

RedCrab

Calculator V

User Manual

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RedCrab Calculator

Version 5.1.3

This program can be used indefinitely as freeware. By purchasing a limited shareware license, additional features are enabled. This manual describes the basic features available in freeware mode.

With **RedCrab** freeware you can load data sheet which includes shareware programs. The worksheet is free to use, but the program code is read only and file saved is disabled.

Copyright

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System requirement

Operating system: *Microsoft Windows* Vista, W7, W8.x, W10

Framework 4.5 or higher

RedCrab is portable. No installation of the software is required. You can just copy the software to your system and starts the programs. RedCrab can run on removable drives like DVD or USB-Stick.

Calculation range: $\pm 5 \times 10^{-324}$ to $\pm 1.7 \times 10^{308}$

Accuracy: 15 - 16 digits

Display: 15 digits

Hexadecimal 12 digits

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Keyboards

RedCrab – The Calculator

RedCrab is a math program with a full screen editor. Mathematical expressions are not entered here in a single command line, but written in any editor position similar to a sheet of paper. Mathematical symbols like fraction lines and roots are supported.

The handling of the basic functions is just like a conventional calculator. There is no training required. Whoever can operate a pocket calculator can also use **RedCrab** without studying the manual.

This guide describes advanced features which a normal calculator does not possess. Additional RedCrab's menu elements have tool tips with examples in English and German language.

Additional Information: www.redchillicrab.com/en/redcrab/tutor.html

RedCrab is fully portable. The program can be started from external data storage source without installation. Settings will be stored as a file in the RedCrab start directory *Tools\Settings\user.config*.

1.0 Mathematical Expressions

1.1 Basics

You can write your formula basically at any editor position. Any expression may occupy any number of rows and columns. It is not allowed splitting an expression and to continue in the next row.

Wrong: $z = 12+14+15+20$
 $+5+10$

Correct: $z = 12+14+15+20+5+10$

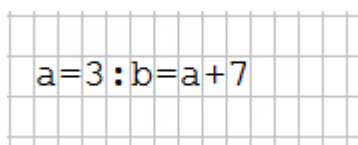
Correct: $X = 12+14+15+20$
 $Z = X+5+10$

You can write several mathematical expressions on one work sheet. The expressions result displays only if terminated with equal sign.

Example 1: $a+b = 108$
 $a=27+9$
 $8*4 = 32$
 $b=12*6 = 72$

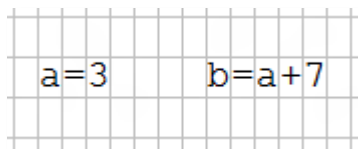
Several mathematical expressions can be written per row. Between each mathematical expression, there must either a minimum number at four blank columns or a colon must be set.

Example 1:



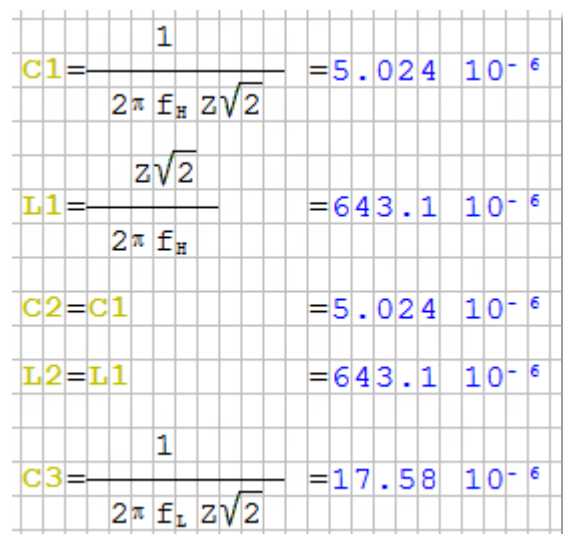
A grid showing the formula $a=3:b=a+7$. The formula is written in a single row, with a colon separating the two expressions. The grid is 10 columns wide and 4 rows high.

Example 2:



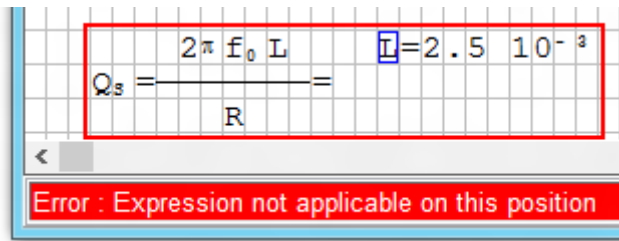
A grid showing the formulas $a=3$ and $b=a+7$. The formulas are written in a single row, separated by four blank columns. The grid is 10 columns wide and 4 rows high.

