

# HiPER Scientific Calculator

## HiPER Calc Pro

MANUAL

Version: 11.3

Instructions and examples in this manual correspond to the selected **Expression mode**.

[www.hiperlabs.eu](http://www.hiperlabs.eu)

# Overview

The calculator is loaded with features. These are the most important ones:

## HIGH PRECISION

The calculator supports up to 100 digits significands and 9 digits exponents (the free version is limited to 15 digits significands and 3 digits exponents).

## REPEATING DECIMALS

The calculator detects repeating decimals and shows them with vinculum over the repeating part:

$$1 \div 7 \checkmark \rightarrow 0.\overline{142857}$$

## EXPRESSION MODE

Expressions are available in the Pro version. They allow you to write your expression and display it as it appears in a text book:

$$\frac{1}{2} \times \sqrt{\left(\frac{3}{4}\right)^2 + \sqrt{\sin(2 \times \pi)}}$$

### Evaluation

An expression is simplified or evaluated according to the selected result format ( $x \Leftrightarrow E$  key). The result is displayed as a number or an expression using fractions, square roots, variables, etc.

$$(2\sqrt{2} + 3\sqrt{3})(\sqrt{2} - \sqrt{3}) \rightarrow -5 + \sqrt{6}$$

### Complex numbers

The calculator is able to perform complex number calculations. They are available in expression mode only.

## NUMBER FORMATS

Numbers can be entered and displayed in several formats:

- Decimal numbers

$$1 \ 2 \ \text{EXP} \ 5 \rightarrow 1\ 200\ 000$$

- Fractions and mixed numbers

$$3 \ \text{d/c} \ 5 \rightarrow \frac{3}{5}$$

When expression mode is enabled, any expression can be placed into the numerator and denominator.

- Degrees, minutes and seconds

→

- Polar coordinates (expression mode only)

→

Tap on the result or press  key to change the result format.

## LAYOUTS

You can choose one of the following button layouts:

- **Pocket** with basic operations in portrait orientation. Suitable for the smallest displays.
- **Compact** containing all operations in both portrait and landscape orientation.
- **Expanded** having all operations and layout designed for big screens.
- **Custom** keyboard layouts defined in settings.

Multiline display can be enabled on big screens.

The most suitable layout is set on startup. You can change it in the **Layout** menu entry.

# Menu

## MODE

The calculator allows you to enter your calculation in three different modes:

- **Classic:** the display has one line in which you enter numbers and see a result. All functions with one parameter are postfix, functions with two parameters are infix.
- **Expression:** there are two lines on the display. An expression line where you enter an expression to be evaluated and a result line. Functions are prefix, infix or postfix according to how they are displayed in an expression.
- **Reverse Polish Notation:** you can see the whole calculation stack on the display. All functions are postfix.

**Complex numbers** can be turned on in expression mode.

## LAYOUT

You can choose one of the following button layouts:

- **Pocket** with basic operations in portrait orientation. Suitable for the smallest displays.
- **Compact** containing all operations (some of them accessible via SHIFT key). Compact layout is available in both portrait and landscape orientation.
- **Expanded** having all operations and layout designed for big screens.
- **Custom** keyboard layouts that are defined in settings, section "Custom keyboard".

**Multiline** display can be turned on on big screens.

## SETTINGS

Many calculator features can be customized here. These are:

- Calculation precision and rounding
- Thousand(th) and decimal separators
- Operand grouping
- Full screen
- Font size
- Haptic feedback (vibration)
- Button sound
- Button titles

- Custom keyboard layouts
- N-base calculations signedness, precision and leading zeros
- Result history settings

See the detailed settings description in the **Settings** help section.

## THEME

Calculator theme can be changed here. Several themes are available in the Pro version only.

## CLIPBOARD

Opens a clipboard window where you can copy an expression, a result, or paste clipboard data. You can also tap the display to open the clipboard window.

## QUICK TOUR

A quick guide that walks you through the main calculator keys and describes their functions.

## HELP

Detailed description of all calculator features.

## ABOUT

Get more information about your calculator.

# Numbers, Fractions, D°M'S''

## NUMBERS

Press  $\boxed{0}$  to  $\boxed{9}$  to enter a number and  $\boxed{.}$  to enter a decimal point.

### Negation

$\boxed{+/-}$  negates significand or exponent depending on what part of number is being entered.

»  $\boxed{6}$   $\boxed{.}$   $\boxed{1}$   $\boxed{+/-}$  →  $-6.1$

### Repeating digits

Use the  $\boxed{\overline{123}}$  key to start entering the repeating digits in the decimal part of the number:

»  $\boxed{1}$   $\boxed{.}$   $\boxed{\overline{123}}$   $\boxed{3}$  →  $1.\overline{3}$

Press the key while the cursor is in the decimal part to set where the repeating part starts:

»  $\boxed{0}$   $\boxed{.}$   $\boxed{1}$   $\boxed{6}$   $\boxed{\leftarrow}$   $\boxed{\overline{123}}$  →  $0.1\overline{6}$

If you press the key again at the start of the repeating part, repeating is canceled.

### Exponent

$\boxed{\text{EXP}}$  starts entering exponent.

»  $\boxed{5}$   $\boxed{.}$   $\boxed{1}$   $\boxed{\text{EXP}}$   $\boxed{3}$  →  $5.1 \times 10^3$

Use  $\boxed{\text{EXP SI}}$  to enter an exponent as SI unit prefix.

The Pro version allows you to change the maximum exponent in settings. The maximum exponent limit is set to 999 999 999.

## CORRECTION

$\boxed{\leftarrow \times}$  deletes the last digit or operation.

$\boxed{\text{AC}}$  deletes the whole expression.

## FRACTIONS

Numbers can also be entered as a fraction or a mixed number. Use  $\boxed{d/c}$  to enter a fraction:

»  $\boxed{7}$   $\boxed{d/c}$   $\boxed{9}$  →  $\frac{7}{9}$

Use  $\boxed{a^{b/c}}$  to enter a mixed number:

»  $\boxed{3}$   $\boxed{a^b/c}$   $\boxed{7}$   $\boxed{\rightarrow}$   $\boxed{8}$   $\rightarrow 3\frac{7}{8}$

When the expression mode is enabled (in the Pro version), the numerator and denominator can contain any expression, including nested fractions.

»  $\boxed{\sin}$   $\boxed{\pi}$   $\boxed{\rightarrow}$   $\boxed{d/c}$   $\boxed{2}$   $\rightarrow \frac{\sin(\pi)}{2}$

## DEGREES, MINUTES, SECONDS

If you want to enter a number as degrees, minutes and seconds (a sexagesimal number), use  $\boxed{D^{\circ}M'S}$  key.

»  $\boxed{3}$   $\boxed{D^{\circ}M'S}$   $\boxed{3}$   $\boxed{0}$   $\boxed{D^{\circ}M'S}$   $\boxed{0}$   $\boxed{D^{\circ}M'S}$   $\rightarrow 3.5$

$\boxed{\leftarrow}$  key converts the result into degrees, minutes and seconds. The key is not present on built-in keyboards but you can place it on your own keyboard.

»  $\boxed{3}$   $\boxed{.}$   $\boxed{5}$   $\boxed{\leftarrow}$   $\rightarrow 3^{\circ}30' 0''$

## INFINITY

The calculator has the infinity symbol. Press the  $\boxed{\infty}$  key to insert the symbol into an expression.

It is possible to perform all calculations with infinity, including sums of series, definite integrals and limits.

## RESULT FORMAT

Tap on the result or press  $\boxed{x\leftrightarrow E}$  key to change the result format to decimal, expression, mixed number, sexagesimal number or polar coordinates.

Selected format is indicated by **EXPR**, **MIXED**, **DMS** and **POLAR** indicators on the display.

## NOTATIONS

Decimal numbers can be displayed in several notations. Use  $\boxed{FSE}$  to choose among them. **FIX**, **SCI**, **ENG** and **ENG SI** are displayed to indicate current notation.

