 ee − 02

The probability is .0016%

Example 3: Given 15 students in a class and 6 desks in the front row, how many arrangements of students in all front row seats are possible:

15	
x↔y	
6	
P^n_m	Answer: 3,603,600 arrangements.

Example 4: How many different bridge hands are there? Bridge is played with a 13 card hand dealt from 52 cards.

52	
x↔y	
13	
FC^n_m	Answer: 635,013,560,900 hands.

Example 5: Hypergeometric distribution.

What is the probability of getting 3 kings in 5 draws from a 52 card standard deck?

$$H\,(m,n,a,b,) = \frac{C^a_m \; C^b_{n\text{-}m}}{C^{a+b}_n}$$ where m = 3, n = 5, a = 4 (total number of kings), b = 48 (remaining cards) a + b = 52 and n − m = 2, therefore:

Key	Display
4	
x↔y	
3	
FC^n_m	$4 = C_3^4$
STO1	
48	
x↔y	
2	
FC^n_m	$1128 = C_2^{48}$
x	
RCL1	
=	4512
STO1	
52	
x↔y	
5	
FC^n_m	$2598960 = C_5^{52}$
$\frac{1}{x}$	
x	
RCL1	
=	1,736079047 −03
EE↑	0.173607904 −02 or 0.17%

Example 6: Binomial Distribution

What is the probability of rolling 7 once out of 3 rolls of 2 dice? There are 6 numbers on each die, therefore, 36 possible total outcomes. Out of these, there are 6 ways of getting 7: 1 + 6, 2 + 5, 3 + 4, 4 + 3, 5 + 2, 6 + 1. The probability of rolling 7 is then $\frac{6}{36} = \frac{1}{6}$ in one roll. The probability of getting 7 k times in n rolls is B (n, p, k) where n = 3, p = $\frac{1}{6}$, k = 1

Key	Display	
3		
α		
6		
$\frac{1}{x}$		
β		
1		
γ		
F BINOM	0.347222222	The probability is 34.72%

Example 7: Poisson Distribution

A switchboard operator receives 48 calls during 8 hours. What is the probability of getting 2 calls during 10 minutes?

We have $\lambda = \frac{48}{8 \times 60} = 0.1$ call per minute, or $\lambda = 1$ per 10 minutes..

The probability is: $P(k, \lambda) = \frac{e^{-\lambda} \lambda^k}{k!}$ with k = 2 and $\lambda = 1$.

Key	Display
2 λ 1β	
F POISS	0.18393972 or 18.39%

Example 8: Exponential Distribution

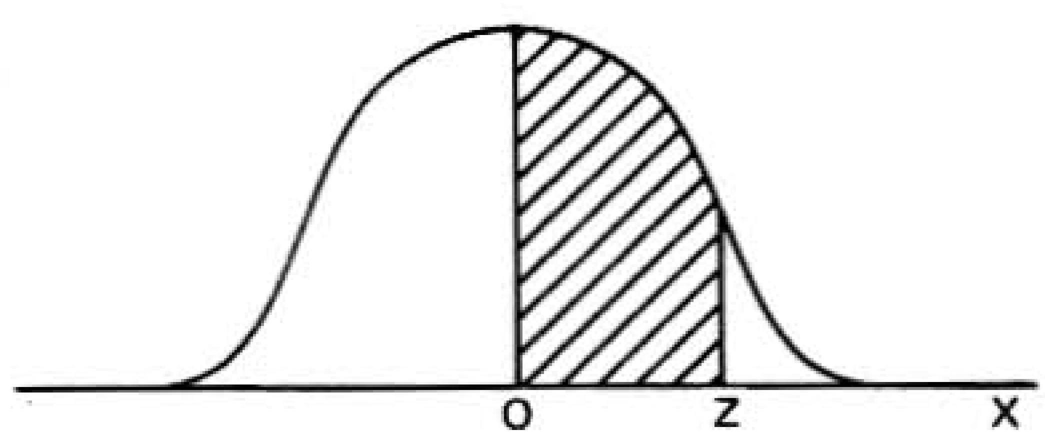
The probability of failure of an electronic device P = 3% per 6 weeks, operating hours. What is the probability for one device not to fail before 3 years?

The probability is given by e^{-np} with n expressed in weeks. The key sequence is:

Key	Display
3	
x	
52	
÷	156 = n
6	
x	
3	
÷	
100	
=	0.78 = np
+/–	
F e^x	0.458406011 or 45.84%

More than half of the devices will fail before 3 years.

Example 9: Area below the normal curve.



