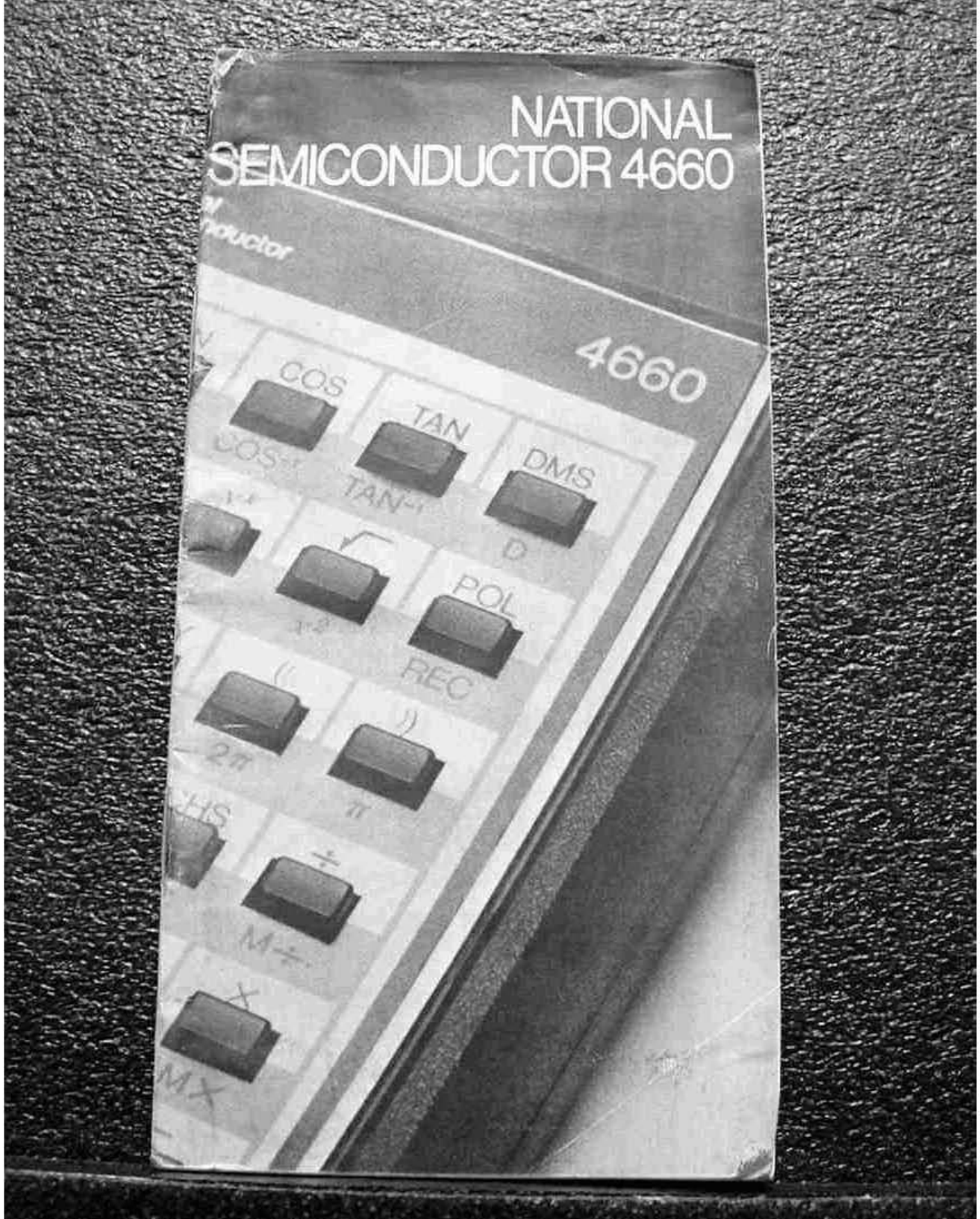

NATIONAL
SEMICONDUCTOR 4660
4660
COS
TAN
DMS
POL
REC
÷
M÷
×
M×

CONTENTS

Getting Started

Your calculator is designed for easy learning and efficient operation. It is recommended that you charge your calculator for 3 hours before initial use. See Battery Information. To get started, turn your calculator on with the switch on the left side. The display will show a digit or digits. Depress C to clear the display. The display should now show a single zero. If it does not, the battery probably needs recharging.

Low Battery Indicator

An "L" lights on the left side of the display when the battery needs recharging. Charge the batteries immediately.

Double Labeled Keys

Notice that many of the keys on your calculator have two labels, i.e., a designation appears above and below the key.

÷
□ Doubly Labeled Key
M+

This means that the key has two functions. When the key is depressed directly after the F, the lower function, e.g. M+ (memory plus) is accessed. In this manual, the F is illustrated as a required prefix to all secondary functions. The M+ (memory plus) for example, will be shown as F M+. If F has been depressed by mistake, depress = to clear the erroneous depression without affecting the display or calculation in progress.

Keying in Numbers

Floating Decimal

The standard format in which numbers within the range .000000001 to 9,999,999,999 are entered and displayed is the floating decimal point format. Numbers are entered in the normal calculator fashion, i.e., key in numbers by touching the number keys in the same sequence as if you were writing them down on paper. If a decimal appears in the number, key it in sequence as part of the number. The calculator accepts the first decimal keyed in as the decimal in the number. The decimal need not be keyed in when keying in whole numbers.

The decimal point in the result of a calculation is automatically positioned. This is known as "floating point" notation because the decimal point can "float" to any digit location.

Results of calculations which exceed 9,999,999,999 or are less than .000000001 are automatically displayed in scientific notation since the number of display digits cannot accommodate these very large or very small numbers in the floating point format.

Scientific Notation

Any number within the range 10^{-99} to 10^{99} may be entered into your calculator and displayed in scientific notation using EEX, Enter Exponent key. Entries in scientific notation are made as they are written, i.e., a decimal numeral (referred to as the mantissa) between 1 and 9.999999999 and a power of ten.

