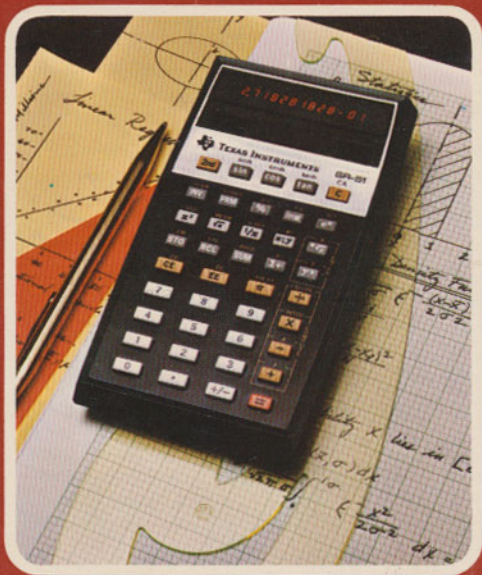


# Texas Instruments

super slide-rule calculator  
SR-51



OPERATING  
GUIDE



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This manual is designed to serve as an easy take-along reference describing step-by-step all the basic operations performed by your SR-51. For a more detailed discussion of complex applications problems, register arithmetic, operating hints and warranty information, please refer to your SR-51 Owner's Manual.

## Battery Considerations

- **CAUTION:** Before recharging, check to make sure the battery pack is properly installed in the bottom of the SR-51 and that the switch on the Adapter/Charger is set at the line voltage corresponding to your AC outlet.
- Recharge battery pack when the display flashes erratically or fades out.
- To prolong operating time before the next recharging, press **C** after desired answers have been displayed. Turn your SR-51 OFF when not in use.

## Keyboard Operation

Your SR-51 has single function and dual function keys. To execute a function shown on the key, press the desired key. To perform the second function indicated above the key, precede the key depression with **2nd**.

First function operations are indicated by **□**.

Second function operations are indicated by **2nd** **■**.

**Flashing Display** – Invalid operation. Press **C** to remove.

**Calculator Range** –  $\pm 1. \times 10^{-99}$  to  $\pm 9.999999999 \times 10^{99}$ .

## Switches

**On/Off** – Located below display window in upper right corner of calculator. Slide to the right to turn calculator ON. Numbers in display indicate that power is ON. Press **2nd** **CA** before proceeding.

**D/R** – Slide to D if angle entered or calculated is to be expressed in degrees. Slide to R if it is to be expressed in radians.

## Data Entry Keys

**0** through **9** – Enter numbers 0 through 9.

**.** – Enters a decimal point.

**$\pi$**  – Enters the value of  $\pi$ .

**+/-** – Changes sign of displayed number when used with mantissa entry. Changes sign of the exponent when pressed after **EE**.

**x:y** – Exchanges contents of X and Y registers. Used to enter dual arguments for polar-rectangular conversions, decibel conversions and permutations.

## Clear Keys

**CE** – Clears last numeric entry made with **0** - **9** keys in combination with **.**, **+/-** or **EE** keys.

**C** – Clears current calculation in progress and the display. Contents of memories or location of fixed decimal point are not affected.

**2nd** **CD** – Clears display only.

**2nd** **CM** – Clears data in all three memories.

**2nd** **CA** – Clears all calculator registers, operations and memories.

## Second Function Key

**2nd** – Instructs calculator to perform second function. Cancels second function instruction when pressed twice in succession.

## Inverse Function Key

**INV** – Used prior to trigonometric and hyperbolic functions to calculate inverse functions. Used with list of 20 conversions to reverse order of conversion. Cancels inverse instruction when pressed twice in succession.

## Scientific Notation

**EE** – Instructs calculator to enter the next entry as an exponent of 10. All further results will be displayed in scientific notation until the **C**, **2nd** **CA**, or **2nd** **⌘** **=** keys are pressed.

**2nd** **⌘** **=** – Instructs calculator to remove both display and calculations from scientific notation when the absolute value of the number is less than  $1 \times 10^{10}$  or greater than  $1 \times 10^{-10}$ .

## Mathematical Hierarchy

The mathematical hierarchy establishes the operational precedence of each calculator function. Your SR-51 uses a sum of products precedence. For full details on calculator hierarchy consult your Owner's Manual.

