



hp calculators

HP 9s Operating Modes and Display Format

The Operating Modes of the HP 9s

The Angular Mode

Display Format



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This learning module introduces the different operating modes in which your HP 9s can work. It then describes the angular mode used by the trigonometric functions and the coordinate conversion functions. You will also find a description of the various display formats available.

The operating modes of the HP 9s

Besides the main operating mode, the HP 9s has five more modes in which it can work, namely: Complex ($\overset{2ndF}{\text{CPLX}}$), Statistics ($\overset{2ndF}{\text{STAT}}$), Binary ($\overset{2ndF}{\text{BIN}}$), Octal ($\overset{2ndF}{\text{OCT}}$) and Hexadecimal ($\overset{2ndF}{\text{HEX}}$). These five modes light their corresponding annunciator when they are active – the main mode does not have its own annunciator, though. You can always select the main mode by pressing $\overset{2ndF}{\text{DEC}}$. The main mode is the default mode and the one you will use most of the time. Use this mode for most calculations (both arithmetic and function calculations).

In Complex mode the four basic arithmetic functions expect complex numbers as their arguments. Except for some caveats described in the HP 9s learning module *Solving Problems Involving Complex Numbers*, postfix functions are available in this mode. Also, the coordinate conversion functions are available too, which are particularly useful in this mode. The running memory is available, but parentheses are disabled. Note that the HP 9s will stay in this mode until another mode is selected or until power is turned off.

In STAT mode the running memory is not available but the contents of M are not lost. Parentheses are not active either, but chain calculations are possible (e.g. $1 + 2 \times 3 = 7$). This mode remains active even if power is turned off in order to preserve the statistical data entered by the user (up to 80 different items). The data is lost, however, when another operating mode is selected. There is a special mode in which the data can be edited, the ED mode, which is described in the HP 9s learning module *Clearing, Editing and Correcting*. The modules *Statistics – Process Capability* and *Statistics – Averages and Standard Deviations* deal with statistical calculations.

In Binary, Octal and Hexadecimal modes (often referred to as Base-N mode) the displayed number is not cleared when these modes are selected (unlike CPLX and STAT mode) but is converted into the corresponding base instead. Also, pending operations are not cleared so that you can perform mixed calculations, e.g. $720 \times (25d + 4Fh)$ which can be calculated by pressing: $\overset{2ndF}{\text{OCT}}$ $\overset{2ndF}{\text{OCT}}$ 7 2 \times ($\overset{2ndF}{\text{DEC}}$ $\overset{2ndF}{\text{DEC}}$ 2 5 + $\overset{2ndF}{\text{HEX}}$ $\overset{2ndF}{\text{HEX}}$ 4 10° $\overset{2ndF}{\text{ENTER}}$. Both parentheses and the running memory are available, as well as basic arithmetic functions, but most function keys are not active (e.g. $\overset{2ndF}{\text{sin}}$, $\overset{2ndF}{\text{RND}}$, unit conversions, etc.) For a more detailed description refer to the HP 9s learning module *Base Conversions and Arithmetic*.

The angular mode

The angular mode is shown in the display of your HP 9s with one of these annunciators: DEG, RAD and GRAD. You can change the angular mode in any operating mode. This setting is kept even if another operating mode is selected or the power is turned off. To select the desired angular mode, press $\overset{2ndF}{\text{DRG}}$; if the displayed setting is not the desired one, simply press $\overset{2ndF}{\text{DRG}}$ again. Angle values are:

Degrees	360 degrees in a circle
Radians	2π radians in a circle
Grads	400 grads in a circle

The angle measure affect trigonometric calculations and polar/rectangular coordinate conversions.

Display format

The default display format is Floating Point, in which the number of displayed decimal places is not fixed beforehand but depends on the result. All digits are displayed except *trailing* zeros. Up to 9 decimal places can be displayed. If the display format has been changed, the sequence $\text{2ndF} \text{FIX} \text{.}$ (decimal point) restores the default setting.

The number of decimal places displayed can be set or fixed to any number from 0 to 9 by pressing $\text{2ndF} \text{FIX}$ and then the desired number – you need not press the ENTER key. ($\text{2ndF} \text{FIX}$ is disabled in Base-N mode since it works with integers only). This is called a fixed display format because the number of displayed decimal digits is always the same, trailing zeros are appended if needed. $\text{2ndF} \text{FIX} n$ displays results rounded to n decimal places, but the actual numbers (that is, the ones internally stored) are not altered. Note that in the default mode rounding does not always occur. For example: $\text{2ndF} \text{FIX} \text{.} \text{ON/C} \text{2ndF} \pi \text{A}$ returns 3.141592654, which is the internal value 3.14159265359 rounded to 9 decimal places; but, now press: $\text{—} \text{3} \text{ENTER}$ which results in 0.141592653 because for values between -1 and 1 , the result appears truncated instead ¹. If you want the results to be always rounded to nine decimal digits use $\text{2ndF} \text{FIX} \text{9}$.

The FIX setting is retained so long as it is not changed by the user. But, the pseudo-random number returned by the RND function ($\text{2ndF} \text{RND}$) is always displayed in FIX 3 (the display format setting is not actually changed, though, and is still used in the current calculation); this is convenient because the resulting number is always a number between 0 and 0.999 with three significant digits, that is to say: a result of, say, 0.000 is as though three random digits were generated, all of them being equal to zero.