An equal sign behind a formula is always assigned to the previous formula, even if the distance to the formula is greater than the column space setting. In the example right, the distance of the equal sign is up to eight columns, although the minimum distance is only four columns.



A grid showing multiple mathematical expressions with results. The grid is 10 columns wide and 10 rows high. The expressions are written in a single row, with results displayed in the following rows. The expressions are: $C1 = \frac{1}{2\pi f_H Z\sqrt{2}} = 5.024 \cdot 10^{-6}$, $L1 = \frac{Z\sqrt{2}}{2\pi f_H} = 643.1 \cdot 10^{-6}$, $C2 = C1 = 5.024 \cdot 10^{-6}$, $L2 = L1 = 643.1 \cdot 10^{-6}$, and $C3 = \frac{1}{2\pi f_L Z\sqrt{2}} = 17.58 \cdot 10^{-6}$.

Close proximity can cause unexpected errors. For error localization **RedCrab** marks the cell where an error is detected with a blue frame. It also marks the incorrect formula with a red frame. In the example below, an invalid assignment is signaled. The red box shows, however, that two formulas were joined because the distance is too close. The setting in this example is 4 columns; the distance between the formulas is only 2 columns.



1.1.1 Start Calculation

Start the calculation with a click on the Enter button or press **F8** or **Ctrl + Enter** keys.

Reset clears the displayed results. Clear clears the worksheet complete. The Stop symbol terminated a running calculation. But this is only in the calculation of large data fields of importance.



1.2 Simple Addition

1. Enter the expression $17 + 4$
2. For result press **Ctrl + Enter**

The **Ctrl + Enter** key starts **RedCrab** and displays the result. Alternatively, click the function panels **Enter** button. Results are always displayed in blue.

The display shows: $17 + 4 = 21$

Variable and Values

1. Enter the expression $17 + 4 + X$
2. Enter the assignment $X = 43$
3. For result press **Ctrl + Enter**

RedCrab displays the result: 64

The display shows: $17 + 4 + X = 64$
 $X = 43$

The assignment can be entered at any position.

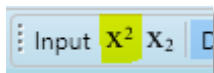
1.3 Exponent

The expression: $c = a^2 + 4^2$.

1. Enter the expression: $c = a$ **Ctrl** + 2 + 4 **Ctrl** + 2 =
2. Press **Ctrl** + **Enter** to display result.

The display shows: $c = 3^2 + 4^2 = 25$

The keys **Ctrl**+2 write the exponent 2. With the keys **Ctrl**+3 you can write the exponent 3.



For use of any other values for exponents, press the **Ctrl**+6 keys or click the **Superscript** Button to enter the **Super** mode. Then enter the exponent value. Press **Ctrl**+6 or **Enter** or click the **Superscript** Button to leave the super mode.

Key functions:

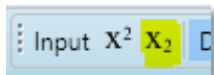
- Function key **Ctrl** + 6 enabled / disabled **Superscript** mode
- Function key **F3** enabled / disabled **Superscript** mode.
- The **Enter** key leaves the Superscript mode.

If you activate Superscript when the cursor is over a character, or a range is selected, the character under the cursor or the selected range changed from normal letters in superscript. The **Superscript** mode is not enabled in this case, only the sign is changed. Similarly, the character can be reset by **Superscript** in normal font.

1.4 Subscript

Enter the formula: $X_L = 2 * 628$

Press the keys: X **Ctrl**+ _ **L** **Enter** = $2 * 6_2 8 =$



With the keys **Ctrl**+ _ (**underscore**) you can switch **Subscript** on / off. Alternative you can use **Enter** to leave the **Subscript** region.

Key functions:

- The **underscore**_ key and **Ctrl** + _ (**underscore**) toggles **Subscript** too.
- **Subscript** mode can be enabled / disabled using the function key **F4**.
- The **Enter** key leaves the **Subscript** mode.

If you activate **Subscript** when the cursor is over a character, or a range is selected, the character under the cursor or the selected range changed from normal letters in subscript. The **Subscript**

mode is not enabled in this case, only the sign is changed. Similarly, the character can be reset by *Subscript* in normal font.