## Arithmetic Operations

**+** – Instructs calculator to add previous entry or result to the next entry or result.

**-** – Instructs calculator to subtract next entry or result from the previous entry or result.

**X** – Instructs calculator to multiply display by the next entered quantity.

**÷** – Instructs calculator to divide display by the next entered quantity.

**=** – Completes the calculations of all algebraic functions. This key is used to obtain both intermediate and final results.

## Functions of X

**x<sup>2</sup>** – Squares the number displayed.

**√x** – Takes the square root of the number displayed.  
 $X \geq 0$ .

**1/x** – Finds the reciprocal of the number displayed.

$Y \sqrt[x]{Y}$  **X =** – Finds the Xth root of Y.  $Y \geq 0$ .

$Y y^x$  **X =** – Raises Y to the power X.  $Y \geq 0$ .

## Logarithmic Functions:

**lnx** – Calculates the natural logarithm of the number displayed.  $X \geq 0$ .

**e<sup>x</sup>** – Raises e to the power shown in display.

**2nd log** – Calculates the common logarithm of the number displayed.  $X \geq 0$ .

**2nd 10<sup>x</sup>** – Calculates the common antilogarithm of the number displayed.

## Memory Keys

Your SR-51 has three user accessible memories. All memory related commands **must** be followed by the memory address  $n$  (1, 2 or 3).

**STO**  $n$  – Stores display into memory  $n$ .

**RCL**  $n$  – Displays data stored in memory  $n$ .

**SUM**  $n$  – Algebraically sums display to contents of memory  $n$ . Stores result in memory  $n$ .

**2nd** **PROD**  $n$  – Multiplies contents of memory  $n$  by number displayed. Stores result in memory  $n$ .

**2nd** **EXC**  $n$  – Exchanges contents of memory  $n$  with the display.

## Trigonometric Functions

Trigonometric and inverse trigonometric functions use the D/R switch mode selected when accepting an argument or returning a result. The domain of the inverse sine or cosine function is defined for  $-1 \leq y \leq 1$ .

**sin** – Calculates the sine of the angle displayed.

**cos** – Calculates the cosine of the angle displayed.

**tan** – Calculates the tangent of the angle displayed.

**INV** **sin** – Calculates the  $\sin^{-1}$  of the number displayed.

**INV** **cos** – Calculates the  $\cos^{-1}$  of the number displayed.

**INV** **tan** – Calculates the  $\tan^{-1}$  of the number displayed.

## Hyperbolic Functions

**2nd** **sinh** – Calculates the hyperbolic sine of the number displayed.

**2nd** **cosh** – Calculates the hyperbolic cosine of the number displayed.

**2nd** **tanh** – Calculates the hyperbolic tangent of the number displayed.

**INV** **2nd** **sinh** – Calculates  $\sinh^{-1}$  of the number displayed.

**INV** **2nd** **cosh** – Calculates  $\cosh^{-1}$  of the number displayed.

**INV** **2nd** **tanh** – Calculates  $\tanh^{-1}$  of the number displayed.

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## Linear Regression

Your SR-51 performs a least squares linear regression on two-dimensional random variables  $(x_i, y_i)$  from a minimum of 2 to a maximum of 99 data points. Always press **2nd** **CL** at start of problem. Always enter  $x_i$  value first followed by  $y_i$  value. For trend analysis, enter only the  $y_i$  values in sequence  $y_1, y_2, \dots, y_n$ . Your SR-51 automatically assigns  $x_i$  the value  $i$ . Because the linear regression routine uses all calculator registers, only functions which operate on the display may be used. Attempts to use any other will cause data loss or will cause display to flash. Press **2nd** **CL** to clear regression routine. The calculated expression for the linear regression curve is:

$$f(x) = y = mx + b$$



**2nd** **x** – Enters the number displayed as the x coordinate of an (x,y) data point.

**2nd** **y** – Enters the number displayed as the y coordinate of an (x,y) data point. Forms closed loop on data entry. Number of data points entered thus far appears in display.

**2nd** **SLOPE** – Displays the slope ,m, of the calculated linear regression curve.

**2nd** **INTCP** – Displays the Y intercept ,b, of the calculated linear regression curve.

**2nd** **y'** – Calculates  $f(x)$  where x is the value in display and f is the linear regression curve.

**2nd** **x'** – Calculates  $f^{-1}(y)$  where y is the value in display and f is the linear regression curve.

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**STATISTICAL FUNCTIONS**  
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## Factorials

**2nd** **x!** – Calculates the factorial of the number displayed where  $0 \leq X \leq 69$ , and X is an integer.

## Random Numbers

**2nd** **RAN#** – Generates a two-digit random number from 00 to 99. Each execution of this key sequence will produce a new two-digit random number.