Scientific Notation Entry Procedure

1. Key in the mantissa as a decimal number between 1 and 9.999999999.
   Note: If the mantissa is keyed in as a number outside this range, the calculator will automatically adjust the mantissa and exponent upon depression of a function key. See example 2.
2. Depress EEX; 00 is displayed in the exponent display positions.
   Note: If a mantissa entry is not keyed in prior to depressing EEX, the calculator automatically assumes and displays a mantissa of 1. .
3. Enter the power of ten exponent digit(s).

Note: If more than two digit keys are depressed directly following EEX, the last two digits entered constitute the exponent and the earlier entered digits are discarded. See example 3.

Example 1: Solve $(4 \times 10^{19}) \times (3 \times 10^{8}) = 1.2 \times 10^{28}$

ENTER	DISPLAY
4 EEX	4. 00
19 ×	4. 19
3 EEX	3. 00
8 =	1.2 28

Example 2: Solve the preceding problem, except enter 40×10^{18} instead of 4×10^{19} to observe automatic normalization performed on mantissa entries outside the range 1 to 9.999999999.

ENTER	DISPLAY
40 EEX	40. 00
18 ×	4. 19
3 EEX	3. 00
8 =	1.2 28

Example 3: Enter 2×10^{15} and then change the exponent to 27.

ENTER	DISPLAY
2 EEX	2. 00
1	2. 01
5	2. 15
2	2. 52
7	2. 27
C	

Reformat Display Keys: SCI and FLT

When the calculator is turned on, it is in the floating decimal mode. Although amounts may be entered

in scientific notation using EEX, upon depression of a function key they will be converted to floating decimal notation if capacity permits.

Example:

ENTER	DISPLAY	COMMENTS
5 EEX	5. 00	
3	5. 03	
×	5000.	Automatically converts to floating notation.
=	25000000.	

Depress F SCI to establish the Scientific Notation mode.

ENTER	DISPLAY	COMMENTS
F SCI		Sets scientific mode.
5 EEX	5. 00	
3	5. 03	
×	5. 03	
=	2.5 07	

Observe in the next example that in the scientific mode, entries and results of calculations are displayed in scientific notation even when you key in factors without an exponent.

ENTER	DISPLAY
F SCI	
5 ×	5.
2 =	1. 01
12345 ×	1.2345 04
2 =	2.469 04

To cancel Scientific Notation mode and set Floating Decimal mode, depress F FLT. Observe in the example below that results which exceed 9,999,999,999 or are less than .000000001 are automatically converted to scientific notation.

ENTER	DISPLAY
F FLT	0.
123456 ×	123456.
789123 =	9.742196909 10

Calculator will display 97421969000 in scientific notation because it exceeds 10-digit capacity.

Changing Signs: CHS

The CHS, change sign key, changes the algebraic sign of an entry or result from positive to negative and vice versa. Depress CHS after mantissa entry or after depression of EEX to enter these respective values as negatives.

Example:

ENTER	DISPLAY
456 CHS	−456.
EEX	−456. 00
CHS	−456. −00
2	−456. −02
CHS	−456. 02
C	0.

Observe that CHS may be depressed at any time during exponent entry.

Clearing Mistaken Key Depressions: C and F CA

The C, clear key, is designed to keep operator decision to a minimum. Depress C directly following an erroneous key depression and the calculator will clear the affected register(s) only. More explicitly, C operates as follows:

Depressed directly following a digit key or EEX Clears the digit key depression and displays the contents of the calculating register. Operations are not disturbed and may be continued. The purpose of this function is to enable correction of mistaken digit key depressions.

Depressed directly following other keys (Including C, i.e., two consecutive C key depressions). Clears display and calculating register.

The key sequence F CA, clear all, clears the display, calculator register and all three memories. Any mode setting, i.e., scientific notation (SCI), floating decimal notation (FLT), degree, radian or grad mode, is not cleared by depression of F CA.

Basic Arithmetic Operations

The procedure for performing simple addition, subtraction, multiplication or division is to key in the problem as it is written.

Enter first number; depress +, −, × or ÷.

Enter the second number; depress =.

It is a good practice to depress C before performing calculations in order to clear any calculations pending from previous key depressions.

Multifactor (Chain) Calculations

The final result of any calculation may be used in further calculations, eliminating the need to re-enter the value.

Example: A piece of equipment costs $5000. The salvage value is $1200. Find the depreciation expense per year if the equipment has a lifetime of eight years.

$$\text{Formula: } \frac{5000 - 1200}{8} = 475$$

ENTER	DISPLAY	COMMENTS
5000 −	5000.	

1200 =	3800.	May be used in further calculations.
÷	3800.	
8 =	475.	

The same problem may be performed more efficiently, with fewer keystrokes, by using the *chaining* feature. Perform the problem as you would say it, depressing = only once, on completion of the problem: 5000 minus (−) 1200 divided (÷) by 8 equals (=).

Short Method

ENTER	DISPLAY
5000 −	5000.
1200 ÷	3800.
8 =	475.

Rule for performing chain calculations

Perform the problem as it is written with one exception; rewrite formulae which indicate multiplication in the denominator portion of fractions as shown below.

Use parenthesis keys when necessary, i.e., when addition/subtraction is mixed with multiplication/division to form a parenthecated expression. See Parenthesis Keys section of this manual.

Perform on calculator this way:

$$144 \div 2 \div 12 = 6$$

Do not perform on calculator as written here:

$$\frac{144}{2 \times 12} = 6$$

ENTER	DISPLAY
144 ÷	144.
2 ÷	72.
12 =	6.