- **Normal notation** – the number is displayed as a floating point value. If it is not possible (due to a value too big or small), the scientific notation is used.

»  $\boxed{1}$   $\boxed{2}$   $\boxed{3}$   $\boxed{4}$   $\boxed{5}$   $\rightarrow 12\,345$

- **Fixed notation** – the number is displayed with a fixed number of decimal places.

»  $\boxed{1}$   $\boxed{2}$   $\boxed{3}$   $\boxed{4}$   $\boxed{5}$   $\rightarrow 12\,345.000\,000$

• **Scientific notation** – the number is displayed in  $A \times 10^B$  format.

»      → 1.234 5 × 10<sup>4</sup>

• **Engineering notation** – the same as scientific notation but the exponent is set to the multiple of three.

»      → 12.345 × 10<sup>3</sup>

• **Engineering SI notation** – the engineering notation having the exponent displayed as SI unit prefix if such prefix exists (e.g., M as mega for 10<sup>6</sup>).

»      → 12.345 k

A number of decimal places for each notation can be set in Settings / Precision / Decimal precision.

# Expression Mode

## EXPRESSION MODE

Expression mode is available in the Pro version. It allows you to write your expression and display it as it appears in a text book:

$$\cdot \frac{1}{2} \times \sqrt{\left(\frac{3}{4}\right)^2 + \sqrt{\sin(2 \times \pi)}}$$

$$\cdot \sqrt{x^2 + 2x + 1}$$

$$\cdot \int x \sin(x^2) dx$$

$$\cdot e^{-4.5} \times |^3\sqrt{\ln(2)}|$$

$$\cdot \frac{\sqrt{1 - \sin(\pi)^2}}{\sin(\pi)}$$

$$\cdot 4_{\text{HEX}} \wedge (\neg(8A_{\text{HEX}}) \vee 6_{\text{HEX}}) \oplus 3_{\text{HEX}}$$

## TYPING

Numbers, functions and operators should be typed in order they appear in an expression:

- Functions like sine, combination, square root, etc., are prefix. Press them before operand:

$$\gg \sqrt{x} \ 9 \ \checkmark \rightarrow 3$$

$$\gg nCr \ 5 \ \blacktriangleright \ 3 \ \checkmark \rightarrow 10$$

- Functions like powers, factorial, etc., are postfix. Press them after operand:

$$\gg 3 \ x^2 \ \checkmark \rightarrow 9$$


When a function or operator key is pressed, parameters' placeholders are displayed in expression and the cursor is set to the first parameter:

$$\gg nPr \text{ displays } nPr(\square, \square)$$

Some functions have optional parameters. In such a case ellipsis (...) is displayed as the last parameter. If you start writing in the place of ellipsis, parameters are gradually added.

$$\gg \gcd(\square, \square, \dots)$$

Use arrow keys  $\blacktriangleleft$  and  $\blacktriangleright$  or tap on the expression to navigate through parameters or through the whole expression.

Backspace key  can be used anywhere in the expression to delete the digit or symbol before the cursor.

Keep ,  and  keys pressed to repeat their operation.

## SELECTION




You can select part of the expression and perform various contextual operations, either at the cursor position or on the selected text.


Tap on the cursor position to open the contextual menu; any chosen action is applied at the cursor.

To select a portion of the expression, press and hold it. Drag the selection handles to adjust the range; the contextual menu opens automatically.


The menu offers clipboard actions (cut, copy, paste), options to insert new lines or add and remove rows and columns in matrices, among others.

When part of an expression is selected, pressing a function key applies that function to the whole selection. For example:

-  wraps it in parentheses,
-  places it under a square-root sign,
-  raises it to an exponent.

»  $7 \times 8 + 6$ , press  →  $7 \times \sqrt{8 + 6}$

## EVALUATION

An expression is simplified or evaluated according to the selected result format ( key). The result is displayed as a number or an expression using fractions, square roots, variables etc.


»  $(2\sqrt{2} + 3\sqrt{3})(\sqrt{2} - \sqrt{3}) \rightarrow -5 + \sqrt{6}$

»  $\ln(2e^x) \rightarrow x + \ln(2)$

»  $\sin\left(\frac{\pi}{3}\right) \rightarrow \frac{\sqrt{3}}{2}$

An expression is being immediately evaluated as you type and the result is displayed. If the expression is not complete (e.g., contains a placeholder), the result line is empty.

If there is an error in an expression, the corresponding part is highlighted after pressing .

To change the format of result, press  and choose one of the following formats:

- Decimal number:  $4.50\bar{5}$
- Expression:  $\frac{2\sqrt{3}}{5}$
- Mixed number:  $11\frac{2}{7}$
- Sexagesimal:  $4^{\circ}3'0''$
- Polar coordinates:  $7 \angle 45$

## DETAILS

When an expression is evaluated,  button appears on the display. Press the button to open a window containing additional information about the expression and a result.

Detailed information is e.g. result in various formats, prime factorization, complex plane graph, all complex roots etc. See Calculation details and graphing section of help for more information.

# RPN Mode

## REVERSE POLISH NOTATION

Reverse Polish Notation (RPN) is a notation in which the operator follows its operands. The operands are numbers stored on stack and the operations are performed with the numbers that are placed at the top.

To switch to the RPN mode, go to the Mode menu entry and select RPN.

## DISPLAY

The calculator display shows the entire content of the stack. The topmost number is marked with the letter "X", the second and the third number with the letters "Y" and "Z" respectively. Other numbers are marked with their positions on the stack ("4", "5", etc.).

```
» Y 2 025
   X 4 065
```

## TYPING

Enter the number and press the **ENT** key to push the number on the stack. After typing the appropriate number of parameters, press the operation key. The calculator pops the parameters from the stack, performs the operation and pushes the result on the stack.

Press **X $\leftrightarrow$ Y** to swap the two topmost stack registers (X and Y).

Press **DROP** to drop the topmost register (X) from the stack.

Press **LAST X** to insert the value of register X before the last operation to the stack.

Parentheses are not used in RPN mode. All priorities are handled by the order of operators and their parameters.

# Image Recognition

This tool allows you to capture mathematical expressions using your device's camera and seamlessly enter it into the calculator for evaluation.

Recognition is available only in the premium version of the calculator and requires internet connectivity.

## CAMERA PREVIEW

Press the  key to activate the camera and open the camera preview screen.

Point your device's camera at the mathematical expression you wish to capture and adjust the selection box around the expression by dragging its corners.

Tap the **flashlight icon** to toggle the flash.

Finally, press the **shutter button** to capture the image, or tap the gallery icon to choose an image from the gallery.

## CHOOSING AN IMAGE FROM THE GALLERY

Tap the **gallery icon** in the camera preview screen to open the list of images stored on your device.

After choosing an image, adjust the selection box around the expression or drag the image to fit the box.

Then press the **Recognize Image** button to begin recognition.

## IMAGE RECOGNITION

After capturing an image or choosing an image from the gallery, the image is sent to the server. Therefore, internet connectivity is necessary.

Then the result of the recognition is displayed on the screen.

Please press the **thumb-up** or **thumb-down** button to rate the recognition and help us improve the feature.

Finally, press the **Copy to Display** button to copy the recognized expression to the calculator display.

# Basic Operations

## SHIFT

Compact layout has some functions accessible via  $\boxed{\text{SHIFT}}$  key. Symbols of these secondary functions are displayed above their keys.

» Enter "=" symbol into the expression (to find roots of an equation):

$\boxed{\text{SHIFT}} \boxed{=}$

Secondary functions are also accessible by long pressing a function key.

Expanded and pocket layouts do not have  $\boxed{\text{SHIFT}}$  key and all functions are accessible by "one click".

## BASIC OPERATIONS

» Calculate  $23 - 7$

$\boxed{2} \boxed{3} \boxed{-} \boxed{7} \boxed{\checkmark} \rightarrow 16$

Operator precedence is applied when you mix various operators in an expression.