## Permutations

**n** **x:y** **r** **PRM** – Determines the number of permutations of n items taken r at a time,  $0 \leq n \leq 69$ ,  $r < n$ , n and r integers. This expression is defined as:

$$\text{Perm} \binom{n}{r} = \frac{n!}{(n-r)!}$$

## Mean, Variance, Std. Dev.

Press **2nd** **CM** before proceeding. To calculate the mean, variance and standard deviation of data  $X_1, X_2, X_3, \dots, X_n$ , enter  $X_1$  and press  **$\Sigma+$** . The number 1 will appear in the display. Continue for  $X_2, X_3, \dots, X_n$ . The numbers 2, 3, ..., n will appear in the display after each successive entry, to indicate the number of data points thus far entered.

**$\Sigma+$**  – Enters displayed number as data point for calculation of mean, variance and standard deviation.

**2nd**  **$\Sigma-$**  – Removes displayed number as data point when calculating mean, variance and standard deviation.

**2nd** **MEAN** – Calculates mean defined as:

$$\text{Mean} = \bar{X} = \frac{\sum_{i=1}^N X_i}{N}$$

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**2nd** **S. DEV** **D** – Calculates standard deviation of sample data using N-1 weighting.

$$\text{S.Dev.} = \sqrt{\frac{\sum_{i=1}^N (X_i - \bar{X})^2}{N - 1}}$$

**2nd** **VAR** – Calculates population variance using N weighting.

$$\text{Variance} = \frac{\sum_{i=1}^N (X_i - \bar{X})^2}{N}$$

To find the standard deviation using N weighting, press **2nd** **VAR**  **$\sqrt{x}$** .

To find the variance using N-1 weighting, press **2nd** **S. DEV**  **$x^2$** .

## BUSINESS FUNCTIONS

### Fixing the Decimal Point

Calculated results may be displayed with 0 to 8 decimal places. Calculator continues to calculate to 13 decimal-place accuracy internally.

**2nd** **Fix Pt.** n – Fixes decimal point in calculated results at n decimal places. Fixed point 9 is interpreted as floating point. **2nd** **CL** restores calculator to floating point.

### Percentages

**%** – Converts displayed number from a percentage to a decimal.

**+** n **%** **=** – Adds n% to number displayed.

**-** n **%** **=** – Subtracts n% from number displayed.

**X** n **%** **=** – Multiplies number in display times n%.

**÷** n **%** **=** – Divides number in display by n%.

$X_1$  **2nd** **Δ%**  $X_2$  **=** – Calculates the percentage change between  $X_1$  and  $X_2$  defined as  $\frac{X_2 - X_1}{X_1} \times 100$ .

## Constant Calculations

The **CONST** key can be used to enter a number as a constant in a **+**, **-**, **X**, **÷**, **y<sup>x</sup>**, **<sup>x</sup>√y** or **Δ%** operation. Repetitive calculations are completed by entering the variable and pressing **=**.

**+** n **2nd** **CONST** – Adds n to each subsequent entry.

**-** n **2nd** **CONST** – Subtracts n from each subsequent entry.

**X** n **2nd** **CONST** – Multiplies each subsequent entry by n.

**÷** n **2nd** **CONST** – Divides each subsequent entry by n.

**y<sup>x</sup>** n **2nd** **CONST** – Raises each subsequent entry to the power n.

**<sup>x</sup>√y** n **2nd** **CONST** – Takes the nth root of each subsequent entry.

**2nd** **Δ%** n **2nd** **CONST** – Calculates percent change between n and each subsequent entry defined as

$$\frac{X - n}{n} \times 100.$$

Pressing **C** or entering any of the above functions will clear constant mode operation.

## CONVERSIONS

Refer to Table 1.

### Basic Conversions (Codes 00 through 16)

n **2nd** code – Converts n number of units in left column to units in center column of table 1.

n **INV** **2nd** code – Converts n number of units in center column to units in left column of table 1.