Since your calculator uses true algebraic logic, no guess work or knowledge of mathematical hierarchy is required to perform long, complex problems. An infinite number of problems may be chained together. The calculator displays an intermediate answer upon depression of +, −, ×, ÷, Y^x for information purposes and to remind you that upon depression of these keys any pending add, subtract, multiply, divide, or power command is executed.

Example: $\frac{5 \times 2 \times 3 \times 4}{6} + 7 + 8 - 3 = 32$

ENTER	DISPLAY	COMMENTS
5 ×	5.	
2 ×	10.	Previous instruction executed, intermediate answer displayed.
3 ×	30.	
4 ÷	120.	
6 +	20.	"
7 +	27.	"
8 −	35.	"
3 =	32.	"

Two Factor Function Keys

The following keys require the entry of two (or more) factors: + − × ÷ Y^x. The first factor is entered on one of these keys. The second factor is entered on = to complete the calculations.

Although you already know how to add, subtract, multiply and divide from previous sections, the following functional description of + − × and ÷ is given along with a description of Y^x for a complete understanding of the relationship of the two factor function keys.

÷ Divide Key

Enters the dividend (first number in division). For

chain calculations it completes a "pending two factor calculation" (i.e., a "+, −, ×, ÷, Y^x" calculation which is in progress, not yet terminated by a depression of =). When depression of this key completes a pending calculation, the intermediate result is displayed and set up as a dividend.

× Times Key

Enters the multiplicand (first number in multiplication). For chain calculations, completes a pending two factor calculation and sets up intermediate result as a multiplicand; displays intermediate result.

− Minus Key

Enters the minuend (top or first number in subtraction). For chain calculations, completes a pending two factor calculation and sets up the intermediate result as a minuend, displays intermediate result.

+ Plus Key

Enters the addend. For chain calculations, completes a pending two factor calculation and sets up the intermediate result as an addend; displays the intermediate result.

= Equals Key

Terminates a two factor calculation, +, −, ×, ÷, Y^x, and displays the final result. Causes the value entered on = to be stored as a constant divisor, multiplier, subtrahend or addend depending upon the operation. If no algebraic operation is pending, numbers entered on = will be used for calculations with the constant.

Y^x Y to the x^{th} Power Key

Raises a number entered on Y^x to a power entered on =.

Example 1: Compute $5^3 = 125$

ENTER	DISPLAY
5 Y^x	5.
3 =	125.

Example 2: Compute $(125 \div 5)^{-3.2} = .000033619$

ENTER	DISPLAY
125 ÷	125.
5 Y^x	25.
3.2 CHS	−3.2
=	0.000033619

The example above illustrates that Y^x functions just like +, −, × and ÷ in that it completes a a pending two factor calculation which in this case is "125 divided by 5" and sets up the intermediate result, 25, as "Y".

Y must be positive ($Y > 0$). X value is unrestricted.

Correcting Mistaken Function Key Depressions

When you depress an incorrect two factor function key, a depression of the correct two factor function key will change the mode of operation to that which you originally intended. It is therefore not necessary to clear the calculator and re-enter your problem.

For example, if you depress + instead of −, just depress − directly after + to change the mode of operation to subtract.

Performing Constant Calculations

The second factor in a two factor calculation is retained as a constant in the calculating register.

To use the constant:

Perform an addition, subtraction, multiplication or division problem in the usual manner remembering to enter the constant value last, on =.

Enter variable numbers; depress =, display shows answers.

ENTER	DISPLAY	COMMENTS
5 ×	5.	Problem performed in standard manner.
2 =	10.	
3 =	6.	$3 \times 2 = 6$

4 =	8.	$4 \times 2 = 8$
5 =	10.	$5 \times 2 = 10$

To record a new constant, simply perform another addition, subtraction, multiplication, division or power problem in the usual manner.

When Y^x is used, the power, "x" is retained as a constant.

ENTER	DISPLAY	COMMENTS
13 Y^x	13.	
2 =	169.	$13^2 = 169$
5 =	25.	$5^2 = 25$
3 =	9.	$3^2 = 9$

One Factor Function Keys

The single factor function keys are the easiest to use and understand. These keys are:

SIN SIN^{-1} COS COS^{-1} TAN TAN^{-1}
LN e^x LOG 10^x $\sqrt{}$ X^2 1/x x!

A general procedural statement can be applied to these keys:

With a value entered into the display, depression of a one factor function key executes the indicated, sin, cos $\sqrt{}$ etc., function and instantly displays the answer.

These keys may be depressed at any time during a calculation without disturbing any two factor calculation in progress. This feature provides great flexibility in problem solving as shown in the examples on subsequent pages.

Trigonometric Keys

Your calculator has three selectable modes of operation for trigonometric and the inverse functions: degree, grad or radian mode. The calculator is automatically set in degree mode upon turn on. The

following key descriptions assume the degree mode setting. A discussion of these modes follows on subsequent pages.

SIN Sine Key
Enter into the display a decimal angle within the range −8999.999999° to 8999.999999°.* Depress this key; display shows sine (x).

F SIN^{-1} Arc Sine Key
Enter into the display a sine within the range −1 to 1. Depress these keys; display shows the principal value, $-90° \leq$ result $\leq 90°$, of the arc sine (x).

COS Cosine Key
Enter into the display a decimal angle within the range −8999.999999° to 8999.999999°.* Depress this key; display shows cosine (x).

F COS^{-1} Arc Cosine Key
Enter into the display a cosine within the range −1 to 1. Depress these keys; display shows the principal value, $0° \leq$ result $\leq 180°$, of the arc cosine (x).

TAN Tangent Key
Enter into the display a decimal angle within the range −8999.999999° to 8999.999999°.* Depress this key; display shows tangent (x). Error will be displayed on entries of 90°, 270°, etc.

F TAN^{-1} Arc Tangent Key
Enter into the display a tangent of unrestricted magnitude. Depress these keys; display shows the principal value, $-90° \leq$ result $\leq 90°$, of arc tangent.

