Instructions

ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR
ELECTRONIC CALCULATOR

SR-65

CONTENTS

INSTRUCTION MANUAL
Model SR65

SECTION I GENERAL INFORMATION

INTRODUCTION

Congratulations! You have made a wise and logical choice in acquiring the really super scientific ESR (Electronic Slide Rule) calculator which is a most powerful tool in solving your engineering calculations and daily mathematical problems. This specially designed ESR eliminates cumbersome and time consuming mathematical tables and scratch notes. It is easier, faster and more accurate than any slide rule or 4 digit mathematical tables. In addition, it has 2 level parentheses and a store memory which can be used for continued operations. The ESR is very easy and simple to operate, but it has many sophisticated features which must be understood and mastered. Please be sure to read this manual thoroughly to fully understand the many uses of this ESR. Its logic to solve problems is purely algebraic. It is small in size, and yet it has the equivalent of a 35 function keyboard! The organization of its constants and display "registers" (working memories), its built-in mathematical shortcuts, its accuracy, its time saving STORE memory, its ability to give answer to trigonometry problems in either degrees and radians, all combine to make your ESR a miracle in your shirt pocket available to you any time you want, in your office, your house or during your travels. Another design feature is your calculator will operate on 3 "AA" type alkaline batteries, or 3 UM3 penlight batteries.

CAUTION

Discard exhausted batteries! Exhausted batteries leak and corrode your machine. No responsibility is accepted by the manufacturer for damages caused by leaking batteries!

BATTERY REPLACEMENT

To change batteries, make sure the calculator power switch is in the "off" position and the AC adaptor is disconnected. Remove the battery cover from the back of the calculator by sliding it unwards towards the top of the machine. Remove and discard the old batteries. When inserting new batteries, observe the battery polarity. The (+) pole of the battery must correspond with the (+) indication in the battery compartment. DAMAGE TO THE CALCULATOR CAN BE CAUSED BY INCORRECT PLACEMENT OF THE BATTERIES. To insert the batteries, press the (−) pole of the batteries against the spring, push and snap the battery in place.

KEYBOARD LAYOUT

The keyboard consists of 35 labelled keys one R-D (Radians-degrees) switch and one power "on-off" switch. The numbers of functions are imprinted on each key. Although the calculator has built-in leading zero suppression, it will be a good practice if you will depress [C/CA] buttons before each calculation. This will avoid unnecessary errors in the event of a previous entry being made and you are not aware of it. The following instruction assume that this has been done!

DIGIT ENTRY [0] through [9]: Pressing one of these keys will enter that digit into the display (X) register.

DECIMAL POINT [•] Depression of this key will correctly position the decimal point in your entries.

ARITHMETIC FUNCTION KEY [+], [−], [×], [÷]: Depression of any one of these keys tells the machine what operation to perform with the next number entered. During calculations intermediate results are also displayed when these keys are depressed.

ANSWER KEY [=]: Depression of this key displays the answer of the previous operations.

If [+] or [×] key was previously entered, then (y) register is now automatically entered as constant after depression of the [=] key. For [+] and [−] the (Y) register is entered as a constant after depression of the [=] key. (refer to section II constant operations). The second operand is always the constant.

CHANGE SIGN KEY [+/−]: Depression of this key changes the sign of the display (X) register When entering numbers with negative values, enter the number first, then depress the [+/−] key. A negative sign will appear at the left side of the display.

PI KEY [π]: 3.1415926.

EXPONENTIAL ENTRY KEY [EXP]: Depression of this key enters the exponentials.

PARENTHESIS KEYS [(] [)]: Depression of the first parenthesis key will start the first part of the parentesis and calculations within the parenthesis will be performed independently regardless of what had been entered first. Parenthesis may be performed on two levels. The second parenthesis key causes the pending operation to be performed (i.e. performs also the [=] function).