**TABLE 1**  
**Conversion Codes**

<u>FROM</u>	<u>TO</u>	<u>CODE</u>
mils	microns	00
inches	centimeters	01
feet	meters	02
yards	meters	03
miles	kilometers	04
miles	nautical miles	05
acres	square feet	06
fluid ounces	cubic centimeters	07
fluid ounces	liters	08
gallons	liters	09
ounces	grams	10
pounds	kilograms	11
short ton	metric ton	12
BTU	calories, <i>gram</i>	13
degrees	grads	14
degrees	radians	15
° Fahrenheit	° Centigrade	16
deg.min.sec.	decimal degrees	17
polar	rectangular	18
voltage ratio	decibels	19

## Degrees-Minutes-Seconds/Decimal Degrees Conversions

Always press **2nd** **Fix Pr** 5, 6, 7 or 8. The format for entering degrees, minutes, and seconds is dd.mmss.  
dd – Enter number of degrees.

• – Enter **.**

mm – Enter two-digit minutes (00-59).

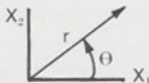
ss – Enter two-digit seconds and decimal fractions of seconds.

dd.mmss **2nd** 17 – Converts degrees, minutes, and seconds to decimal degrees.

n **INV** **2nd** 17 – Converts n number of decimal degrees to degrees, minutes, and seconds.

## Polar/Rectangular Conversions

The reference system used for polar/rectangular conversions is as shown:



Position the D/R switch to the angular units desired for both entry and retrieval.

$r$   $\boxed{x:y}$   $\theta$   $\boxed{2nd}$  18—Converts polar to rectangular coordinates and displays  $X_2$  coordinate.  
 $\boxed{x:y}$  displays  $X_1$  coordinate.

$X_1$   $\boxed{x:y}$   $X_2$   $\boxed{INV}$   $\boxed{2nd}$  18—Converts rectangular to polar coordinates and displays angle  $\theta$ .  
 $\boxed{x:y}$  displays  $r$  coordinate.

## Ratio/Decibel Conversions

The voltage ratio  $\frac{X_1}{X_2}$  expressed in decibels is defined as

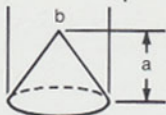
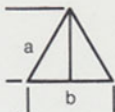
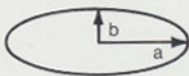
$$20 \log \frac{X_1}{X_2}$$

$X_1$   $\boxed{x:y}$   $X_2$   $\boxed{2nd}$  19—Converts ratio of  $\frac{X_1}{X_2}$  to decibels.

dB  $\boxed{INV}$   $\boxed{2nd}$  19—Converts dBs to decimal equivalent of a ratio  $\frac{X_1}{X_2}$ .

Because conversion 18 processes data in the Y and Z registers and 19 processes data in the Y register, any mathematical expression will be erased.

## Appendix



**Circumference:** Circle  $2\pi r$

<b>Area:</b> Circle	$\pi r^2$
Ellipse	$\pi ab$
Sphere	$4\pi r^2$
Cylinder	$2\pi r[r+l]$

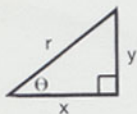
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<b>Volume:</b> Ellipsoid of revolution	$\frac{4}{3}\pi b^2 a$
Sphere	$\frac{4}{3}\pi r^3$
Cylinder	$\pi r^2 l$
Cone	$\frac{\pi b^2 a}{12}$

<b>Analytical:</b> Circle	$\frac{x^2}{r^2} + \frac{y^2}{r^2} = 1$
Ellipse	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$
Hyperbola	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$
Parabola	$y^2 = \pm 2px$
Line	$y = mx + b$

## Trigonometric Relations



$$\sin \theta = \frac{y}{r}$$

$$\cos \theta = \frac{x}{r}$$

$$\tan \theta = \frac{y}{x}$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$e^{i\theta} = \cos \theta + i \sin \theta$$

$$i = \sqrt{-1}$$

$$\sinh \theta = \frac{e^{\theta} - e^{-\theta}}{2}$$

$$\cosh \theta = \frac{e^{\theta} + e^{-\theta}}{2}$$

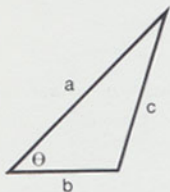
$$\tanh \theta = \frac{e^{\theta} - e^{-\theta}}{e^{\theta} + e^{-\theta}}$$

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

$$e^{\theta} = \sinh \theta + \cosh \theta$$

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## Law of Cosines:



$$a^2 + b^2 - 2ab \cos \theta = c^2$$



$$\text{Binomial Distribution} - \frac{n!}{(n-r)! r!} (p)^r (1-p)^{n-r}$$

$p$  = probability of success

$n$  = number of trials

$r$  = number of successes

$$\text{Poisson Distribution} - \frac{e^{-m} m^x}{x!}$$

$m$  = average number of  
occurrences per unit  
time

$x$  = number of occurrences

$$\text{Gaussian Distribution} - \frac{1}{\sqrt{2\pi} \sigma} e^{\left[ -\frac{(x - \bar{x})^2}{2\sigma^2} \right]}$$