Logarithm Keys

LN Natural Logarithm Key
Enter into the display a value greater than zero. Depress this key; display shows the base e, natural logarithm (x).

*Very small numbers, e.g. .0000000001 or 1×10^{-50} are interpreted as zero when entered on trigonometric keys.

F [e^x] Natural Antilogarithm Key

Enter a natural logarithm within the range −227.9 to 230.2. Depress these keys; display shows e raised to the power entered.

[LOG] Common Logarithm Key

Enter into the display a value greater than zero. Depress this key; display shows the base 10, common logarithm (x).

F [10^x] Common Antilogarithm Key

Enter a common logarithm within the range −99.99999999 to 99.99999999. Depress these keys; display shows 10^x.

Other One Factor Function Keys

[√] Square Root Key

Enter a positive radicand into the display. Depress this key; display shows the square root.

F [X²] "X" Squared Key

Enter a value less than or equal to 10^{50} into the display. Depress these keys; display shows the value squared.

F [1/x] Reciprocal Key

Enter a non zero value into the display. Depress these keys; display shows result of 1 divided by (x).

F [X!] Factorial Key

Enter a positive integer within the range 0 to 69. Depress these keys; display shows the factorial.

One Factor Function Key Examples

Example: Compute $5.12^{\log 2.3}$

ENTER	DISPLAY
5.12 [Y^x]	5.12
2.3 [LOG]	0.361727836
[=]	1.805355312

Observe in the examples above and below, that one factor function keys may be depressed while a two factor operation is pending without affecting the pending calculation.

Example: Find the cube root of 125

Formula: $\sqrt[3]{125} = 125^{1/3}$

ENTER	DISPLAY
125 [Y^x]	125.
3 [F] [1/x]	0.333333333
[=]	5.

Example: $(\sin 30 \times \sin 60) + \sqrt{144}$

ENTER	DISPLAY
30 [SIN] [×]	0.5
60 [SIN]	0.866025403
[+]	0.433012701
144 [√]	12.
[=]	12.4330127

Example Problem: What is the equivalent resistance of a 220-ohm resistor, a 145-ohm resistor, and a 175-ohm resistor connected in parallel using the following equation?

$$R_{eq} = \frac{1}{1/R_1 + 1/R_2 + 1/R_3}$$

$$= \frac{1}{1/220 + 1/145 + 1/175}$$

ENTER	DISPLAY
220 [F] [1/x]	0.004545454
[+]	0.004545454
145 [F] [1/x]	0.006896551
[+]	0.011442006
175 [F] [1/x]	0.005714285
[=]	0.017156291
[F] [1/x]	58.28765335

Example: Permutations

For example: Out of a dinner party for 10, how many ways can the hostess assign players to one table of bridge (4 positions)? The equation for permutations with random arrangement of n items taken r at a time is:

$$ {}_nP_r = \frac{n!}{(n-r)!} = \frac{10!}{(10-4)!} $$

ENTER	DISPLAY	COMMENTS
10 [=]	10.	
4 [=] [F] [X!]	720.	(10 – 4)!
[÷]	720.	
10 [F] [X!] [x–y]	720.	
[=]	5040.	

Observe that in the example above, the x–y key (see Other Keys section for a discussion of x–y) is used to swap the dividend and divisor. In other words, the problem was performed such that (10–4)!/10! was pending. The formula was reversed; 10!/(10–4)! by depressing [x–y].

Degree/Grad/Radian Mode: DEG GRAD RAD

As stated previously, your calculator has three selectable modes of operation for trigonometric and the inverse functions: degree, grad or radian mode.

When you turn your calculator on, it is automatically set in degree mode. In degree mode, numbers entered on [SIN] [COS] [TAN] are interpreted as degrees. Angular results displayed after depression of [F] [SIN⁻¹], [F] [COS⁻¹], [F] [TAN⁻¹] are given in degrees.

Depressing [F] [RAD] or [F] [GRAD], sets the calculator in radian or grad mode respectively. Angular input on trig functions and angular results on inverse trig functions are then read as radians or grads.

Example: Calculate the sine of 50 grads.

ENTER	DISPLAY
[F] [GRAD]	
50 [SIN]	0.707106781

Important Note: Remember that your calculator will remain in the angular mode last selected until you turn off the calculator or change the mode to degree or radian.

Degree/Grad/Radian Conversion

Converting angles (for example, from degrees to grads) is done by computing a trigonometric function in one mode, switching modes, than computing the inverse trigonometric function.

Example: How many grads is 45 degrees?

ENTER	DISPLAY	COMMENTS
[F] [DEG]		
45 [SIN]	0.707106781	
[F] [GRAD]	0.707106781	
[F] [SIN⁻¹]	50.	45 degrees = 50 grads

Example: How many degrees is 1 radian?

ENTER	DISPLAY	COMMENTS
[F] [RAD]		
1 [SIN]	0.841470984	
[F] [DEG]	0.841470984	
[F] [SIN⁻¹]	57.29577951	1 radian = 57.29577951 degrees

Conversion Keys

Polar, Rectangular Conversion

The angle of inclination input for polar to rectangular and angular output for rectangular to polar is affected by the degree/grad/radian mode setting.

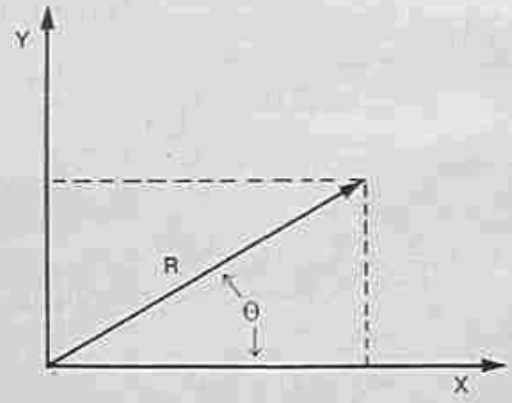
The angle of inclination, θ, is read in degrees, radians or grads according to the mode setting.