INV KEY [INV]: Depression of this key will enable the [INV] function to begin, i.e. arcsine, arccosine or arctangent depending on which key is immediately followed.

CLEAR AND CLEAR ENTRY KEY [C]: Press once for cancel entry or reset overflow and press twice for clear all registers (X and Y, except memory).

RECIPROCAL KEY [1/x]: Depression of this key will automatically calculate the reciprocal of the numbers entered.

EXPONENTIAL KEY [e^x]: Depression of this key will raise "e" to the "x" power, "x" being the number entered into the "X" register.

EXPONENTIAL TO THE BASE 10 [10^x]: Depression of this key will raise the number 10 to the "x" power.

MEMORY STORE KEY [STO]: Depression of this key will add the display register to the memory.

NATURAL LOGARITHM KEY [Ln]: Depression of this key will display the nautral logarithm of the number entered.

COMMON LOGARITHM KEY [Log]: Depression of this key will display the common logarithm (to the base 10) of the number entered.

SQUARE ROOT KEY [√]: Depression of this key will display the square root of the number entered.

MEMORY RECALL KEY [RCL]: Depression of this key will recall the memory.

SINE KEY [SIN] : Depression of this key will display the sine of the number entered.

COSINE KEY [COS] : Depression of this key will display the cosine of the number entered.

TANGENT KEY [TAN] : Depression of this key will display the tangent of the number entered.

RADIANS-DEGREES SWITCH [D/R]

POWER ON-OFF SWITCH ON Switch

MACHINE CAPACITY

The capacity of all registers (X, Y and memory) is 5 digits with 2 digits for exponents, and one digit each for sign for the mantissa and exponents. or 8 digits with one digit for sign. Therefore the range of the machine on scientific notation is (10^{-99} to 10^{100}).

SECTION II BASIC OPERATIONS

Learning the key and switch functions of your calculator is easy. The following pages both tell you and show you so that you can learn in a few minutes. We suggest you practise the examples on your machine.

Your machine has a feature that automatically clears all registers when power is turned on. Place the power switch in the "ON" position. A zero will appear at the left side of the display. You are ready to begin.

ADDITION

Addition

Example: 5 + 3 = 8

Key in	Display	Comments
5	5	5 entered into X register.
⊞	5	5 duplicated in Y register.
3	3	3 in X register and 5 still in Y register before ⊟ is entered into Y-register.
⊟	8	

SUBTRACTION

Example: 5 − 3 = 2

Key in	Display	Comments
5	5	5 entered into X register
⊟	5	5 duplicated in register
3	3	
⊟	2	3 entered into Y register

NEGATIVE BALANCE

Example: 55.755 − 108.71 = −52.955

Key in	Display	Comments
55.755	55.755	
⊟	55.755	
108.71	108.71	
⊟	− 52.955	NEGATIVE INDICATOR LIGHTS indicating a negative or credit balance

MIXED ADDITION, SUBTRACTION

Example: 2 − 6 + 9 = 5

Key in	Display	Comments
2	2	
⊟	2	
6	6	
⊞	− 4	NEGATIVE INDICATOR LIGHTS
9	9	NEGATIVE INDICATOR GOES OUT
=	5	

MULTIPLICATION

Example: 4.2 × 5.31 = 22.302

Key in	Display	Comments
4.2	4.2	
⊠	4.2	Sets multiply mode
5.31	5.31	
=	22.302	5.31 in Y register, multiply mode is still set

DIVISION

Example: 22.302 ÷ 0.4 = 55.755

Key in	Display	Comments
22.302	22.302	
⊞	22.302	Sets divide mode
.4	0.4	No need to key-in leading zero
=	55.755	0.4 in Y register, divide mode is still set.

REPEATED OPERATIONS

ADDITION

Example: 2 + 3 + 3 + 3 = 11

Key in	Display	Comments
2	2	2 entered into the X register
⊞	2	2 entered into the Y register
3	3	
⊟	5	3 entered into the register becomes constant
=	8	3, constant, is added to register
=	11	Another 3 is added to reqister.