» Calculate  $2 + 7 \div 3$

$\boxed{2} \boxed{+} \boxed{7} \boxed{\div} \boxed{3} \boxed{\checkmark} \rightarrow 4.\bar{3}$

You can use an unlimited number of parentheses to change the operator precedence.

» Calculate  $(2 + 7) \div 3$

$\boxed{(} \boxed{2} \boxed{+} \boxed{7} \boxed{)} \boxed{\div} \boxed{3} \boxed{\checkmark} \rightarrow 3$

Modulo calculates a remainder left after division.

» Calculate 23 modulo 5

$\boxed{2} \boxed{3} \boxed{\text{mod}} \boxed{5} \boxed{\checkmark} \rightarrow 3$

$\boxed{x^{-1}}$  calculates the reciprocal ( $1 / x$ ) for a number.

» Get the reciprocal of 25

$\boxed{2} \boxed{5} \boxed{x^{-1}} \boxed{\checkmark} \rightarrow 0.04$

## RESULT

Use  $\boxed{\checkmark}$  key to get the result. Any unclosed parentheses are automatically closed and all errors are highlighted.

If "Immediate Evaluation" is turned on (see Settings / Expression), it is not necessary to press the key.

» Calculate  $5 \times (2 + 3)$

→

## PREVIOUS RESULT

The  function inserts the last result to the calculation.

This function can be also used to perform repeated calculations.

» Calculate  $7 \times 9$ , then add 5 to the result:

→

## PERCENTAGE

Use  key to get the result if you want to calculate the percentage.

Calculation depends on the "Percentage calculation" setting in the "Expression" section of settings. There are two variants of percentage calculation: direct and relative.

### Direct

If you choose direct percentage calculation, then number of percents is converted to a decimal by dividing by 100.

» Add 10% to 50:

→

» Subtract 10% from 50:

→

### Relative

In this variant, the percentage is calculated based on the preceding value in the expression.

» How much is 50 increased by 10%?

→

» How much is 50 decreased by 10%?

→

» How much is 10% of 50?

→

» What percentage is 5 out of 50?

→

More percentage operations can be combined in a calculation:

»         →

## Delta percentage

There is a special operation delta percentage calculating a relative difference between two numbers in percentage.

» What is a relative difference between 60 and 90?

$\Delta\%$  6 0 ▶ 9 0 → 50

## REPEATING CALCULATIONS

The  $\text{Ans}$  key can be also used to perform repeating calculations:

» 5 ✓ → 5

$\text{Ans}$  + 2 ✓ → 7

✓ → 9

✓ → 11

# Powers, Logarithms

## POWERS

» Calculate 5 to the second power ( $5^2$ )

→

» Calculate 5 to the 1.6th power ( $5^{1.6}$ )

→

» Calculate  $e^{-3}$

→

» Calculate  $10^4$

→

## ROOTS

» Calculate  $\sqrt{81}$

→

» Calculate  $\sqrt[3]{-27}$

→

» Calculate  $\sqrt[4]{625}$

→

## LOGARITHMS

» Calculate natural logarithm:  $\ln(12)$

→

» Calculate common (base 10) logarithm:  $\log(1\ 000)$

→

» Calculate logarithm with other bases:  $\log_4(256)$

→

# Trigonometric Functions

## ANGULAR UNIT

Trigonometric function parameter can be defined in degrees, radians or gradians. Use **DRG** key (or **DEG** etc. in expanded layout) to switch among these units.

**DEG**, **RAD** and **GRAD** indicator is shown on the display to indicate current mode.

**▷DRG** key in compact layout opens the menu to choose source and target angular units and converts the current display number.

**▷DEG**, **▷RAD** and **▷GRAD** keys in expanded layout converts the current display number from the current angular unit to the required one.

» Convert 90° to radians:

**▷DRG** **9** **0** → 1.570 796 326

## TRIGONOMETRIC FN

» Calculate  $\cos(\pi)$ :

Cycle by **DRG** until **RAD** angular unit is checked, then press

**cos** **π** **✓** → -1

» Calculate  $\sin(90^\circ)$  (in degrees):

**sin** **9** **0** **✓** → 1

To calculate inverse trigonometric functions, use **sin<sup>-1</sup>**, **cos<sup>-1</sup>** and **tan<sup>-1</sup>** keys.

More functions (cotangent, secant, cosecant) can be found in menu that opens after pressing the **OTHER** key.

## HYPERBOLIC FN

To find the result of hyperbolic or hyperbolometric functions, press **hyp** key before the function key.

» Calculate  $\sinh(5)$ :

**hyp** **sin** **5** **✓** → 74.203 210 57

» Calculate  $\cosh^{-1}(3)$ :

**hyp** **cos<sup>-1</sup>** **3** **✓** → 1.762 747 174

Regardless of the selected angular unit, all parameters of hyperbolic and hyperbolometric functions are in radians.

# Derivatives and Integrals

## DERIVATIVES

The calculator is able to find both a derivative of a function and a derivative of a function at a point.

Press  $\boxed{d/dx}$  key to enter the derivative. You can enter the point at which you want to find a derivative or leave it undefined. You can also change the derivative variable.

» Find derivative of  $\cos(x)$ :

$$\boxed{d/dx} \boxed{\cos} \boxed{X} \rightarrow -\sin(x)$$

» Find derivative of  $\ln(x)$  at the point 6:

$$\boxed{d/dx} \boxed{\ln} \boxed{X} \boxed{\blacktriangleright} \boxed{\blacktriangleright} \boxed{6} \rightarrow \frac{1}{6}$$

» Find derivative of  $y^2$  of variable  $y$ :

$$\boxed{d/dx} \boxed{\blacktriangleleft} \boxed{Y} \boxed{Y} \boxed{x^2} \rightarrow 2y$$

## INTEGRALS

The calculator can calculate both definite (Riemann) and indefinite integral.

To calculate a definite integral enter lower and upper limit:

» Find integral of  $x^2$  from 2 to 5:

$$\boxed{\int dx} \boxed{\blacktriangleleft} \boxed{\blacktriangleleft} \boxed{\blacktriangleleft} \boxed{2} \boxed{\blacktriangleright} \boxed{5} \boxed{\blacktriangleright} \boxed{X} \boxed{x^2} \rightarrow 39$$

Press the  $\boxed{\infty}$  key to set the limit as infinity or  $\boxed{-} \boxed{\infty}$  to set the limit as minus infinity.

If you want to calculate an indefinite integral, just leave the limits undefined:

» Find integral of  $x \sin(x^2)$ :

$$\boxed{\int dx} \boxed{X} \boxed{\sin} \boxed{X} \boxed{x^2} \rightarrow -\frac{\cos(x^2)}{2}$$

To change a variable of integral, set cursor to  $dx$  and enter another variable:

» Find integral of  $x y^3$  of variable  $y$ :

$$\boxed{\int dx} \boxed{X} \boxed{Y} \boxed{x^3} \boxed{\blacktriangleright} \boxed{Y} \rightarrow \frac{xy^4}{4}$$

# Equations and Inequalities

## EQUATIONS

Equations are available in Expression mode.

If you want to evaluate an equation, just write it down. Enter the left side of the equation, then press  $\boxed{=}$  key, then enter the right side of the equation.

The calculator is able to find roots of many types of equations: linear, polynomial, rational, exponential, logarithmic, trigonometric etc.

Examples of equations:

- $3x + 5 = 11$
- $x^2 + 3x + 2 = x + 6$
- $ax^2 + bx + c = 0$
- $2\cos(x)^2 - \sin(x) - 1 = 0$
- $200\left(1 - \frac{6}{2 + e^{-0.01x}}\right) = 300$

## Systems of equations

If you enter an equation with more than one variable,  $\boxed{\leftarrow}$  key is displayed to the right of the equation. Press it to enter the next equation of equation system. The calculator will find the root of all the variables in the equation system.