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$\bar{x}$  = mean

$\sigma^2$  = variance

## VALUES OF FUNDAMENTAL PHYSICAL CONSTANTS

Constant	Symbol	Value	Units	
			mks	cgs
1. Speed of Light	C	2.9979250	$10^8 \text{ m sec}^{-1}$	$10^{10} \text{ cm sec}^{-1}$
2. Electron Charge	e	1.6021917	$10^{-19} \text{ C}$	$10^{-20} \text{ emu}$
3. Avogadro Number	N	6.022169	$10^{23} \text{ kmole}^{-1}$	$10^{23} \text{ mole}^{-1}$
4. Electron Rest Mass	me	9.109558	$10^{-31} \text{ kg}$	$10^{-28} \text{ g}$
	me	5.485930	$10^{-4} \text{ amu}$	$10^{-4} \text{ amu}$
5. Proton Rest Mass	Mp	1.672614	$10^{-27} \text{ kg}$	$10^{-24} \text{ g}$
	Mp	1.00727661	amu	amu
6. Neutron Rest Mass	Mn	1.674920	$10^{-27} \text{ kg}$	$10^{-24} \text{ g}$
	Mn	1.00866520	amu	amu
7. Atomic Mass Unit	amu	1.660531	$10^{-27} \text{ kg}$	$10^{-24} \text{ g}$
8. Ratio of proton to electron rest mass	Mp/me	1836.109	—	—
9. Electron Charge to Mass ratio	e/Me	1.7588028	$10^{11} \text{ C kg}^{-1}$	$10^7 \text{ emu g}^{-1}$
10. Planck Constant	h	6.626196	$10^{-34} \text{ J-sec}$	$10^{-27} \text{ erg-sec}$
11. Rydberg Constant	R <sub>∞</sub>	1.09737312	$10^7 \text{ m}^{-1}$	$10^7 \text{ cm}^{-1}$
12. Gas Constant	R <sub>m</sub>	8.31434	$10^3 \text{ J-kmole}^{-1} \text{ K}^{-1}$	$10^7 \text{ erg-mole}^{-1} \text{ K}^{-1}$
13. Boltzmann Constant	k	1.380622	$10^{-23} \text{ JK}^{-1}$	$10^{-16} \text{ erg K}^{-1}$
14. Gravitational Constant	G	6.6732	$10^{-11} \text{ N-M}^2 \text{ kg}^{-2}$	$10^{-8} \text{ dyn-cm}^2 \text{ g}^{-2}$
15. Electron Volt	eV	1.6021917	$10^{-19} \text{ J}$	$10^{-12} \text{ erg}$
16. Magnetic Flux Quantum	Φ <sub>0</sub>	2.0678538	$10^{-15} \text{ T-m}^2$	$10^{-7} \text{ G-cm}^2$
17. Bohr Magneton	μ <sub>B</sub>	9.274096	$10^{-24} \text{ JT}^{-1}$	$10^{-21} \text{ erg G}^{-1}$
18. Electron Magnetic Moment	μ <sub>e</sub>	9.284851	$10^{-24} \text{ JT}^{-1}$	$10^{-21} \text{ erg G}^{-1}$
19. Proton Magnetic Moment	μ <sub>p</sub>	1.4106203	$10^{-26} \text{ JT}^{-1}$	$10^{-23} \text{ erg G}^{-1}$
20. Compton Wavelength of the Electron	λ <sub>e</sub>	2.4263096	$10^{-12} \text{ m}$	$10^{-10} \text{ cm}$
21. Compton Wavelength of the Proton	λ <sub>e,p</sub>	1.3214409	$10^{-15} \text{ m}$	$10^{-13} \text{ cm}$
22. Compton Wavelength of the Neutron	λ <sub>e,n</sub>	1.3196217	$10^{-15} \text{ m}$	$10^{-13} \text{ cm}$
23. Faraday Constant	F	9.648670	$10^7 \text{ Ckmole}^{-1}$	$10^9 \text{ emu mole}^{-1}$

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## NOTES

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DALLAS, TEXAS 75222

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1220604-1A