Instead of using the keyboard, you can activate the subscript mode with a click on the *Subscript* button on the *Input* toolbar.

1.5 Alternative Font

Enter the formula: $\omega = 2 * \pi * f$

The *Ctrl* key shifts the letters to the alternative font. The example above shows that the keys *Ctrl + P* displayed the Hellenic letter *Pi* (π).

For a complete list of special symbols, you can refer to the description of the keyboard below. If you work with RedCrab, the simplest way is to open the virtual keyboard with a click on the *Virtual keyboard* button on the *Tools* menu ribbon.

1.6 Implied Multiplication

Enter the formula: $\omega = 2 \pi f$

The example above show one more features of RedCrab: the *implied multiplication*. That means you do not need to include the multiplication operator

Example: *RedCrab* interprets $\omega = 2 \pi f$ as $\omega = 2 * \pi * f$

A space is required between the names of the variables. Related letters are interpreted as one word.

Example: $a \ b \ c$ is equivalent to $a * b * c$

$3 \ a \ b$ is equivalent to $3 * a * b$

$2X_L$ is equivalent to $2 * X_L$

$R_1 \ R_2$ is equivalent to $R_1 * R_2$

1.7 Fractions

Entering a fraction line: Press the *Slash* key (/) two times and a three-character fraction bar will be displayed. By repeatedly pressing the key the fraction bar is extended by one character. In general, it is sufficient if you continue entering data above and below the fracture line. When typing the numerator or denominator data, the fraction bar is automatically extended by the

editor as far as it is required.

If you have taken the fraction line, the cursor is in the first column after the line. Press in this position **Enter** key, the cursor moves over the slash to the first position of the numerator. After entering the numerator, press again **Enter**, the cursor jump to the first position of the Denominators. After entering the data, press **Enter** again. The cursor jumps back into the column right of the fraction line.

! The fraction bar must exceed at least 1 character front and rear.

Examples:

$\frac{123}{abc}$ wrong

$\frac{123}{Abc}$ correct

The display shows:

$$f = \frac{1}{2\pi\sqrt{LC}} = 2.6 \cdot 10^3$$
$$L = 0.8 \cdot 10^{-3}$$
$$C = 4.7 \cdot 10^{-6}$$

1.8 Root

Set the root character with the keys **CTRL+I** to the desired position. Then mark the area which is to be included under the root. Finally set the cursor on the root of character, the editor draws the root symbol over the marked area.

For one-line root calculation, the following steps apply:

1. Set root symbol with **CTRL+I**.
2. Enter the data
3. Holding down the Shift key and with **Cursor-left** key reposition to the root sign.

The editor draws the root symbol over the marked area.

For multi-line data in the root (e.g., fractions):

1. Set root symbol with **CTRL+I**.
2. Data entry.
3. Mark the area for the root with the mouse.
4. Click the mouse on the root symbol.

The editor draws the root symbol over the marked area.

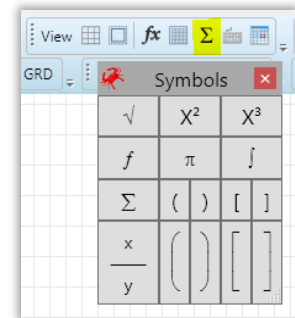
In order to highlight the area, it is sufficient if the last column under the root is marked.

To change the area under the root, highlight, as described above, the new field and then click the cell of the root sign. The roots then marked the new area.

By double-clicking on the root symbol the root lines around the data is removed.

1.9 Symbol Panel

Instead per keyboard you can insert the special symbols per mouse click. To do that, open the **Symbol** panel with a click on the **Tools** menu ribbons **Symbol pad** button.



1.10 Hexadecimal, Octal and Binary Input

The **RedCrab** editor accepts input of hexadecimal numbers up to 13 digits. The hexadecimal number must mark with a dollar symbol before it. The use of small or capital letters are allowed.

Example: \$1F2A or \$1f2a

An octal number is marked with the dollar symbol and the letters **oct**.

Example: \$oct3721

A binary number is marked with the dollar symbol and the letters **bin**.

Example: \$bin110101

You can use hexadecimal, octal or binary numbers in any position of a formula like decimal numbers. Between this number and the following number or variable must be a space or operator symbol.

Example: Correct: \$1F2A*X or \$1F2A X
Wrong: \$1F2AX => generate an error message.