### » Find the roots of an equation system

Enter the equations on the display:

$$2x + 4y = 0$$

$$6x - 8y = 2$$

The result is:

$$x = \frac{1}{5}; y = -\frac{1}{10}$$

## Equations with more than one variable

When an equation with more than one variable is entered, the calculator expresses one of them. The variable being expressed is selected by the calculator. If you want to see other variables expressed, press the  $\boxed{\text{More...}}$  button on the display and see "Other variables expressed" in the calculation details.

### » Find roots of an equation with more than one variable

Create variables a, b and c in  $\boxed{\text{XY,M}}$  window

Enter the following equation:

$$a x^2 + b x + c = 0$$

The result is:

$$x = -\frac{b}{2a} + \frac{\sqrt{-4ac + b^2}}{2a}$$

$$x = -\frac{b}{2a} - \frac{\sqrt{-4ac + b^2}}{2a}$$

Press  $\boxed{\text{More...}}$  button on the display and see the section "Other variables expressed":

$$a = -\frac{b}{x} - \frac{c}{x^2}$$

$$b = -ax - \frac{c}{x}$$

$$c = -ax^2 - bx$$

## Equations with periodical solutions

Some equations don't have a finite set of distinct solutions. Instead, they have infinitely many solutions that repeat periodically.

In this case, the calculator displays a periodic result. The repeating part is shown in gray.

### » Find roots of trigonometry equation

Enter equation on the display:

$$\cos(2x) = \frac{1}{2}$$

The result is:

$$x = \frac{\pi}{6} + \pi n$$

$$x = \frac{5\pi}{6} + \pi n$$

## Graph of equations

If the roots are calculated, a graph of equation can be displayed in calculation details.

Press  $\boxed{\text{More...}}$  key to open details and see "Graph of equation sides" section. There are two functions displayed: left and right sides of an equation. Intersection points are highlighted.

If there is an equation system with two variables, a graph of both equations is displayed in details.

## INEQUALITIES

Write down inequalities in the same way as equations. Just use the inequality relation sign instead of the equals sign.

The calculator has four inequality relations:  $>$ ,  $\geq$ ,  $<$  and  $\leq$ . All operations are placed in the menu on the  $=, <, >$  key.

## Interval notation and number line

Press the **More...** button on the display to display the calculation details. Then you see the result of inequalities using the interval notation. The result is also displayed in the number line.

» **Solve quadratic inequality**  $x^2 \geq 8$

Press  $x$   $x^2$   $=, <, >$   $\geq$   $8$

The result is:

$$x \leq -2\sqrt{2}; x \geq 2\sqrt{2}$$

Press the **More...** key and see the interval notation:

$$x \in (-\infty; -2\sqrt{2}] \cup [-2\sqrt{2}; \infty)$$

The number line is also displayed below the interval notation of the result.

# Matrices and Vectors

## EDITING

Press the  $\left[ \begin{smallmatrix} \square & \square \\ \square & \square \end{smallmatrix} \right]$  key to insert a matrix into an expression. Tap on any matrix element and edit the contents.

An initial size of a matrix is 1x1. If you move the cursor to ellipsis (...) and start writing, a new column is inserted into the matrix. When all elements in the last column are deleted, the last column is removed.

Tap on the  $\left[ \leftarrow \right]$  button in a matrix to insert a new row. If all elements in the last row are empty, just press the  $\left[ \times \right]$  key on the first element in the last row to delete the row.

## MATRIX OPERATIONS

Standard arithmetic operations can be used with matrices, e.g. addition, multiplication, etc.

» Multiply two matrices:

$$\begin{bmatrix} 3 & -1 \\ 4 & 1 \\ 5 & 2 \end{bmatrix} \times \begin{bmatrix} 1 & 7 & -2 \\ 5 & 3 & 4 \end{bmatrix} \rightarrow \begin{bmatrix} -2 & 18 & -10 \\ 9 & 31 & -4 \\ 15 & 41 & -2 \end{bmatrix}$$

In addition, there are many special matrix functions. Press the  $\left[ \text{MTRX} \right]$  key to open a menu with matrix functions.

All of these functions have one or two matrices as parameters. Several functions, e.g. determinant, require a square matrix as a parameter. A square matrix has the same number of rows and columns.

» Find the determinant of a matrix:

$$\det\left(\begin{bmatrix} 7 & 5 \\ 4 & 2 \end{bmatrix}\right) \rightarrow -6$$

## VECTORS

Row matrix can be considered as a vector. There are several more functions available for vectors. You can find them also in the MTRX menu.

» Calculate the Euclidean distance between two vectors:

$$\text{eucDist}\left(\begin{bmatrix} 3 & 6 & 9 \end{bmatrix}, \begin{bmatrix} 5 & 4 & 1 \end{bmatrix}\right) \rightarrow 6\sqrt{2}$$

## GETTING MATRIX ELEMENTS

Various functions are available to assist you in retrieving elements from a matrix, vector, or creating a submatrix.

When providing parameters, you must specify the position or range of the element. Element indices start from 1, with the first parameter addressing rows and the second parameter addressing columns.

If you leave the range blank in the *submatrix* function, the entire row or column will be extracted.

» Get the element in the second row and fourth column of the matrix *m*:

```
element(m, 2, 4)
```

» Get the elements in the second and third rows and first to third columns of the matrix *m*:

```
submatrix(m, 2:3, 1:3)
```

» Get the second row of the matrix *m*:

```
submatrix(m, 2:2, :)
```

# Statistics

## PARAMETERS

Statistical functions summarize a set of values. A set is represented by a row matrix (matrix that has a single row with values) or two-row matrix (with frequencies in the second row). Press the  $\left[ \begin{smallmatrix} \square & \square \\ \square & \square \end{smallmatrix} \right]$  key to enter a row matrix.

If your data set has at least 3 values, you can also insert them into the matrix vertically. That is, you can create a single-column matrix with each value in every row, or a two-column matrix with values in the first column and frequencies in the second column.

If you press the  $\left[ \begin{smallmatrix} X & Y, M \end{smallmatrix} \right]$  key, you can create your own variable and set a row matrix as a value. Then you can easily reuse the set of values in more situations.

## STATISTICAL FUNCTIONS

Press the  $\left[ \text{STAT} \right]$  key to open a menu with all statistical functions. Then select a function and insert a set of values.

» Calculate an average of 5, 12 and 13:

$$\left[ \text{STAT} \right] \left[ \overline{\text{arith}} \right] \left[ \begin{smallmatrix} \square & \square \\ \square & \square \end{smallmatrix} \right] 5 \left[ \blacktriangleright \right] 1 \left[ 2 \right] \left[ \blacktriangleright \right] 1 \left[ 3 \right]$$
$$\text{arithMean}\left(\left[ \begin{array}{ccc} 5 & 12 & 13 \end{array} \right] \right) \rightarrow 10$$

» Calculate a standard deviation of 5, 12 and 13:

$$\left[ \text{STAT} \right] \left[ \sigma \right] \left[ \begin{smallmatrix} \square & \square \\ \square & \square \end{smallmatrix} \right] 5 \left[ \blacktriangleright \right] 1 \left[ 2 \right] \left[ \blacktriangleright \right] 1 \left[ 3 \right]$$
$$\text{stdDeviation}\left(\left[ \begin{array}{ccc} 5 & 12 & 13 \end{array} \right] \right) \rightarrow 4.358\dots$$

## GROUPED DATA

The calculator is able to evaluate the statistical function over the grouped data.

Place frequencies of the data to the second row of a matrix. The frequencies can be entered as absolute number of occurrences or relative frequencies.

$$\text{arithMean}\left(\left[ \begin{array}{ccc} 5 & 7 & 8 \\ 2 & 1 & 1 \end{array} \right] \right) \rightarrow 6.25$$

$$\text{arithMean}\left(\left[ \begin{array}{cc} 5 & 7 \\ 0.75 & 0.25 \end{array} \right] \right) \rightarrow 5.5$$

## SAMPLE VS. POPULATION

Sample variants of functions are performed as a default.