The area value is the probability for the normal variable not to exceed the value Z. For a normal distribution having τ as standard deviation and n as mean this area is:

$$\frac{1}{\sigma\sqrt{2\pi}} \int_{o}^{k} e^{-\frac{(x-\overline{x})^2}{2\sigma^2}} dx$$

The writing is simplified by using the standard normal variable:

$Z = \frac{x - \overline{x}}{\sigma}$ and $Z = \frac{K - \overline{x}}{\sigma}$. This variable has 0 for mean and 1 for standard deviation. The area formula becomes:

$$\frac{1}{2\pi} \int_{o}^{Z} e^{\frac{-z^2}{2}} dz$$

Numerical integrations allows quite an acceptable approximation of this integral. The key F GAUSS allows to compute the intermediate values of

$$\frac{1}{2\pi} e^{\frac{-z^2}{2}}$$

These values are then entered in numerical integration.

For instance if Z = 0.3, proceeding with large z increments and keeping only 4 significant digits in the intermediate results for z = 0, z = 0.2, z = 0.3:

Key		Display
0 α 1 β 0 γ		
F GAUSS		0.3989
.2 α 1 β 0 γ		
F GAUSS		0.3910
.3 α 1 β 0 γ		
F GAUSS		0.3810
0 x↔y	.3989	
∫		0
.2 x↔y	.3910	
∫		7.899 -02
.3 x↔y	.3810	
∫		0.11759

(The exact value is .11791. By taking .1 increment of z, the result is .1178.) The probability for z not to exceed $.3\sigma + x$ is therefore 11.7%.

Example 10: Complex hyperbolic and trigonometric functions.

An electrical transmission line of length s miles, distributed impedance z ohms/mile and distributed shunt admittance y mhos/mile is matched to a load. Which voltage V must be delivered to the line in order to deliver a voltage V_o to the load?

The formula is: $v = V_o (\cosh s\sqrt{zy} + \sinh s\sqrt{zy})$ with z and y complex numbers. Let us give: $v_o = 1$ volt, s = 100 miles, z = 10 + 23j ohms/mile and y = $(0.8 + 52j)\ 10^{6}$ mho/mile.

We must compute first $s\sqrt{zy} = 100\sqrt{(10 + 23j)}$ x

$\sqrt{(0.8 + 52j)\ 10^{-6}}$ or $s\sqrt{zy}$ =

$0.1\sqrt{(10 + 23j)(0.8 + 52j)}$.

Key	Display
10 x↔y 23 F jx 0.8 x↔y 52 =	−1188
x↔y	538.4
→P STO1	1304.307694
x↔y F STO2	155.6200303
C/CE RCL1 $\sqrt{x}$ STO1	36.11520031
F RCL2 ÷2 = F STO2	77.81001516
RCL1 x↔y F RCL2 →R STO1	7.625866959
x↔y F STO2	35.30090433
C/CE 0.1 x RCL1 = STO1	0.762586695
0.1 x F RCL2 = F STO2	3.530090433
d↔r RCL1 e^x STO1	
(or: RCL1 F sinh + RCL1 F cosh = STO1)	2.143814451
F RCL2 cos x RCL1 =	−1.98405556
F RCL2 sin x RCL1 =	−0.812073847
1.98405556 +/− x↔y	
0.812173847 +/− →P	2.143852332 Volts
x↔y d↔r	−157.7382435 Degrees

OTHER QUANTITIES

Quantity	Qty. Symbol	SI Unit	Unit Symbol	Identical Unit
length	l	meter	m	
mass	m	kilogram	kg	
time	t	second	s	
frequency	f, υ	hertz	Hz	1/s
angular frequency	ω	radian per sec	rad/s	
area	$A \ldots S$	sq meter	m^2	
volume	V	cubic meter	m^3	
velocity	v	meter per second	m/s	
acceleration (linear)	α	meter per sec^2	m/s^2	
force	F	newton	N	
torque	$T \ldots M$	newton meter	N·m	
pressure	p	pascal	Pa	N/m^2
temperature (absolute)	$T \ldots O$	kelvin	K	
temperature (customary)	$t \ldots \theta$	degree Celsius	°C	
attenuation coefficient	a	neper per meter	Np/m	
phase coefficient	β	radian per meter	rad/m	
propagation coefficient ($\gamma = a + j\beta$)	γ	reciprocal meter	m^{-1}	
radiant intensity	I	watt per steradian	W/sr	
radiant flux	P, ϕ	watt	W	
irradiance	E	watt per sq meter	W/m^2	
luminous intensity	I	candela	cd	
luminous flux	ϕ	lumen	lm	
illuminance	E	lux	lx	lm/m^2