1.11 Operators

RedCrab enable you to enter numbers and functions in a simple, straightforward sequence. The table below shows the order in which functions in expressions are entered and evaluated.

- 1 SIN(), NOT(), root... and all functions left of the argument
- 2 X^2 , .. ,
- 3 join
- 4 *, /, DIV, MOD, AND, SHL, SHR, INCL, EXCL,
- 5 +, -, OR, XOR

Within a priority group, **RedCrab** evaluates functions from left to right. Calculations within a pair of parentheses are evaluated first.

1.12 Variable Overload

You can assign different values to the same variable.

Example: $P = U \cdot I =$
 $P = U^2 / R =$

But an overloaded variable has no defined value and can't be used for further calculations or result boxes.

Overloaded constants can be reused. Example: the constant *e* is occupied by the **Euler** number *e* = **2.7182818**. You can overload this value and use *e* for further calculations.

Example 1: $x = e = 2.7182818$

Example 2: $e = 11$
 $X = 2e = 22$

Predefined Values

e	Eulerscher Number: 2.7182818284590452...
π	PI : 3.1415....
TRUE	1
FALSE	0
NIL	undefined

IPRE	360
------	-----

1.13 Data Fields

The following section describes how to work with dynamic data fields. *RedCrab* can manage multi-dimensional fields. Size and dimensions are limited by the resources of the computer only.

The handling of the fields corresponds to the simple variables. That means no special declaration of variables is required. To generate a field, a sequence of numbers is assigned to a variable. The sequence is written in square brackets and separated by commas.

Example: $x = [1, 3, 7, 12]$

The assignment of a series shows the following example. It will be assigned to the variable x 180 indices with the values 1 to 180.

Example: $x = [1..180]$

A series is always expanded in increments of ± 1 . Other step sizes can multiply or divide by the field generated, or in definition of data fields you can optionally specify the increment of a range (example 2).

Example 1: $x = 5[0..4] = 0 \quad 5 \quad 10 \quad 15 \quad 20$
 $x = [0..5]/5 = 0 \quad 0.2 \quad 0.4 \quad 0.6 \quad 0.8 \quad 1$
 $x = 5/[1..5] = 5 \quad 2.5 \quad 1.67 \quad 1.25 \quad 1$
 $x = 2[5..0] = 10 \quad 8 \quad 6 \quad 4 \quad 2 \quad 0$

Example 2: $x = [2..5:0.75] = 2 \quad 2.75 \quad 3.5 \quad 4.25 \quad 5$

Series, individual values and variables can be combined.

Example: $x = [1, 5..8, 12, 15] = 1 \quad 5 \quad 6 \quad 7 \quad 8 \quad 12 \quad 15$

Example: $a = 3$
 $b = 12$
 $x = [1, a..5, b] = 1 \quad 3 \quad 4 \quad 5 \quad 12$

Fields are treated as normal values in calculations and can be combined with all operators and functions. The result is a field as well.

Example: $[2, 4, 7] + 10 = 12 \quad 14 \quad 17 \quad (2+10 \quad 4+10 \quad 7+10)$

Example: $\sin([30, 60, 90]) = 0.5 \quad 0.87 \quad 1$

Example: $[12, 18, 36, 44] \bmod 10 = 2 \quad 8 \quad 6 \quad 4$

Example: $C = 4.6 \cdot 10^{-6}$
 $f = [1200, 1600, 2000, 2600]$

$$X_C = \frac{1}{2\pi f C} = \begin{matrix} 28.2 & 21.2 & 16.9 & 13 \end{matrix}$$

The example above shows a list as a result, which contains four different values of f .

Individual components of a field can be accessed via the index.

Example: $x = [11..20]$
 $y = x[1, 4, 6..8] = \begin{matrix} 11 & 14 & 16 & 17 & 18 \end{matrix}$

1.14 Multidimensional Fields

To generate multi-line fields, separate each row by semicolon.

Example: $x = [1, 2, 3; 4, 5, 6] = \begin{matrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{matrix}$

If rows have different length, the missing indexes are filled with zeros.

Example: $x = [1..5; 2, 4, 6; 3..9] = \begin{matrix} 1 & 2 & 3 & 4 & 5 & 0 & 0 \\ 2 & 4 & 6 & 0 & 0 & 0 & 0 \\ 3 & 4 & 5 & 6 & 7 & 8 & 9 \end{matrix}$

Fields with three rows can be written alternative with a large bracket.