Only if you enter data with relative frequencies, the population variant of a function is calculated because the number of elements is unknown.

## REGRESSION FUNCTIONS

There are several types of regression functions that can be found by the calculator. You can find them also in the **STAT** key.

The first parameter of regression function is a data set respresented by a two-row matrix. The first row contains the X variable, the second row contains the Y variable.

Data in a matrix can be arranged also vertically. Then the X variable is placed in the first column and the Y variable in the second column.

» Find quadratic function from points (2, 3), (3, 4), (5, 6) and (6, 8):

$$\text{quadReg}\left(\begin{bmatrix} 2 & 3 & 5 & 6 \\ 3 & 4 & 6 & 8 \end{bmatrix}\right) \rightarrow \frac{x^2}{6} - \frac{2x}{15} + \frac{27}{10}$$

If you press the **More...** button on the display, you will see a graph of regression function and all points.

# Other Functions

## UNIT CONVERSIONS

Conversions are used to convert a display number among many units.

Use **CONV** to open the conversion window. Select a group of units and a source unit of the number. Then, a list of all units from the group and the display number converted to them are displayed. Tap on the number to insert it to the current calculation.

## PHYSICAL AND MATHEMATICAL CONSTANTS

The calculator contains a list of physical and mathematical constants.

The values of physical constants are 2022 CODATA recommended values.

Use **CNST** to open a window with a list of constants. Select a group of constants and tap on the constant to insert it to the current calculation.

## SERIES

If you would like to calculate a sum or a product of a serie or a sequence, use  $\Sigma$  and  $\Pi$  functions.

» Calculate a sum from 1 to 5 of  $x^2$ :

$\Sigma$  1 ▶ 5 ▶  $x^2$  → 55

» Calculate a product from 3 to 7 of  $x$ :

$\Pi$  3 ▶ 7 ▶  $x$  → 2 520

Press the  $\infty$  key to set the limit as infinity or  $-$   $\infty$  to set the limit as minus infinity.

## TABLE

If you want to see a list of function values in a specific interval, use the table function. Press the **TBL** key (in the **OTHER** key menu) and fill the parameters:

- function
- iteration variable
- lower limit
- upper limit
- step

» List the values of  $x^2$  from 2 to 5:

... →

The result is:  $\begin{bmatrix} 2 & 4 \\ 3 & 9 \\ 4 & 16 \end{bmatrix}$

Then press the  key to see a graph of table values.

## LIMITS

The calculator evaluates all types of limits: two-sided, left and right. Press the  key to insert the limit function into an expression.

» Calculate limit of  $x^2$  for  $x = 5$ :

→

If you want to calculate one-sided limit, just add the + or - sign at the end of the point definition.

» Calculate right-sided limit of  $1/x$  for  $x = 0$ :

→

Press the  key to set the point of a limit as infinity or   to set the point of a limit as minus infinity.

## COMBINATORICS

» Calculate a combination of 5 items out of 52:  $nCr(52, 5)$

→

» Calculate a partial permutation of 5 items out of 52:  $nPr(52, 5)$

→

» Calculate a permutation of 5 items:  $5!$

→

If you enter a decimal or negative number as a parameter of , Gamma function is calculated:  $n! = \Gamma(n + 1)$

Besides, there is a separate Gamma function provided.

» Calculate Gamma function of 5:  $\Gamma(5)$

→

## ARITHMETICS

GCD and LCM functions can have multiple parameters in expression mode.

» Calculate the greatest common divisor of 8 and 12:  $\text{gcd}(8, 12)$

`gcd` `8` `▶` `1` `2` `✓` → 4

» Calculate the least common multiple of 8, 12 and 6:  $\text{lcm}(8, 12, 6)$

`lcm` `8` `▶` `1` `2` `▶` `6` `✓` → 24

» Calculate absolute value of -61:  $|-61|$

`abs` `+/-` `6` `1` `✓` → 61

» Calculate signum of -61:  $\text{sgn}(-61)$

`sgn` `+/-` `6` `1` `✓` → -1

## ROUNDING

There are several rounding functions in the calculator. All of them have two parameters. The first parameter denotes the number to be rounded. The second parameter is optional and defines the number of decimal places for rounding. If the parameter is omitted, the number of decimal places is 0.

• `round` – rounds the number equal and above the half up and below the half down;

»  $\text{round}(7.57, 1)$  → 7.6

• `roundUp` – rounds the number up, i.e. far from the zero;

»  $\text{roundUp}(-3.1)$  → -4

• `roundDown` – rounds the number down, i.e. towards the zero;

»  $\text{roundDown}(2.588, 2)$  → 2.58

• `floor` – rounds the number towards the minus infinity;

»  $\text{floor}(3.22)$  → 3

• `ceiling` – rounds the number towards infinity.

»  $\text{ceiling}(3.62)$  → 4

• `decimalPart` – removes the integer part of a number.

»  $\text{decimalPart}(5.47)$  → 0.47

## RANDOM NUMBERS

In decimal base, random number is generated in a range (0, 1).

» Get random number in decimal base

ran# → 0.862 390 168 525 24

In other bases, random number is generated in a range from 0 to maximal value.

» Get random number in hexadecimal base

ran# → 3B23 F00F 1DC0 5D83<sub>HEX</sub>

# Complex Numbers

Complex numbers are available in expression mode only. They can be enabled in Mode menu entry.

## TYPING

Use  $i$  key to enter an imaginary part of complex number.

»  $3 + 5i$

Press  $\angle$  key to enter the complex number in polar form. An angle should be entered in degrees, radians or gradians according to the checked angular unit.

»  $3 \angle 90 \rightarrow 3i$

## DISPLAY

Complex numbers can be displayed in rectangular or polar coordinates. Press  $x \leftrightarrow E$  key and choose appropriate result format.

»  $4 + 4i$   
 $x \leftrightarrow E$  : Polar  $\rightarrow 5.65685424949238 \angle 45$

After pressing  $\checkmark$  key in expression, you can also press  $\angle$  key to change the number format.

## OPERATIONS

All arithmetic operations, powers, logarithms, trigonometric and hyperbolic functions are defined on complex numbers.

Besides, there are several other complex number operations:

» Get real part of  $4 + 6i$   
 $\text{Re } 4 + 6i \rightarrow 4$

» Get imaginary part of  $4 + 6i$   
 $\text{Im } 4 + 6i \rightarrow 6$

» Get complex modulus of  $1 - 1i$   
 $\text{abs } 1 - 1i \rightarrow 1.4142135623731$

» Get complex argument of  $-2 + 2i$   
 $\theta \text{ +/- } 2 + 2i \rightarrow 135$

» Get complex conjugate of  $4 + 6i$

$$\bar{z} \quad 4 \quad + \quad 6 \quad i \quad \rightarrow \quad 4 - 6i$$

# Graphing and other Calculation Details

Calculation details are available in Expression mode.

When an expression is evaluated,  button appears on the display. Press the button to open a window containing additional information about an expression and a result.

There are many types of additional information. Only information relevant to the evaluated expression are displayed.

## DETAIL OPERATIONS

You can copy a value in a detail to the clipboard or display or export it as a bitmap. It is also possible to export all details in a single bitmap.

Press the menu button on the right side of the detail or at the top of the screen to perform these functions.

## DETAIL TYPES

### Decimal number

A result displayed as a decimal number in normal, scientific, engineering and "engineering SI" notation. Engineering SI notation is a notation in which an exponent is displayed as a SI unit prefix if possible.

» Example of the number 360 in the scientific notation:

$$3.6 \times 10^2$$

You can see the "left" and "right" buttons at the detail showing a number with exponent. Press these buttons to move the decimal point to the left and right with a corresponding change in exponent.

» Example of the number 360 after pressing the "left" key:

$$36 \times 10^1$$

### Alternative forms

Results in other forms than the result on the display.