It is important to bear in mind the fact that in, say, FIX 3 a 0.000 in the display does not necessarily mean that the result is exactly zero. For example, the number 10^{-4} in FIX 3 is displayed as 0.000: $\text{ON/C} \text{2ndF} \text{FIX} \text{3} \text{EXP} \text{+/-} \text{4} \text{ENTER}$

Example 1: Calculate $8\pi^2$ in the default mode.

Solution: To make sure you are currently in the default mode, press $\text{2ndF} \text{FIX} \text{.}$. Now the calculator is in Floating Point mode with all digits (except trailing zeros) being displayed. Press:

$\text{8} \text{X} \text{2ndF} \pi \text{A} \text{x}^2 \text{ENTER}$

Answer: 78.95683521

Example 2: Calculate $8\pi^2$ showing only two decimal digits.

Solution: With the previous result still displayed, simply press

$\text{2ndF} \text{FIX} \text{2}$

The result has been rounded (not truncated) to two decimal digits.

Answer: 78.96. When you set FIX ($\text{2ndF} \text{FIX} \text{.}$) again, all digits re-appear because the internal value remains intact, and is used in chain calculations to full precision.

¹ The tenth decimal digit can be displayed by pressing F-E : $1.415926535 \cdot 10^{-1}$, which is also a truncated number. In Engineering format the number appears rounded: pressing ENG returns $141.5926536 \cdot 10^{-3}$.

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It is sometimes necessary to replace a number by its truncated or rounded value. Even though there's no specific function to do it on the HP 9s, it can be easily done: to truncate a number to n decimal places, simply add and subtract 10^{13-n} .

Example 3: Truncate π to four decimal digits.

Solution: Let's select the default mode: 2ndF Fix . . Now press ON/C or ENTER to cancel/finish any previous calculation, and 2ndF π A to display the number 3.141592654. To truncate it to four decimal places, press:

+ EXP 9 - EXP 9 ENTER

It is important not to use the ENTER key to display the partial result $\pi + 10^9$: the sequence 2ndF π A + EXP 9 ENTER - EXP 9 ENTER returns 3.14 instead of 3.1415 because the 13-digit precision is only maintained in chain calculations.²

Answer: 3.1415

To truncate a number to zero decimal digits, that is to say, to obtain its integer part, the following sequence is shorter: 2ndF -HEX 2ndF -DEC provided the number is between -999999999 and 999999999 .

Rounding a number to n decimal digits is a bit more involved, $5 \cdot 10^{-n-1}$ must be added to the number and then the result must be truncated using the above procedure.

Example 4: Round π to four decimal digits.

Solution: Press 2ndF π A again and then:

+ EXP +/- 5 + EXP 9 - EXP 9 ENTER

Answer: 3.1416. Note that this is *not* the same result as the one obtained by pressing 2ndF π A 2ndF Fix 4 , even though they appear to be the same number. Set FIX 6 (2ndF Fix 6) in both cases to tell the difference.

The HP 9s provides two keys to convert the number that is currently in the display to scientific format (i.e. displayed with an exponent, and only *one* digit to the left of the decimal point) and engineering format (i.e. with an exponent that is a multiple of 3). This conversion affects only the displayed number so that results can be easily interpreted as multiples or submultiples of a unit, for example, but keying in any new number or continuing the calculation restores the display setting (i.e. either fixed or floating point). The number of decimal digits in scientific and engineering format is the one previously set by FIX. In the following example we'll try to show all possible cases:

Example 5: Let's set FIX 4 (2ndF Fix 4), press ON/C and key in 123.45678:

1 2 3 . 4 5 6 7 8

² The following example will help you tell the difference: 1234567809 X-M + 0.001 - MR returns 0.001, but MR + 0.001 ENTER - MR returns 0.

To display it in scientific notation press ENTER $\text{F}\text{-}\text{E}$ (press $\text{F}\text{-}\text{E}$ again if you want to restore FIX 4): the display now reads $1.2346 \cdot 10^2$. Pressing ENTER is necessary because the $\text{F}\text{-}\text{E}$ key is disabled while keying in a number, it can only be pressed after ENTER or when the display contains a result. Alternatively, you can press $\text{F}\text{-}\text{E}$ after the ENG key, because ENG is enabled while a number is being keyed in.

Press ENG to express this number with an exponent that is a multiple of three (including zero): $123.4568 \cdot 10^{00}$. To change the exponent in multiples of three press the ENG and 2^{nd}F ← keys as many times as needed. For example, pressing ENG ENG returns $123456800 \cdot 10^{-06}$ (NB: not $123456780 \cdot 10^{-06}$) and pressing now 2^{nd}F ← 2^{nd}F ← 2^{nd}F ← results in $0.1234568 \cdot 10^3$ (NB: not $0.12345678 \cdot 10^3$). These numbers reveal that ENG and 2^{nd}F ← actually convert the displayed number as is displayed, not its internal value, which is not modified in any case, though.

Press $\text{F}\text{-}\text{E}$ to display the number in scientific format and $\text{F}\text{-}\text{E}$ once again to restore FIX 4.