PHYSICAL CONSTANTS

electronic charge.	e	1.602×10^{-19} C
speed of light in vacuum	c_o	2.9979×10^{8} m/s
permittivity of vacuum, elec const. .		8.854×10^{-12} F/m
permeability of vacuum, mag const .		$4\pi \times 10^{-7}$ H/m
Planck constant	h	6.626×10^{-34} J · s
Boltzmann constant.	k	1.38×10^{-23} J/K
Faraday constant	F	9.649×10^{4} C/mol
standard gravitational acceleration .	g_n	9.807 m/s^2
normal atmospheric pressure	atm	101.3 kPa

FACTOR, UNIT PREFIX, SYMBOL

10^{12}	tera	T	10^{1}	deka da	10^{-6}	micro	μ
10^{9}	giga	G			10^{-9}	nano	n
10^{6}	mega	M	10^{-1}	deci d	10^{-12}	pico	p
10^{3}	kilo	k	10^{-2}	centi c	10^{-15}	femto	f
10^{2}	hecto	h	10^{-3}	milli m	10^{-18}	atto	a

Conversion to Metric Measures

Symbol	Given	Multiply by	To Obtain	Symbol
FORCE				
oz_f	ounces-force	0.2780	newtons	N
lb_f	pounds-force	4.448	newtons	N
kg_f	kilograms-force	9.807	newtons	N
dyn	dynes	10^{-5} *	newtons	N
WORK, ENERGY–POWER				
$ft\text{-}lb_f$	foot pounds-force	1.356	joules	J
cal	calorie (thermochem)	4.184*	joules	J
Btu	British thermal units (Intl)	1055.	joules	J
hp	horsepower (elec)	746.*	watts	W
$ft\text{-}lb_f/s$	foot pounds-force per second	1.356	watts	W
Btu/h	British thermal units per hour (Intl)	0.2931	watts	W
PRESSURE				
lb_f/in^2	pounds-force/inch²	6.895	kilopascals	kPa
lb_f/in^2	pounds-force/foot²	47.88	pascals	Pa
kg_f/m^2	kilograms-force/meter²	9.807	pascals	Pa
mb	millibars	100.0*	pascals	Pa
mmHg	millimetrs of Hg	133.3	pascals	Pa
inH_2O	inches of water (39°F)	0.2491	kilopascals	kPa
ftH_2O	feet of water	2.989	kilopascals	kPa
LIGHT				
fc	footcandles	10.76	lux	lx
fL	footlamberts	3.426	candelas per sq meter	cd/m^2
Symbol	**To Obtain**	**Divide by**	**Given**	**Symbol**

Conversion From Metric Measures

TEMPERATURE

Symbol	Given	Compute by	To Obtain	Symbol
°F	°Fahrenheit	(°F−32)5/9	°Celsius	°C
°C	°Celsius	°C9/5 + 32	°Fahrenheit	°F

* Indicates exact value   5 omit when rounding

Rechargeable Battery

AC Operation

Connect the charger to any standard electrical outlet and plug the jack into the Calculator. After the above connections have been made, the power switch may be turned "ON." (While connected to AC, the batteries are automatically charging whether the power switch is "ON" or "OFF").

Battery Operation

Disconnect the charger cord and push the power switch, "ON," and interlock switch in the calculator socket will prevent battery operation if the jack remains connected. With normal use a full battery charge can be expected to supply about 2 to 3 hours of working time.

When the battery is low, figures on display will dim. Do not continue battery operation, this indicates the need for a battery charge. Use of the calculator can be continued during the charge cycle.

Battery Charging

Simply follow the same procedure as in AC operation. The calculator may be used during the charge period. However, doing so increases the time required to reach full charge. If a power cell has completely discharged, the calculator should not be operated on battery power until it has been recharged for at least 3 hours, unless otherwise instructed by a notice accompanying your machine. Batteries will reach full efficiency after 2 or 3 charge cycles.

Use proper Commodore/CBM adapter recharger for AC operation and recharging.

Adapter 640 or 707 North America

Adapter 708 England

Adapter 709 West Germany

IMPORTANT – Low Power

If battery is low:

a. Display will appear erratic
b. Display will dim
c. Display will fail to accept numbers

If one or all of the above conditions occur, you may check for a low battery condition by entering a series of 8's. If 8's fail to appear, operations should not be continued on battery power. Unit may be operated on AC power. See battery charging explanation. If machine continues to be inoperative see guarantee section.

CAUTION

A strong static discharge will damage your machine.

Shipping Instructions:

A defective machine should be returned to the authorized service center nearest you.

See listing of service centers.

Temperature Range

Mode	Temperature °C	Temperature °F
Operating	0° to 50°	32° to 122°
Charging	10° to 40°	50° to 104°
Storage	–40° to 55°	–40° to 131°

NOTES

cos x = x   root r = 0.739085133

NOTES