SUBTRACTION

Example: 15 − 3 − 3 − 3 = 6

Key in	Display	Comments
15	15	
⊟	15	15 entered into Y register
3	3	
=	12	3 entered into Y register becomes constant
=	9	3, constant, is subtracted from register
=	6	Another 3 is subtracted from register

MULTIPLICATION

Examples: $4^4 = 256$

Key in	Display	Comments
4	4	
⊠	4	4 entered into Y register
=	16	4 becomes constant and multiplied by 4
=	64	Another 4 is used for multiplication
=	256	Another 4 is used for multiplication

DIVISION

Example: 2 ÷ 2 ÷ 2 ÷ 2 = 0.25

Key in	Display	Comments
2	2	2 entered into X register
⊞	2	2 entered into Y register
⊟	1	2 becomes constant and divided by 2
⊟	5 (= 0.5)	Another 2 used for division
⊟	2.5 (= 0.25)	Another 2 used for division

CONSTANT OPERATIONS

ADDITION

Examples: 3 + 5 = 8
7 + 5 = 12
9 + 5 = 14

Key in	Display	Comments
3	3	3 entered into X register
⊞	3	3 entered into Y register
5	5	
⊞	8	5 entered into Y register, becomes constant
7	7	7 entered
⊞	12	5 is added to register
9	9	8 entered to register
⊞	14	5 added to register. Sequence terminated by ⊞ No need to depress C/CA key before beginning a new operation.

SUBTRACTION

Example: 9 − 3 = 6
15 − 3 = 12
21 − 3 = 18

Key in	Display	Comments
9	9	
⊟	9	
3	3	
⊟	6	3 entered into Y register, becomes constant
15	15	15 entered
⊟	12	Constant 3 is subtracted
21	21	21 entered
⊟	18	Constant 3 is subtracted

MULTIPLICATION

Example: 4 × 5 = 20
7 × 5 = 35
12 × 5 = 60

Key in	Display	Comments
4	4	4 entered into X register
⊠	4	
5	5	5 entered into Y register
⊞	20	5 entered into X register and becomes constant because x button had been depressed followed by ⊞ key.
7	7	7 entered
⊞	35	5, constant, used for multiplication
12	12	12 entered
⊞	60	5, constant used for multiplication

DIVISION

Example: $20 \div 5 = 4$
$35 \div 5 = 7$
$60 \div 5 = 12$

Key in	Display	Comments
20	20	20 entered into X register
⊞	20	
5	5	5 entered into Y register
⊟	4	5 entered into Y register becomes constant because ⊞ key had been entered followed by ⊟ key
35	35	35 entered
⊟	7	5, constant, used to divide
60	60	60 entered
⊟	12	5, constant, used to divide

CHAIN OPERATIONS

The following example show how the Y register is used to solve complex mathematical problems with a minimum of key depressions. It illustrates how the Arithmetic Function keys perform previous operations and cause intermediate results to be displayed.

Example: $\frac{(3+4)\,2-6}{5} = 1.6$

Key in	Display	Y Register	Comments
3	3		
⊞	3	3	
4	4	3	
⊠	7	4	$(3+4)$ performed
2	2	7	
⊟	14	2	$(3+4)^2$ performed
6	6	14	
⊞	8	6	$(3+4)\,2-6$ performed
5	5	8	
⊟	1.6	5	Final result

MUTLIPLE CHAIN OPERATIONS

Parenthesis. This example shows how complicated mathematical problems can be solved using parenthesis.

Example: $(3 \times 2)\ [4(\frac{2.5}{5})] - 2\,(4-6) = 16$

To solve this problem appropriate signs must be added to the above equation so the machine can act properly.