Example: $x = \begin{bmatrix} 1, 2, 3 \\ 4, 5, 6 \\ 7, 8, 9 \end{bmatrix} = \begin{matrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{matrix}$

This standard is generally used in matrix notation, but has no effect on the following calculations. For multiplication of matrices, refer to section below **Mulx** function.

By entering the data, as described above, one-and two-dimensional fields are generated. Fields with three or more dimensions can be generated computationally.

1.15 Work with Fields

Two fields can be operands of a mathematical expression when the fields are of the same type. This means they must have the same size and number of dimensions. An exception is different length in the first dimension. The excess of the longer field are ignored.

Example: $a = [2, 3, 4, 5]$
 $b = [10, 11, 12, 13]$
 $c = a + b = \begin{matrix} 12 & 14 & 16 & 18 \end{matrix} \quad (2+10 \ 3+11 \ 4+12 \ 5+13)$

Example: $a = [2, 3, 4, 5]$
 $b = [10, 11, 12, 13, 14, 15]$
 $c = a + b = \begin{matrix} 12 & 14 & 16 & 18 \end{matrix}$

Excess field length of ***b*** (14,15) is ignored.

Example: $a = [2..5; \ 20..23]$
 $b = [10..13; \ 30..33]$
 $c = a + b = \begin{matrix} 12 & 14 & 16 & 18 \\ 50 & 52 & 54 & 56 \end{matrix}$

Example: $a = [2..5; \ 20..23]$
 $b = [10..13; \ 30..33; \ 40, 44, 45, 48]$
 $c = a + b = \begin{matrix} 12 & 14 & 16 & 18 \\ 50 & 52 & 54 & 56 \end{matrix}$

In this example, the third row of ***b*** is ignored

Example: $a = [2..5; \ 20..23]$
 $b = [10..13; \ 30..33; \ 40, 44, 45, 48]$
 $c = a + b[1, 3] = \begin{matrix} 12 & 14 & 16 & 18 \\ 60 & 65 & 67 & 71 \end{matrix}$

In this example, ***a*** from row 1 is added with ***b*** from row 3

In the examples above, each index of ***a*** is added with the corresponding index of ***b***. Alternatively ***RedCrab*** can calculate fields in which each index of an field ***a*** is calculated with each index of the field ***b***. The result is a multidimensional field of the size indices ***a*** times indices ***b***.

The empty brackets following ***c*** declares the result as a multidimensional field and determines the type of the following calculation.

Example: $a = [10, 15]$
 $b = [2..4]$
 $c[] = a+b = \begin{matrix} 12 & 13 & 14 & (10+2 \ 10+3 \ 10+4) \\ 17 & 18 & 19 & (15+2 \ 15+3 \ 15+4) \end{matrix}$

Example: $a = [3..6]$
 $b = [11..15]$

$c[] = a * b =$	33	36	39	42	45
	44	48	52	56	60
	55	60	65	70	75
	66	72	78	84	90

The next example shows to multiply a one-dimensional field by a two-dimensional field. The result is a three-dimensional field.

Example: $a = [3..6]$
 $b = [11..15]$
 $c[] = a * b$

$d[] = a * c =$	99	108	117	126	135
	132	144	156	168	180
	165	180	195	210	225
	198	216	234	252	270

The display above shows the two-dimensional field of the first level. This is the field that lies behind the first row. Other fields can be accessed via index.

Example: $d[2] =$

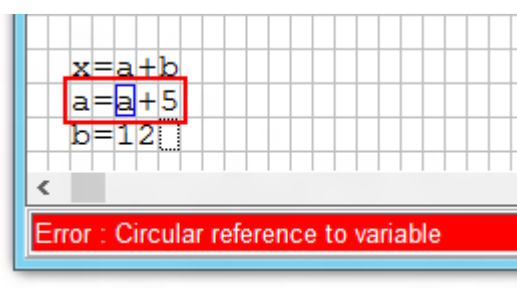
132	144	156	168	180
176	195	208	224	240
220	240	260	280	300
264	288	312	336	360

The following example shows reading of a single cell from a multi dimensional field. b is the value of the cell in the second row and the third column of a . The apostrophe is the delimiter.