POL

Converts rectangular coordinates to polar coordinates. The "Y", northing coordinate is entered on X, the "X", easting coordinate is entered on POL. The display shows the θ angle expressed in degrees, radians or grads depending on the mode setting. Depress x–y to read the radius.

F REC

Converts polar coordinates to rectangular coordinates. The radius is entered on X; the angle expressed in degrees, radians or grads depending on the mode setting, is entered on F REC. The "X", easting coordinate is displayed. Depress x–y to read the "Y", northing coordinate.



Example: Convert the following rectangular coordinates to polar coordinates:

Y = 5 X = 3

Y = 2.6 X = 10

ENTER	DISPLAY	COMMENTS
F DEG	0.	
5 X	5.	
3 POL	59.03624347	Angle θ
x–y	5.830951895	Radius
2.6 X	2.6	
10 POL	14.5742162	Angle θ
x–y	10.33247308	Radius

Example: Convert the following polar coordinates to rectangular coordinates:

Radius = 10.5 θ = 55°

Radius = 7 θ = 30°

ENTER	DISPLAY
10.5 X	10.5
55 F REC	6.022552582
x–y	8.601096465
7 X	7.
30 F REC	6.062177827
x–y	3.5

Degrees, Minutes, Seconds/Decimal Degree Conversion

F D

The key sequence F D, to degrees, converts degrees, minutes, seconds to decimal degrees.

Enter the angle expressed in degrees, minutes and seconds as follows:

1. Key in degrees.
2. Depress the decimal point to separate degrees from the minutes/seconds portion of your entry.
3. Key in minutes as a two-digit number, e.g., 3 minutes would be keyed in as 03.
4. Key in seconds.

Depress F D; display shows degrees, minutes, seconds converted to decimal degrees.

Example: Convert 110 degrees, 35 minutes, 15 seconds to decimal degrees.

ENTER	DISPLAY	COMMENTS
110.3515 F D	110.5875	Decimal equiv. of 110°35'15"

DMS

This key converts decimal degrees to degrees, minutes and seconds.

Example: Convert 45.988 degrees to degrees, minutes and seconds.

ENTER	DISPLAY	COMMENTS
45.988 DMS	45.5917	or 45°59'17"

Example: Compute the tangent of 56°42'16".

ENTER	DISPLAY	COMMENTS
F DEG		Not necessary if previously set for degree mode.
56.4216 F D	56.70444444	
TAN	1.522611881	

The F D and DMS keys are especially useful in calculations dealing with time. Hours, minutes and seconds correspond to degrees, minutes and seconds, therefore, the F D and DMS keys can be used to convert hours, minutes and seconds (HMS) to decimal hours and back.

Example: How many manhours are expended if 17 people work an a project for 2 hours and 15 minutes?

ENTER	DISPLAY	COMMENTS
2.15 F D ×	2.25	
17 =	38.25	
DMS	38.15	Decimal manhours 38 hrs, 15 min.

Metric Conversions

F →KG

Converts the number in the display from pounds to kilograms.

Example: If a French chef uses an English recipe calling for 3 pounds of sugar, how many kilograms must the chef use?

ENTER	DISPLAY	COMMENTS
3 F →KG	1.3607772	Kilograms of sugar used.

F →LB

Converts the number in the display from kilograms to pounds.

Example: If an U.S. importer receives a 42-kg shipment from Holland and the shipping charge on the American ship is 23¢ per pound, how much does the importer pay for shipping?

ENTER	DISPLAY
42 F →LB ×	92.59414399
.23 =	21.29665312

F →CM

Converts the number in the display from inches to centimeters.

Example: If to fix a dress, a woman needs a 5-inch zipper, how many centimeters of zipper should she order from the French store?

ENTER	DISPLAY
5 F →CM	12.7

F →IN

Converts the number in the display from centimeters to inches.

Example: If the electrical schematic for your Mercedes calls for a 45.5-cm lead wire, how many inches of wire would you need?

ENTER	DISPLAY
45.5 F →IN	17.91338583

F →LIT

Converts the number in the display from U.S. gallons to liters.

Example: If a Dutch firm imports 30 gallons of California wine, how many 2-liter carafes will they need to bottle the wine?

ENTER	DISPLAY
30 F →LIT ÷	113.56236
2 =	56.78118

(They need 56 carafes, and there's a little left over to drink!).

F →GAL

Converts the number in the display from liters to U.S. gallons.

Example: If the Fiat you buy in Italy has a 48-liter tank capacity, how many gallons will the car hold?

ENTER	DISPLAY
48 F →GAL	12.68025779

F →°F

Converts the number in the display from degrees centigrade to degrees fahrenheit.

Example: If the doctor in Toronto tells you that you have a temperature of 37°C, should you worry?

ENTER	DISPLAY	COMMENTS
37 F →°F	98.6	(No need to worry!)

F →°C

Converts the number in the display from degrees fahrenheit to degrees centigrade.

Example: The antifreeze sticker on your Celica says that antifreeze should be added at −35°C. If the temperature is −27°F, should you add the antifreeze?

ENTER	DISPLAY	COMMENTS
27 CHS F →°C	−32.77777778	(Close, but not quite!)

Memory Operations

Your calculator features three independent memories which operate as follows:

Key Sequence
MS 1
MS 2 Memory Store Key
MS 3

Key a number into the display, depress MS followed by a digit key 1, 2 or 3; the displayed number is stored in the respective memory one, two or three. Any number previously stored in memory is erased; i.e., the new number "writes over" any previous memory contents. The display does not change.

Key Sequence
MR 1
MR 2 Memory Recall Key
MR 3

Depress MR followed by a digit key 1, 2 or 3; contents of the respective memory are recalled to the display. Recalling memory contents will not clear the memory.