Other forms are for example a result converted to a common denominator, a polynomial factorization, non-natural logarithms converted to a natural logarithm, interval notation of inequality result etc.

» Example of the source expression

$$x^2 - 3x + 2$$

### Other variables expressed

When just one equation with more than one variable is entered, the calculator expresses one of them. The detail shows the other variables expressed from an equation.

» Example of the source expression

$$a x^2 + b x + c = 0$$

## Expression roots

If you enter an expression with one variable, you will see the roots of the expression, i.e. the solutions of the equation where the expression is equal to zero.

» Get roots of  $x^2 - 4$ :

See the detail:  $x = 2$ ;  $x = -2$

## Domain of expression

If there is a function with one variable in the result, its domain is displayed (if evaluated) in details.

» Get domain of  $1/x$ :

See the detail:  $x \in (-\infty; 0) \cup (0; \infty)$

## Mixed number

Result displayed as a mixed number.

## Number line

Displays the number line with graphical visualization of inequality result.

## Graph of a function

A graph is displayed when you enter a function of one or two variables, a set of functions, an equation system with two equations, limit, table function, regression function, or you calculate a definite integral. To display a graph, a variable in function must not have a value set.

If you enter an equation with one variable, there are two functions displayed: left and right sides of an equation. Intersection points are highlighted.

» Examples of the source expressions

$$x + \sin(2x) ,$$

$$\int_0^{\pi} x \sin(x) dx ,$$

$$\sin(x) \cos(y) ,$$

$$x^2 + 3x + 2 = x + 6 ,$$

$$x^2 + y^2 = 1 ,$$

$$\lim_{x \rightarrow 1} \left( \frac{x}{x-1} \right) ,$$

$$\text{table}(x^2, x, 5, 1, -1) ,$$

$$\text{linReg} \left( \begin{bmatrix} 1 & 2 & 3 \\ 2.1 & 4.5 & 6.2 \end{bmatrix} \right)$$

A graph of a function can be displayed in two variants: rectangular and polar. If you switch the graph to polar, you can change limits of displayed graph using the button under the graph.

If you want to plot multiple functions in the same graph, you can enter them in two ways:

- enter a one-column matrix (press the  $\begin{bmatrix} \square & \square & \square \\ \square & \square & \square \end{bmatrix}$  key) with one function per row,
- enter a multi-line expression with one function per line. To add a new line, long-press the last line and select the "Insert new line below" item in the context menu.

» Example: two functions entered as a matrix:

$$\begin{bmatrix} \sin(x) \\ \cos(x) \end{bmatrix}$$

» Example: two functions entered as a multi-line expression:

$$\sin(x)$$
$$\cos(x)$$

Several types of special values are displayed under a graph:

- Zeros of a function
- Minima
- Maxima
- Inflex points

You can swipe with one or two fingers (depending on display settings) to move the center of a graph, to change a scale or to rotate a graph.

Press buttons under a graph to:

- Bind the  $x$  and  $y$  axes scale to the same value or release it.
- Set limits of polar graph.
- Switch between decimal values on graph axes and multiples of  $\pi$ .
- Show or hide a grid (2D graphs only).
- Set the center and the scale to a default value.
- Switch between moving directions and rotation mode (3D graphs only).
- Choose between a light color scheme with shaded slopes and a dark one with color-coded points based on their value (3D graphs only).

## **Matrix properties**

When a result is matrix, several matrix properties are displayed:

- Determinant
- Trace
- Rank
- Characteristic polynomial
- Eigen values
- Eigen vectors
- Diagonalization

## **Statistics**

When a result is a row matrix, results of several statistical functions are displayed for its values:

- Element count
- Sum
- Arithmetic mean
- Median
- Variance
- Standard deviation

## **Fit diagnostics**

If you evaluate any type of regression function, you will get several values characterizing how an estimated function fits the data set:

- Mean squared error,
- $r$  (Pearson correlation coefficient),
- $R^2$  (coefficient of determination),
- Adjusted  $R^2$ ,
- AIC (Akaike information criterion),
- BIC (Bayesian information criterion).

## Degrees, minutes and seconds

Result with decimal part converted to minutes and seconds.

Displayed when the source expression contains a number entered as degrees, minutes and seconds.

## Degrees and minutes

Result with decimal part converted to minutes.

Displayed when the source expression contains a number entered as degrees, minutes and seconds.

## Result in various bases

Result converted to binary, octal and hexadecimal bases.

Displayed when the source expression contains a number in non-decimal base or the calculator base is not decimal (indicated by **BIN**, **OCT** or **HEX** indicators on the display).

» Example of the source expression

$2AF_{\text{HEX}} + 1011001_{\text{BIN}}$

## Prime factorization

Prime factorization of the result or information that the result is a prime number.

Displayed when the result is integer number up to  $1 \times 10^{12}$ .

## Result in various angular units

Result converted to degrees, radians and gradians.

Displayed when there are inverse trigonometric functions in the source expression and the result is a number.

## Polar coordinates

Result converted from rectangular to polar coordinates. Polar coordinates are displayed using degrees, radians and gradians.

Displayed when the result is a complex number.

## Complex plane

Draws a graph of a complex plane with the point of result plotted.

Displayed when the result is a complex number or there is a complex number in the source expression.

» Example of the source expression

$$(3 + i) \div (1 - 2i)$$

## All roots

All real or complex roots (according to a domain set in the Mode window).

Displayed when there is only principal root displayed on the display (see Settings / Expression / Roots ...) and the source expression is a root function.

» Example of the source expression

$$\sqrt[3]{-8}$$

## Unit circle

A unit circle with inscribed triangle. Angles, adjacent and opposite sides and hypotenuse are described.

Displayed when the source expression is a trigonometric function and the result is a number.

» Example of the source expression

$$\sin\left(\frac{\pi}{3}\right)$$

## Limit

Displayed when the expression is the limit function.

Contains results of all remaining limit types (two-sided, left, right).

## Roman numeral

The result expressed as a roman numeral.

Displayed when the result is a positive integer number up to 3 999.

## Parity

Odd and even parity bit of the result.

Displayed when the source expression contains binary, octal or hexadecimal number or the calculator base is not decimal (indicated by **BIN**, **OCT** or **HEX** indicators on the display).

## Division with remainder

The result of a division operation is displayed in a form of a quotient and a remainder.

Displayed when the source expression contains a division of two numbers or two polynomials.

## **Percentage**

How much is a required amount of percent out of a base.

Displayed when the source expression contains percentage calculation.

» Example of the source expression

$25 + 10\%$

## **Derivatives**

All partial derivatives with respect to each variable in an expression (other variables are treated as constants).

## **Indefinite integrals**

All indefinite integrals with respect to each variable in an expression (other variables are treated as constants).

# Variables, Functions, Memories and History

## VARIABLES

In Expression mode, you can insert variables into expressions. Either you can use two predefined variables, X and Y, or define your own variables.

A variable can have an assigned value. In such case, a variable is substituted by a value when an expression is being evaluated. If a variable does not have a value, it is left in an expression, which is then simplified.

Press  and  keys to insert variables X and Y into an expression.

Press  key to open a window containing a variable list.

In this window, you can view defined variables, their values, create new variables, change values, copy them into expression, etc.

## FUNCTIONS

It is possible to define custom functions in the same window.

Press  key first. Then press "New function" button or select any item in a function context menu.

When you are creating a new function or editing existing function, enter a function name, number of parameters and a definition. You can also change parameter names or leave them unchanged.

While editing a function definition, press  key to insert a function parameter into the definition.

### Variable and Function Identifiers

All identifiers must start with a letter. Then letters, digits and underscores may follow the first letter.

Several markups can be used in the identifier to change the formatting:

- `<sub></sub>` – subscript
- `<sup></sup>` – superscript

» `E<sub>k` →  $E_k$

## MEMORIES

The name of a variable can be left undefined. Such a variable is called "memory" and only its value can be inserted into an expression.