$3 \times 2 \times [4 \times (\frac{2.5}{5})] - [2 \times (4-6)] = 16$

Please note that multiply signs had been added otherwise the machine does not know what to do (in the equation, multiplying is understood), and also parenthesis had been added to clearly instruct machine to do the proper calculation according to sequence. In continuous multiplying, note the parenthesis is not required.

Key in	Display	
3	3	
⊠	3	
2	2	
⊠	6	
[(]	6	
4	4	
⊠	4	
[(]	4	
2.5	2.5	
⊞	2.5	
5	5	
[)]	5	−1
[)]	2	
⊟	12	
[(]	12	
2	2	
⊠	2	
[(]	2	
4	4	
⊟	4	
6	6	
[)]	−2	
[)]	−4	
⊜	16	−1

If above equation is entered as follows:—

$3\times2\times[4\times(\frac{2.5}{5})]-2\times(4-6)$, then the answer is wrong,

⊜ −20, because the machine sees the equation as

$[3\times2\times4\times\frac{2.5}{5})-2]\times(4-6)$!

CHANGE SIGN

Example: $\frac{4^2(-3)}{8}=-6$

Key in	Display	Comments
4	4	
⊠	4	
⊜	16	4 × 4 already performed, automatic constant
⊠	16	
3	3	
[+/−]	−3	NEGATIVE INDICATOR LIGHTS
⊞	−48	
8	8	NEGATIVE INDICATOR GOES OUT
⊜	−6	NEGATIVE INDICATOR LIGHTS

MULTIPLICATION & DIVISION INVOLVING LARGE NUMBERS

Example 1: Using exponentials

$$\frac{(98 \times 10^{6}) \times (2 \times 10^{3})}{0.04} = 4.9 \times 10^{12}$$

Key in	Display	
98	98	
EXP	98	
6	98	06 (=98000000)
⊠	98000000	
2	2	
EXP	2	
3	2	03 (= 2000)
⊞	1.96	11 (196000000000)
04	0.04	
⊟	4.9	12 (= 4.9×10^{12})

Example 2: $2198765 \times 6328452 = 1.3914778 \times 10^{13}$

Key in	Display
2198765	2198765
⊠	2198765
6328462	6328462
⊟	1.3914778 13 (= $1.39147784 \times 10^{13}$)

ENTRY CORRECTION

One of the functions of the C key is to correct erroneous entries.

Example: $15 \times 3 = 45$

Key in	Display	Comments
15	15	
⊠	15	
4	4	ERROR!! WANTED TO ENTER 3
C	0	Press once only! Press twice will cancel all.
3	3	Correct entry made.
⊟	45	Correct answer.

RECOVERY TECHNIQUES

Occasionally during long calculations, an undesired arithmetic function key may be depressed. Utilizing these simple recovery techniques makes it unnecessary to begin the calculation again.

For example, if the ⊠ or ⊞ keys are inadvertently depressed, simply enter a (1), depress the intended arithmetic function key and continue with your calculation. If the ⊞ or ⊟ keys are inadvertently depressed, enter a (0), depress the intended arithmetic function key and continue with your calculation. However there is one exception to this technique. If the calculation in progress involves a constant, the constant will be lost and will have to be reentered.

ERROR CONDITION

The following operations lead to the error condition:

a) Division by Zero

b) $\sqrt{\ }$, where $X<0$

c) X^2, where $|X| \geq 10^{50}$

d) Sin, Cos or Tan, where $X >$ (180° (or 3.1415927 radians)

e) Tan, where $|X| =$ (90° (or 1.5707963 radians)

f) Sin^{-1} or Cos^{-1}, where $|X| > 1$

g) Tan^{-1}, where $|X| \geq 5 \times 10^{99}$

h) Log or Ln, where $X \leq 0$

i) e^x, where $X \geq 230.25851$

j) 10^x, where $X \geq 100$

k) a^x, where $a \leq 0$ or $X \text{ Ln } a \geq 230.25851$

l) 1/x, where $X = 0$

m) Result of operation $> 9.9999999 \times 10^{99}$

Underflow Condition

The following operations underflow to zero:

a) X^2, where $|X| \leq 10^{-50}$

b) Sin or Tan, where $|X| \leq 5.7295779 \times 10^{-99}$ degrees

c) e^x, where $X < -227.95592$

d) 10^x, where $X < -99$

e) a^x, where $X \text{ Ln } a < -227.95592$

f) $\frac{1}{X}$, where $X > 10^{99}$

g) Result of operation $< 10^{-99}$

SECTION III THE FUNCTION KEY

Depressing the following keys after pressing the [F] key will activate the scientific functions as stated below:—

Scientific Functions

Trigonometric	[SIN], [COS], [TAN]
Inverse Trigonometric	[INV], [SIN], [COS], [TAN]
Logarithms	[Ln], [Log]
Powers of Numbers	[$\sqrt{\ }$], [1/x], [a^x], [10^x]
Constant	Automatic
Memory Functions	[STO] [RCL]

Radians/Degrees R→D switch is located at the upper left of the keyboard. This switch allows you to obtain the results to your trigonometric problems either in degrees or radians.

TRIGONOMETRIC FUNCTIONS

[SIN], [COS], [TAN]

Example 1: SIN 45° = 0.7071067813

Place the [R/D] switch in the "D" position.

Key in	Display
45	45
[SIN]	0.707107

NOTE: For many operations using scientific function keys, the display will be blanked momentatily. No keyboard entries should be attempted before the display turns back on.

Example 2: COS 300° = 0.5

Key in	Display
300	300
[COS]	5 -1 (= 0.5)

Example 3: TAN 1 radian = 1.557407728

Place [R/D] switch in "R" position.

Key in	Display
1	1
[TAN]	1.55741

Example 4: $(1 + \text{TAN}30°)\ 4 = 6.309401068$

Place the [R/D] switch in the "D" position.

Key in	Display
1	1
[+]	1
30	30
[TAN]	.57735
[×]	1.57735
4	4
[=]	6.3094

INVERSE TRIGONOMETRIC FUNCTIONS

[SIN⁻¹] , [COS⁻¹] , [TAN⁻¹]

The function can be activated after depression of the [INV] key, and then the proper function key. For example, the sequence [INV] [SIN] generates the [SIN⁻¹x].

Example 1: $\text{COS}^{-1}0.5 = 60$

key in	Display
.5	0.5
[INV]	0.5
[COS]	60

Example 2: $\phi = \text{TAN}\ (\omega RC)$ Where $R = 1200$, $C = 2 \times 10^{-6}$ farads, $\omega = 377 = 2 \times \pi \times 60$

Key in	Display	
1200	1200	
[×]	1200	
2	2	
[EXP]	2	00
6	2	06
[+/-]	2	-6
[×]	2.4	-3
377	377	
[=]	9.048	-1 (= 0.9048)
[INV]	9.048	-1 (= 0.9048)
[TAN]	42.1388	

NATURAL LOGARITHMS

[Ln]

Example: $\text{Ln}\ 44^3 = 3\ \text{Ln}\ 44$

$= 11.3525689$

Key in	Display
44	44
[Ln]	3.78419
[×]	3.78419
3	3
[=]	11.35257

LOGARITHM TO ANY BASE

The logarithm to any base can be obtained from the equation.

$$\text{Log}_a b = \frac{\text{Log } b}{\text{Log } a} = \frac{\text{Ln } b}{\text{Ln } a}$$

Example: $\text{Log}_2 8 = \frac{\text{Log } 8}{\text{Log } 2} = 3$; i.e. $2^3 = 8$

Key in	Display	
8	8	n
[Log]	90309	
[⊞]	90309	
2	2	
[Log]	.30103	
[⊟]	3	

COMMON LOGARITHMS

[Log]

Example: $\text{Log}_{10} 1000 = 3$

Key in	Display
1000	1000
Log	3

SQARE ROOT

[√]

Example 1: $\sqrt{\sqrt{4096}} = 8$

Key in	Display
4096	4096
[√]	64
[√]	8

This function does not require the Y register to perform its function. Therefore, chain operations with this function are directly possible.