M1+ Memory One Plus Key

Key a number into the display, depress this key; the displayed number is added to contents of memory one and the resulting sum is stored in that memory. Depress MR 1 to read the sum.

Key Sequence
F M+ 1
F M+ 2 Memory Plus Key
F M+ 3

Key a number into the display, depress these keys; the number is added to the respective memory one, two or three and the sum is stored in that memory. The display does not change. Recall memory contents to the display using the MR key followed by a digit key to see the sum.

Key Sequence
F M− 1
F M− 2 Memory Minus Key
F M− 3

Key a number into the display, depress these keys; the number is subtracted from the respective memory one, two or three and the resulting difference is stored in that memory. The display does not change.

Key Sequence

F M× 1
F M× 2 Memory Times Key
F M× 3

Key a number into the display, depress these keys; the number is multiplied by contents of the respective memory and the resulting product is stored in that memory. The display does not change.

Key Sequence

F M÷ 1
F M÷ 2 Memory Divide Key
F M÷ 3

Key a number into the display, depress these keys; the contents of the respective memory are divided by display contents and the resulting quotient is stored in that memory. Display does not change.

Key Sequence

F X-M 1
F X-M 2 Display/Memory Exchange Key
F X-M 3

Key a number into the display, depress these keys; the contents of the respective memory are exchanged with the contents of the display.

F CA Clear All Key

Depress these keys to clear memories. Also clears display and any pending operation (add, subtract, etc.) in the calculator register.

Memory Overflow

If the result of a memory operation exceeds the capacity of the calculator, 10^{-99} to 10^{99}, *Error* is displayed. The affected memory will contain the value displayed prior to the overflow condition.

Example: The following quantities of parts for construction of a device are priced as follows:

PART NO.	QUANTITY	PRICE
A	152	$7.41
B	76	$6.73
C	45	$2.55

Find the total cost of construction.

ENTER	DISPLAY
F CA	0.
152 ×	152.
7.41 = M_1+	1126.32
76 ×	76.
6.73 = M_1+	511.48
45 ×	45.
2.55 = M_1+	114.75
MR 1	1752.55

Example: Will three works of music, one lasting 1 hour, 14 minutes, 43 seconds, the second lasting 36 minutes, 22 seconds and the third lasting 1 hour, 9 minutes and 2 seconds fit on a 3-hour tape?

ENTER	DISPLAY
F CA	0.
1.1443 F D M_1+	1.245277778
.3622 F D M_1+	0.606111111
1.0902 F D M_1+	1.150555556
MR 1	3.001944444
DMS	3.0007

Calculating Mean and Standard Deviation

The following keys allow fast and easy calculation of standard deviation and mean:

Σ+ Sigma Plus Key

Key in a data point, "x"; depress this key.

1. "x" is added in memory one
2. "x^2" is added in memory two
3. Memory three is incremented by 1 for the n or item count.

The display does not change thereby enabling repeated depressions of Σ+ which sum a single data point to the required frequency.

F Σ− Sigma Minus Key

This key is used to delete summations of a data point incorrectly entered on Σ+ as follows: Key in the "x" to be deleted (not necessary if already in display), depress F Σ−.

1. "x" is subtracted from memory one
2. "x^2" is subtracted from memory two
3. Memory three is decremented by 1 for the n or item count.

F SD Standard Deviation Key

Depress these keys after entering data points on Σ+ to display the standard deviation according to the formula:

$$SD = \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2 \div n}{n-1}} = \sqrt{\frac{m2 - m1^2 \div m3}{m3 - 1}}$$

F x̄ Mean Key

Depress these keys after entering data points on Σ+ to display the mean.

$$\bar{x} = \frac{\Sigma X}{n}$$

Example: Find the mean and standard deviation of the data points 2, 5, 7, 3, 2.

ENTER	DISPLAY	COMMENTS
F CA	0.	
2 Σ+	2.	
5 Σ+	5.	
7 Σ+	7.	
3 Σ+	3.	
2 Σ+	2.	
F x̄	3.8	Mean
F SD	2.167948339	Standard Deviation

New data points can be added to the summations in memory registers and a new mean and standard deviation obtained.

Example: Add to the summations computed in the previous example, the data point 8. Find the new mean and standard deviation.

ENTER	DISPLAY	COMMENTS
8 Σ+	8.	
F x̄	4.5	New mean
F SD	2.588435821	New Standard Deviation

Using Parentheses Keys

The calculator is capable of handling two levels of parentheses which, in combination with the independent calculator register and memory, allow very complex problems to be solved efficiently.

Think of the function of ((and)) in terms of internal machine registers which are accessed upon depression of ((.

((

The open parentheses key, when depressed, signals the calculator to save results of subsequent key depressions in a special internal register. There are two such registers permitting double nesting of parentheses.

))

The close parentheses key, when depressed, causes the calculator to execute the key depressions made from the time of the last ((depression. The intermediate result of these operations is displayed.

=

The equals key is used in conjunction with the parentheses keys to finally complete the equation.

Example: $28 - [(13 + 7) \div (6 - 2)] = 23$

Key in: 28 — ((((13 + 7)) ÷ ((6 — 2)))) =. Display shows: 23.

Register Action

28 —	((	((	13 + 7
28 minus instruction in calculator register.	Opens 1st level parens.	Opens 2nd level parens.	Performs in parens level 2.

))	÷	((6 — 2))
Clears parens level 2 and brings result, 20, to display register.	Displays contents, 20, set up to divide in parens level 1.	Executes in parens level 2 and displays result, 4.

))	=
Takes displayed result, 4, and operates on instructions stored in parens level 1, displays result of 20 ÷ 4 = 5.	Takes display contents, 5, completes pending operation in calculator register. Displays final result, 23.

Rules for Using Parentheses:

Let math symbols represent keys; (indicates ((depression,) indicates)) depression.