The memories being used are indicated by a small number of memory on the top indicator line on the display (e.g., 1, 2, 3, and so on).

## MAIN MEMORY

The main memory is a special case of memory.

Stores the display number in the main memory.

Recalls the display number from the main memory.

Adds the display number to the value stored in the main memory.

Subtracts the display number from the value stored in the main memory.

Clears the value stored in the main memory. This function does not have a dedicated key on the built-in keyboard layouts but can be accessed from the  key menu.

When a value is stored in the main memory, **M** indicator is shown on the display.

## EXPORT AND IMPORT

"Variables, Functions and Memories" window allows you to import and export data. This functionality can be used in expression mode.

### Export

To export variables, functions and memories, press  key and select "Export" in the menu. Then select or enter name of a target file. All items will be exported to the file.

### Import

Press  key and select "Import" in menu. Then you have to pass through a two-step workflow:

1) select a file with data to be imported

2) select import options:

- Data to be imported: check off variables, functions and/or memories. Unselected data will remain unchanged.
- How will the imported / existing data merge work:

*Clear current data* – selected types of data in the calculator will be deleted before the import,

*Merge - prefer current* – if duplicate items in the calculator and imported data are found, items in calculator will be kept,

*Merge - prefer imported* – if duplicate items in the calculator and imported data are found, imported items will overwrite the ones in the calculator.

## HISTORY

The result history stores every result and calculated expression.

Press HIST key to open the result history window and tap on the result to insert it into the display. If the expression mode is enabled, you can tap on an expression to insert it into the display.

The maximum number of results stored in the result history and other settings can be changed in Settings / Other / Result history.

# Binary, Octal and Hexadecimal

## N-BASE

Binary, octal and hexadecimal bases are supported in addition to decimal base.

Non-decimal bases are featured with logical operations, shifts and rotations. If you switch to a non-decimal base, the display number is truncated to an integer value.

Press , ,  and  keys to convert the current display value and change the calculation base.

Expression mode (in HiPER Calc Pro only) enables to mix number bases in an expression. If the number base is different from the current calculation base, it's indicated in a subscript:

$12 + 1AF2_{\text{HEX}} + 11010_{\text{BIN}} + 639_{\text{OCT}}$

» Convert 127<sub>DEC</sub> to hexadecimal base

→ **7F<sub>HEX</sub>**

Press  to get a two's complement of a number

»   → **FFFF FFF5<sub>HEX</sub>**

In non-decimal bases, the keyboard contains keys with logical operations, shifts and rotations.

## LOGICAL OPERATIONS

All logical operations are bitwise.

» Calculate 6 AND 13 ( $6 \wedge 13$ )

→ **2<sub>HEX</sub>**

» Calculate 6 OR 11 ( $6 \vee 11$ )

→ **17<sub>HEX</sub>**

» Calculate 6 XOR 11 ( $6 \oplus 11$ )

→ **17<sub>HEX</sub>**

» Negate 15 ( $-(15)$ )

→ **FFFF FFEA<sub>HEX</sub>**

## SHIFTS, ROTATIONS

Both signed and unsigned shift operations are available. Shifts and rotations have one-bit variants or the number of bits can be defined.

Following examples are one-bit:

» Shift 9 by one bit left

→  <sub>HEX</sub>

» Shift -9 by one bit right

→  <sub>HEX</sub>

» Unsigned shift -9 by one bit right

→  <sub>HEX</sub>

» Rotate 9 by one bit left

→  <sub>HEX</sub>

N-bit shifts and rotations are two-parameter functions. Press required function, shifted or rotated number and a number of bits.

» Shift 9 by 3 bits left

→  <sub>HEX</sub>

» Rotate 7 by two bits right

→  <sub>HEX</sub>

# Settings

## PRECISION

Settings of the number of digits of a result in various situations. You can set up to 100 digits in significand and up to 9 digits in exponent.

Result precision in the "Pocket" layout is set to 12 and cannot be changed.

### Digits in compact portrait layout

Set the number of significand and exponent digits in the "Compact" layout when the device orientation is portrait.

### Digits in compact landscape layout

Set the number of significand and exponent digits in the "Compact" layout when the device orientation is landscape.

### Digits in expanded layout

Set the number of significand and exponent digits in the "Expanded" layout.

### Decimal precision

Number of decimal places when fixed, scientific or engineering notations are selected. Press the  key to change the notation of the result.

## FORMATTING

### Decimal separator

Change the separator between integer and decimal part of numbers.

### Thousand separator

Change the separator between every three digits in the integer part of numbers.

### Thousandth separator

Change the separator between every three digits in the decimal part of numbers.

### Other

The calculator detects repeating decimals. If **Mark repetend by vinculum** is set, the result is displayed in shortened form: the repeating part is shown only once and marked with a horizontal line (vinculum) above it.

» Result 0.595 959 595 95 is displayed as  $0.\overline{59}$

Use **Indian style of digit grouping** in Indian numbering system. Then the rightmost three digits are grouped together and other digits are grouped by two.

» Ten million: 1 00 00 000

## EXPRESSION

These settings apply only in the Expression mode.

### Operand grouping

Select how the operands in expression are grouped together. It affects the order of the evaluation.

When **weak** grouping is set, the operand group with "implicit" multiplication is evaluated as if the explicit multiplication is written there.

» Expression  $6 \div 2 (2 + 1)$  is evaluated as  $6 \div 2 \times (2 + 1)$

When **strong** grouping is set, the operand group with "implicit" multiplication is evaluated first.

» Expression  $6 \div 2 (2 + 1)$  is evaluated as  $6 \div (2 \times (2 + 1))$

### Percentage calculation

Select how the number of percents will be evaluated in the expression.

If you choose **direct** percentage calculation, then number of percents is converted to a decimal by dividing by 100.

» Add 10% to 50:

$50 + 10\% \rightarrow 50.1$

In the **relative** variant, the percentage is calculated based on the preceding value in the expression.

» How much is 50 increased by 10%?

$50 + 10\% \rightarrow 55$

See more examples in the "**Basic operations**" chapter of the help.

### Roots displayed in result

You can select if you want to see only principal root as a result on the display or all roots. If principal root is selected, other roots are displayed in calculation details.

» Calculate  $\sqrt[3]{-8}$  when "only principal root" is selected:

$1 + 1.732\ 050\ 807\ 568\ 88\ i$

» Calculate  $\sqrt[3]{-8}$  when "all roots" are selected:

$1 + 1.732\ 050\ 807\ 568\ 88\ i$

$-2$

## Other

Set **Immediate evaluation** if you want the expression to be evaluated right when you type it. Otherwise it will be evaluated after pressing the  key.

Set **Infinite result of finite expression** if you want to get the result of expressions like  $1 \div 0$  or  $\ln(0)$  as +/- infinity. Otherwise an error is displayed when these expressions are calculated.

## DISPLAY

### Portrait orientation

Adjust the display size in portrait orientation.

Set the **Hide status bar** setting to hide the topmost bar with the information about battery, time, etc. on the device screen.

Set the **Hide navigation buttons** setting to hide the soft keys (home, back, ...) at the bottom the device screen.

### Landscape orientation

The same settings as in the previous section that apply to the landscape orientation.

### Font size

Select the multiple used to scale a font size on the calculator display.

### Clear display

If you turn the **Clear display on startup** setting on, the display is cleared on the application startup.

You can also change the **Required delay after finish** to set the number of seconds from the last termination necessary to clear the display.

### Interval notation

Select type of brackets used for displaying open and closed intervals.

You can choose from several combinations of parenthesis, square brackets, angle brackets and reverse square brackets.

### Other

Set **Keep screen on** to prevent the display from turning off when the calculator is launched.

Turn **Blinking cursor on display** on to use the blinking cursor on the calculator display. Otherwise it is displayed as a static bar.