Example 2: $(6 + \sqrt{8})\ 3 = 26.48528137$

Key in	Display
6	6
[⊞]	6
8	8
[√]	2.8284271
[⊠]	8.8284271
3	3
[⊟]	26.485281

RECIPROCALS

[1/X]

This function, as the [√] function, uses only the display register and can be used in chain operations.

Example 1: Calculate 1/x; x = 625

Key in	Display	
625	625	
[1/x]	1.6	-3 (=0.0016)

Example 2: $\text{CSC } 60^\circ = \frac{1}{\text{SIN } 60^\circ} = 1.154701$

Place the [R/D] switch to "D" position.

Key in	Display
60	60
[SIN]	0.866025
[1/x]	1.154701

Example 3: $R_t = \frac{1}{\frac{1}{R_1}\frac{1}{R_2}\frac{1}{R_3}} = 2$; ; Where $R_1 = 5$, $R_2 = 20$, $R_3 = 4$

Key in	Display	
5	5	
1/x	2	-1 (=0.2)
⊞	2	-1 (=0.2)
20	20	
1/x	5	-2 (=0.05)
⊞	2.5	-1 (=0.25)
4	4	
1/x	2.5	-1 (=0.25)
⊟	5	-1 (=0.5)
1/x	2	

CONSTANT π

π may be entered into the X register at any time by simply depressing π.

Example: The area of a circle 8 feets in diameter is 50.265481 square root.

Formula: $A = \pi r^2$, $D = 8$, $r = 4$.

Key in	Display
4	4
⊠	4
⊟	16
⊠	16
π	3.1415926
⊟	50.265481

MEMORY OPERATIONS KEYS

STO , RCL

Your calculator has an independent memory which is unaffected by arithmetic or scientific operations.
You can perform chain operations involving complex mathematical problems with a minimum of key depressions. The memory operation is described below: —

Example 1: $(9\times9)+(8\times8)+(6\times6)-(5\times5)=156$

Key in	Display	Memory
3	3.	0
⊞	3.	0
STO	3.	3
⊞	6.	3
4	4.	3
⊟	1.5	3
⊟	.375	3
RCL	3	3

SECTION IV ADVANCED OPERATIONS

TRIGONOMETRIC FUNCTIONS

The following examples illustrate the procedure for calculating secants and arccosecant.

Exapmple 1: SEC 43° = 1.367327458

Place R/D switch in the "D" position.

Key in	Display
43	43
COS	0.731354
1/x	1.3673269

Example 2: CSC^{-1} 1.115 = 1.11262

Place R/D switch in the "R" position.

Key in	Display
1.115	1.115
1/x	0.89686098
INV	0.89686098
SIN	1.11262

COMBINED TRIGONOMETRIC FUNCTIONS

Example: $\frac{(\text{SIN } 20)}{3} + 4\,(\text{COS } 30) + 5$

$= 8.5781106$

Key Sequence

$[\frac{\text{SIN } 20}{3}] \times [4 \times (\text{COS } 30)] + 5 = 8.5781106$

Key in	Display
[(]	0
20	20
SIN	.34202
⊞	.34202
3	3
÷	.11400666
⊞	.11400666
[(]	.11400666
4	4
⊠	4
[(]	4
30	30
COS	.866026
÷	.866026
×	.3464104
⊞	3.5781106
5	5
=	8.5781106

EXPONENTIALS (POSITIVE POWERS)

Example: $\sqrt{B+C^2}$ $B=5$ $C=3$.

$\sqrt{5+3^2} = 3.7416573$

Key in	Display
3	3
⊠	3
=	9
⊞	9
5	5
=	14
√	3.741 6573