No: $(5 + 2)(4 - 2) =$ Yes: $(5 + 2) \times (4 - 2) =$
Operator (× depression) required.
No "implied" times.

No: $2(5 + 3) =$ Yes: $2 \times (5 + 3) =$
Operator (× depression) required.
No "implied" times.

No: $((5 + 2) + 3^2) =$ Yes: $(5 + 2) + (3^2) =$
or $3^2 + 5 + 2 =$
Since Y^x is a two factor function key and thereby completes a pending calculation, the left most method performs $(5 + 2 + 3)^2$. Display shows 100. Also, this key sequence allows no equals key depression.

No: (...(...(... Yes: (...(...)..(.
An error condition will occur when there are more than two open parenthesis key depressions without an intervening close parenthesis key depression during a calculation.

Example: Find the vertical stress at a point in a soil which is 4.5 feet deep and located 5 feet horizontally from a concentrated surface load of 12,800 pounds.

$$\text{Vertical Stress} = \frac{3 \times 12{,}800}{2\pi \times (4.5)^2}\,[1 + (5/4.5)^2]^{5/2}$$

Rewrite formula as discussed in Basic Arithmetic Operations section:

$$\frac{\dfrac{3 \times 12{,}800}{2}}{\dfrac{\pi}{4.5^2}}\,[1 + (5/4.5)^2]^{5/2} = 2252.73558$$

ENTER	DISPLAY	COMMENTS
3 ×	3.	$\frac{3 \times 12{,}800}{2\pi \times (4.5)^2}$
12800 ÷	38400.	
F 2π ÷	6111.549815	
4.5 F X²	20.25	
× ((((	301.8049291	
5 ÷	5.	$(5/4.5)^2$
4.5 Y^x	1.111111111	
2)) MS 1	1.234567901	
1 M1+	1.	$1 + (5/4.5)^2$
5 ÷	5.	
2 Y^x MR 1	2.234567901	Sets up $(5/2)^{1+(5/4.5)^2}$
x-y))	7.464210696	X–Y changes order of pending power operation factors to $[1 + (5/4.5)^2]^{5/2}$
=	2252.73558	

Example: Solve

$25.6 + 5.3 - [12.3 + 8) \div (2 + 6.5/4)] = 21.34705882$

ENTER	DISPLAY	COMMENTS
25.6 [+]	25.6	
5.3 [−] ((((	30.9	Problem performed exactly as written.
12.3 [+]	12.3	
8)) [÷] ((	20.3	
2 [+]	2.	
6.5 [÷]	8.5	
4)))) [=]	21.34705882	

Other Keys: [F] [π], [F] [2π], [x-y]

[F] [π] Pi Key

The [F] [π], pi key, displays to ten decimal places, 3.141592654.

Example: Calculate the area of a circle of radius 5 using the formula: Area = $r^2\pi$.

ENTER	DISPLAY	COMMENTS
5 [×]	5.	
[=]	25.	r^2
[×]	25.	
[F] [π]	3.141592654	
[=]	78.53981634	

This problem may also be performed:

ENTER	DISPLAY
[F] [π]	3.141592654
[×]	3.141592654
5 [=]	15.70796327
[=]	78.53981634

[F] [2π] Two-Pi Key

The [F] [2π], two-pi key displays 6.283185307.

Example: Calculate the circumference of a circle of radius 5 using the formula: Circumference = $2\pi r$.

ENTER	DISPLAY
[F] [2π]	6.283185307
[×]	6.283185307
5 [=]	31.41592654

[x-y] Display/Register Exchange Key

The x-y swaps contents of the display and calculator registers. It is used primarily for:

- Recalling the radius or y coordinate after depression of [POL] or [F] [REC].
- With Y^x utilization. See example 1.
- For solving formulae consisting of fractions whose denominators are sums or differences. See example 2.

Example 1: Solve: $2.6^{LN(5.6\times2.1\times3.3)}$

ENTER	DISPLAY	COMMENTS
5.6 [×]	5.6	
2.1 [×]	11.76	
3.3 [=] [LN] [Y^x]	3.658626411	To reverse order of operation from: $LN(5.6\times2.1\times3.3)^{2.6}$
2.6 [x-y]	3.658626411	
[=]	32.97861789	

Example 2: Solve: $\frac{12}{2+3+5} = 1.2$

ENTER	DISPLAY
2 [+]	2.
3 [+]	5.
5 [÷]	10.
12 [x-y]	10.
[=]	1.2

Overflow and Error Indicators

Any result larger than $9.999999999 \times 10^{99}$ or smaller than 1×10^{-99} or logic errors (e.g. division by zero) will result in the error indicator *Error* being displayed. Touching C will clear the affected register except in the case of memory overflow. See Memory Operations. Touching any other key permits continuation of the calculation with the calculator assuming that the contents of the display are zero.

Results and operations resulting in an *Error* indication.

Results $> 9.999999999 \times 10^{99}$

Results $> 1. \times 10^{-99}$

Division by zero

LOG, LN < 0

SIN, COS, TAN $\geq$ 25 revolutions (9000°)

TAN 90°, 270° etc. TAN of 89.99999999

SIN^{-1}, $COS^{-1} > |1|$

SIN^{-1}, $COS^{-1} \leq 10^{-50}$

$\sqrt{x} < 0$

Y^x where $Y \leq 0$

More than two ((((depressions without a)) during calculation

DMS/D conversions $> 10^{10}$

X! where $X < 0$ or > 69

Battery Information

Your calculator is powered by rechargeable NiCad batteries. It is important to charge your battery for a minimum of 3 hours before initial use because if the batteries are completely drained from a long storage period, using the calculator in this state can permanently damage the batteries. The display will blank when batteries need charging. To charge the battery, connect the AC charger to the jack at the top of the machine. A full charge takes five hours and lasts approximately five hours. You can use your machine while the charger is plugged in but it will charge faster if you turn it off. The machine will not overcharge. BE SURE TO TURN YOUR CALCULATOR OFF BEFORE CONNECTING THE AC CHARGER.