When the **"Only one cursor position in a placeholder"** option is enabled, the cursor will stop at the beginning of the placeholder (the rectangle displayed where the number, variable or expression is to be inserted) during movement. If this setting is turned off, the cursor stops at both the beginning and the end of the placeholder.

After turning **Display powers of ten in E notation** on, the letter "E" is displayed between a significand and an exponent in numbers instead of " $\times 10^{\square}$ ".

If **Move graph with one finger** is set, you can move the graph contents in the calculation details just by one finger. In the other case two fingers must be used to move the graph (one finger scrolls the window).

## BUTTONS

### Haptic feedback (vibrations)

You can set if the keys should vibrate on press. Some manufacturers like Samsung do not use the standard Android setting so the "According to system setting" option might not work on such devices.

### Button sound

Enable or disable the sound played on the key press. You can also adjust the volume and select if the calculator proprietary sound or the system default sound is played.

### Title style

Select whether you want to display the button titles using

- **Sharp style:** Operands are represented using a variable,
- **Casio style:** Operands are represented with a rectangle.

### Second function button title

Select the text to be displayed as a title of the "Shift" key.

### Division sign

Select the text used on the calculator display as the "division" operation.

## CUSTOM KEYBOARDS

You can define your own keyboard layouts in the calculator. It is also possible also export and import them so you can share them with your friends.

### Custom Layouts screen

There is a list with all defined custom layouts.

Two custom layouts are provided by the application. You can also change or delete them. If you reset the custom keyboards settings, these built-in layouts are recreated.

Tap on the layout to edit it. Select an item in the context menu next to each layout to make a copy of a layout, change its order or delete it.

Access the overflow menu on the screen to reset the keyboard layouts, export or import them.

## Export Layouts

When you export the data for the first time, you will be prompted to grant rights to external storage. You must then select or specify the target file name. All layouts will be exported to that file.

## Import Layouts

You can be asked for the external storage permission as in the "Export data" function.

Then you have to follow a two-step workflow:

1) select a file with data to be imported

2) select how will the imported / existing layouts merge work:

*Clear current layouts* – layouts in the calculator will be deleted before the import,

*Merge - prefer current* – if duplicate layouts in the calculator and imported data are found, layouts in calculator will be kept,

*Merge - prefer imported* – if duplicate layouts in the calculator and imported data are found, imported layouts will overwrite the ones in the calculator.

## Keyboard Parameters Definition screen

Set the parameters of the layout:

### • Name and a description

Name must be set and unique.

### • Supported orientations





Select if the layout is defined in portrait or landscape orientations. You can also select that both orientations have the same keys. In such a case extended and main keys are placed vertically in portrait orientation and horizontally in landscape orientation.


### • Orientation parameters definition

Set the basic orientation parameters:

Number of rows and columns

Whether the keyboard has extended keys or not. Extended keys are smaller keys above the main "numeric" keypad.

Whether the nondecimal bases are supported or not. Do not forget to place the , ,  and  keys on the keyboard if they are.

Whether the keys have a "second function" or not. Do not forget to place the  key on the keyboard to enable users to perform the second function.

Finally press the **Standard keyboard layout** or **Nondecimal bases layout** buttons to define the keys' functions.

## Key Function Definition screen

You can see a set of buttons on this screen. Number of rows, columns and other parameters corresponds to the values set in the previous screen.

Tap the button and select a function from the menu. Then the function is set as the button function. Make a long press to set the "second function" of the button if the second function is enabled.

The "Custom Functions and Variables" submenu contains all user defined functions and variables. You can create shortcuts to custom functions via the submenu.

The "Custom Keyboards" submenu contains buttons that allows you to change a keyboard layout just by one press.

You can also set a button span in the menu. It defines how many columns the button is spread across. The default button span is 1.

If you turned both portrait and landscape orientations on and the orientations do not have the same buttons, do not forget to turn your device and define the keys also in the other orientation.

The **MENU** key is mandatory in all layouts. The calculator does not allow you to finish the keyboard layout without this key.

If you place the **PARAM** key on the keyboard, it is displayed only when the function is being defined. It is not necessary to set the **PARAM** key. If you omit it and you open the function definition window, the **PARAM** key is placed instead of one of the **M+**, **x→M**, **✓** or **MENU** keys.

You can place the **OTHER** key on the keyboard. This key opens a menu with all functions that are not placed on their own keys.

It is possible to copy the buttons from other layouts. Open the "Copy Keys" entry in the overflow menu. Select the source layout, source buttons rectangle and the target position. In this way you can for example copy the keys and leave the first row empty for your own functions.

## N-BASE

The set of settings that affect calculations in nondecimal number bases.

### Signedness

When the **signed** option is set the most significant bit in a number is treated as the sign bit. When the bit is set the number is negative.

When the **unsigned** option is set all bits define the number value. Numbers are always positive.

## Binary, octal, hexadecimal

Set the size and grouping for each nondecimal number base.

The **size** setting defines the number of bits used to store a result.

» 8-bit unsigned binary can store numbers between 0 and 255.

» 8-bit signed binary can store numbers between -128 and 127.

Set **grouping** to define how many digits should be grouped together. The space is always used as a separator between groups.

## Other

If **Display leading zeros** is turned on zeros are displayed before the first significant digit so a number in a result is displayed with its maximal number of digits.

## OTHER

### Internationalization

Choose the language used in the calculator. You can also set **Default** to use the most suitable language according to the device settings.

### Result history

Set the **Max result history size** value to limit the number of expressions and results in the result history.

When the maximal number of items in the result history is exceeded the oldest items are removed.

If the **Remove duplicates** option is set the result history contains the identical pairs of expression-result just once.

# Hot Keys

Once you pair a hardware keyboard with your device, you can control most of the calculator functions through a set of hot keys.

Besides the keys listed below, you can use all digit keys, navigation keys, backspace and delete keys to edit the display number or expression.

## General keys

AC	C
✓	Enter
HIST	Alt+Enter
FSE	Alt+F
$x \leftrightarrow E$	Alt+C

## Basic operations

+	+
-	-
x	*
÷	/
=	=
mod	O
+/-	N
$d/c$	F
$a^b/c$	Ctrl+F
$\pi$	Alt+P
D°M'S	D
←	Ctrl+D
$x^{-1}$	Ctrl+I
%	%
$n!$	!
ran#	Ctrl+R

## Powers and logarithms

EXP	E
$x^2$	Ctrl+2
$x^3$	Ctrl+3

$x^y$	Ctrl+Y
$x^y$	^
$\sqrt{x}$	Alt+2
$\sqrt[3]{x}$	Alt+3
$\sqrt[x]{y}$	Alt+Y
$\log_{10}$	L
$\ln$	Ctrl+L
$\log_x y$	Alt+L
$e$	Ctrl+Alt+E
$10^x$	Alt+E
$e^x$	Ctrl+E

### Trigonometric functions

DRG	Alt+G
►DRG	Ctrl+G
hyp	Alt+H
sin	Ctrl+S
cos	Ctrl+C
tan	Ctrl+T
$\sin^{-1}$	Ctrl+Shift+S
$\cos^{-1}$	Ctrl+Shift+C
$\tan^{-1}$	Ctrl+Shift+T

### Memory and variables





STO	S
XY,M	R
$x \rightarrow M$	Ctrl+M
MR	M
M+	Alt+M
M-	Ctrl+Alt+M
X	X
Y	Y

### Complex numbers














$i$	I
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	Alt+I
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## Number bases





	Ctrl+Alt+B
	Ctrl+Alt+O
	Ctrl+Alt+D
	Ctrl+Alt+H

The following keys can be used in non-decimal number bases.

	Ctrl+A
	Ctrl+O
	Ctrl+X
	Alt+A
	Alt+O
	Alt+X
	Ctrl+N
	L
	H
	U
	Ctrl+L
	Ctrl+H
	Ctrl+U

## RPN mode

These keys are valid in RPN mode only.

	Enter
	Ctrl+W
	Ctrl+Delete
	Ctrl+Alt+L