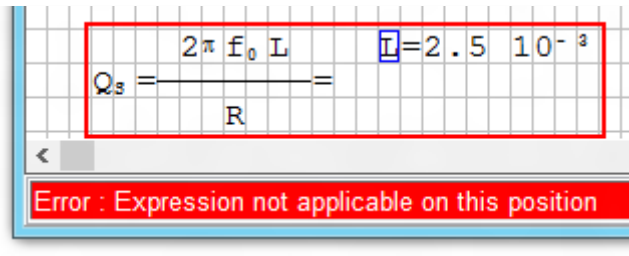
Example: $b = a [2'3]$

1.22 Error Messages

For error location RedCrab marks the cell in where an error is detected with a blue frame. It also marks the incorrect formula with a red frame.



The marking of the entire formula simplifies the localization of errors that cause a false positioning. In the example below, an invalid assignment is signaled. The red selected box indicates, however, that two formulas were joined because the distance is too close. In this example the adjustment of the distance (column space) is 4 columns; the distance between the formulas is only 2 columns.



2.0 Functions and Operators

The following section describes the RedCrab Math functions and text operators. All the functions can be entered per mouse click on the function panel or via the keyboard. The function panel includes tool tips with short description and examples for all functions.

The panel's button size can be changing with the mouse wheel.

7.1 Standard Functions

Abs *Abs* returns the absolute value of numbers and fields.

Example: $x = \text{Abs}(y)$

$X = \text{abs}(4.56) = 4.56$

$X = \text{abs}(-4.56) = 4.56$

Ceil Returns the smallest integer that is not less than the argument.

Example: $\text{ceil}(-2.3) = -1$

$\text{ceil}(2.5) = 3$

DTime The function *DTime* returns the *DateTime* value of the given year, month, day, hour, minute and second. The argument must be a data field that includes six cells which contains the value of year, month, day, hour, minute and second.

The year must be between 1 and 9999.
Valid Month values are 1 through 12.
Valid Hour values are 0 through 23.
Valid Min and Sec values are 0 through 59.

Valid Day values are 1 through 28, 29, 30, or 31, depending on the Month value.
For example, the possible Day values for month 2 (February) are 1 through 28 or 1 through 29, depending on whether or not the Year value specifies a leap year.

Example: `d = dttime([Y, M, D, h, m, s])`

A call of ***DTime*** with the argument ***0*** returns the current date and time.

Example: `current = dttime(0)`

DTimef The function ***DTimef*** returns a data field that includes six cells which contains the value of year, month, day, hour, minute and second of the arguments ***DateTime*** value.

Example `dttimef(d) = 2012 4 12 14 27 18`

Floor Returns the largest integer that is not greater than the argument.

Example: `floor(-2.3) = -3`
`floor(2.5) = 2`

Frac Frac returns the fractional part of an argument.

Example: `x = frac(y)`
`X = frac(4.67) = 0.67`

Int ***Int*** returns the integer part of a value; that is, the value rounded toward zero.

Example: `x = int(y)`
`X = int(4.67) = 4`

Rnd ***Rnd*** returns a random integer number within the range $0 \leq X \leq \text{Range}$.

Example: `x = rnd(y)`

Round ***Round*** returns a value rounded to the nearest whole number.

Example: `x = Round (y)`

`round (2.6) = 3`

`round (3.5) = 4`

`round (2.5) = 2`

If *y* is exactly halfway between two whole numbers, the result is always the even number. This method of rounding is often called "Banker's rounding".

Sign Returns a value indicating the sign of a number.

1: value is greater than zero.

0: value is equal to zero.

-1: value is less than zero.

Sqr The ***Sqr*** function returns the square of the argument.

Example: `sqr (4) = 16`

Sqrt The result of ***Sqrt*** is the square root of the argument.

Example: `sqrt (4) = 2`

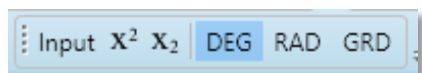
URnd ***URnd*** fills a field with a series of random numbers between 0 and the highest argument of the field. In contrast to ***Rnd***, which also can be used for fields, ***URnd*** returns a set of unique numbers.

Example: `a = urnd ([1..5, 45])`
 `B = urnd ([44..45])`

Both examples return a list of six different numbers between one and 45.

2.2 Scientific Functions

The buttons *Degree*, *Radian* and *Gradient* in the *Input* toolbar determine whether the parameters of trigonometric functions be specified in degrees, radian or grads.