If your calculator is left on for an extended period of time, the batteries may be drained to the extent that the calculator will not operate after being recharged for a few minues. The batteries can usually be restored by charging overnight.

Repeated extensive draining of batteries causes permanent damage to batteries.

Mailing Instructions

Should your calculator need servicing, pack it carefully in a sturdy box for shipping. Proof of original purchase date must be enclosed. Be sure to include your name and return address. The package should be mailed postpaid to the nearest National Semiconductor Service Center. If your calculator is returned for warranty repairs more than ninety days after the original purchase date, you must enclose the appropriate service charge (if the service charge during the POST WARRANTY period has been changed, National Semiconductor will request you to supply the additional amount, if any is needed, or make the appropriate refund, if there is any difference, by check or money order payable to National Semiconductor).

Product Service Locations

United States
N.C.P.S.—Central U.S.
P.O. Box 1000
West Jordan, UT 84084

Asia
NS Electronics
4 Hing Yip Street,
Kwun Tong,
Hong Kong.

Canada
N.C.P.S.
286 Wildcat Road
Downsview
Ontario M3J-2N5
Canada

Australia
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Corner Stud Road and
Mountain Highway
Bayswater
Victoria 3153
Australia

Great Britain
NS—UK Ltd.
National Semiconductor
Product Service
Larkfield Industrial Estate
Greenock PA16 0EQ.
Great Britain

Germany
National Semiconductor GmbH
Product Service
D808 Furstenfeldbruck
Industriestrasse 10
Bundesrepublik
Deutschland

Consumer Warranty Claim Certificate

Should your calculator ever require repair, please return this form with the unit.

Model 4660

Purchase Date _____
(month/day/year)

Purchased from _____

Address _____

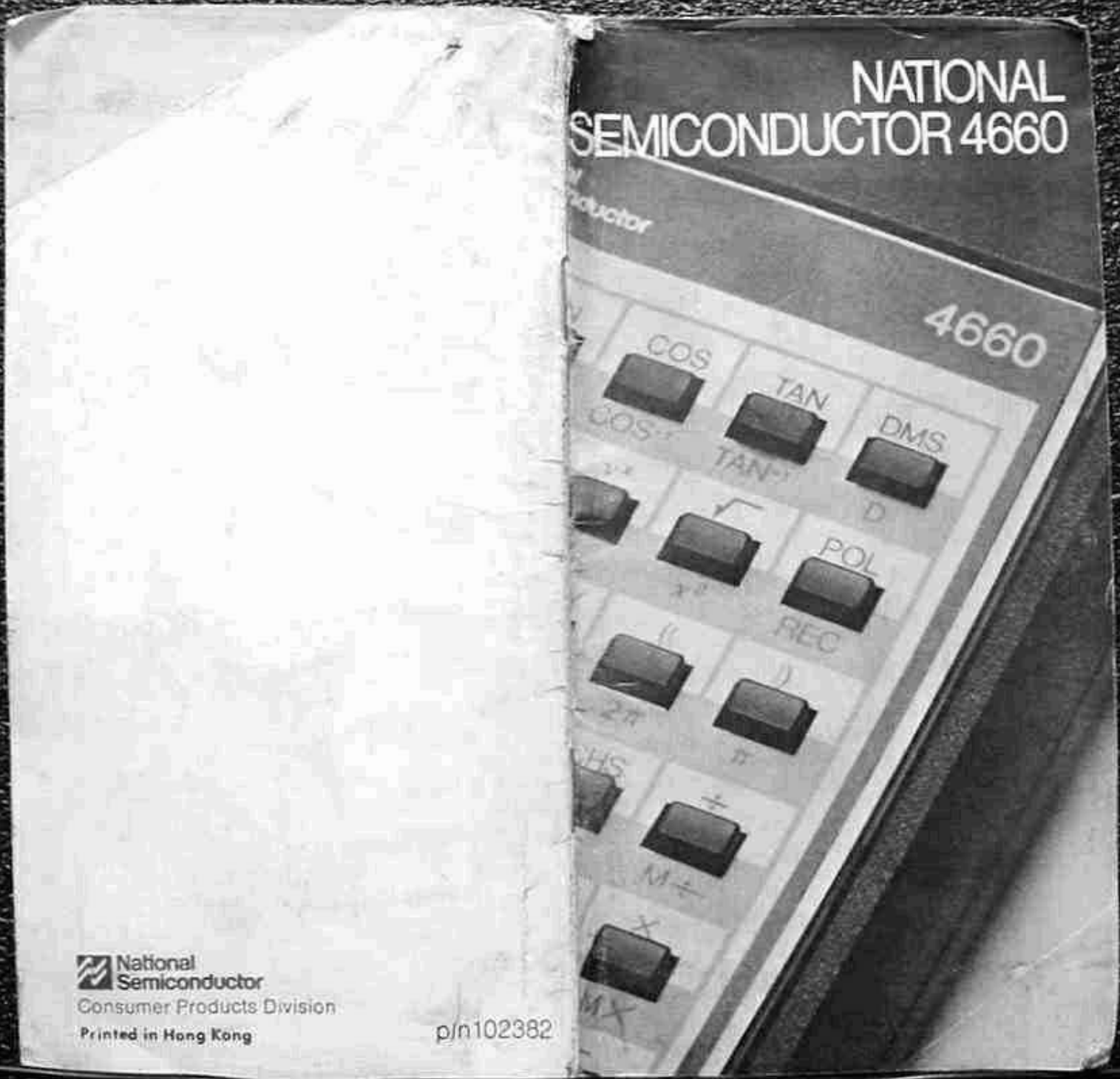
City, State, Zip _____

Your Name _____

Your Address _____

City, State, Zip _____

Description of problem: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