<i>ACos</i>	inverse cosine
<i>ASin</i>	inverse sine
<i>ATan</i>	inverse tangent
<i>Cos</i>	cosine
<i>Cosh</i>	hyperbolic cosine
<i>Cot</i>	cotangent
<i>Deg</i>	converts radian in degrees
<i>Exp</i>	exponent to Euler's constant: 2.7182818284590452...
<i>Ln</i>	natural logarithms to base e (2.7182818284590452...)
<i>Log</i>	logarithms base 10
<i>Log2</i>	logarithms base 2
<i>Log8</i>	logarithms base 8
<i>Log16</i>	logarithms base 16
<i>Rad</i>	convert degrees in radians
<i>Sin</i>	sine
<i>Sinh</i>	hyperbolic sine
<i>Tan</i>	tangent
<i>Tanh</i>	hyperbolic tangent

Alternated notations (enter only with keyboard)

Ld logarithms base 2 (equal to log2)

Lg logarithms base 10 (equal to log)

Log10 logarithms base 10 (equal to log)

2.3 Programmer Functions and Operators

And The logical ***And*** operator performs bitwise AND manipulation on integer operands

Example: $Z = X \text{ and } Y$

Div The ***Div*** operator returns the result of an integer number division without remainder. If floating point numbers are entered, the ***Div*** operator cuts off all digits after the decimal point before executing the division ***Div***.

Example: $11 \text{ div } 3 = 3$
 $11.2 \text{ div } 3.9 = 3$

Excl clears the bit from the first argument, which is determined in the second argument.

Example: $Z = \text{excl}(X, Y)$

In the example above ***Excl*** clears the bit number ***Y*** in argument ***X***

Example: $\text{excl}(15, 4) = 7$

Incl sets the bit from the first argument, which is determined in the second argument.

Example: `Z =incl(X, Y)`

In the example above ***Incl*** sets the bit number *Y* in argument *X*

Example: `incl(8, 3) = 12`

Mod The ***Mod*** operator returns the remainder of the division of two integer numbers. If floating point numbers are entered, the ***Mod*** operator cuts off all digits after the decimal point before executing the division ***Mod***.

Example: `11 mod 3 = 2`
`11.7 mod 3.9 = 2`

Not The logical ***Not*** function performs bitwise negation on integer operands.

Example: `Z = not(X)`

Or The logical ***Or*** operator performs bitwise OR manipulation on integer operands.

Example: `Z = X or Y`

Shl performs an arithmetic left shift on a bit pattern. The value of *Y* is interpreted modulo 32. Thus for example, if *X* is 40, *X* is interpreted as 8.

Examples: `Z = shl(X, Y)`
`shl(9, 2) = 36`

Shr performs an arithmetic right shift on a bit pattern. The value of *Y* is interpreted modulo 32. Thus for example, if *X* is 40, *X* is interpreted as 8.

Examples: `Z = shr(X, Y)`
`shr(8, 2) = 2`

Xor The logical ***Xor*** operator performs bitwise XOR manipulation on integer operands.

Exemple: `Z = X xor Y`

4.4 Data Fields Functions

Aver The function ***Aver*** returns the mean values of successive elements of fields. The result is always one element smaller than the original field.

Example: `a = [1..5]2 = 1 4 9 16 25`
 `b = aver(a) = 2.5 6.5 12.5 20.5`

Cols The function ***Cols*** returns the number of columns of a two dimensional data field.

Example: `x = [1..4; 12..15]`
 `c = cols(x) = 4`

Count Return the number of elements of one- or multidimensional fields.

Example: `z= count(x)`
 `x= [9, 7, 2, 8, 12, 3, 5]`
 `count(x) = 7`

Diff Calculates the difference values of successive of a set of numbers

Example: `diff([2, 5, 9, 11]) = 3 4 2`

Dim returns the number of dimensions of a multi dimensional data field.

Example: `X = [1..4; 12..15]`
 `dim(x) = 2`

Fill fills the data field of the first argument with the value of the second argument.

Example: `x = fill([1..5], 8) = 8 8 8 8 8`

Join

connects 2 one or two-dimensional fields with each other.

Example: a = [1..5] = 1 2 3 4 5
 b = [6..10] = 6 7 8 9 10

 c = join(a, b) = 1 2 3 4 5
 6 7 8 9 10

If the fields are different lengths, the shorter field is filled with zeros.

 x = [11..18] = 11 12 13 14 15 16 17

 d = join(x, c) = 11 12 13 14 15 16 17
 1 2 3 4 5 0 0
 6 7 8 9 10 0 0

Maxi

returns the greatest value of the argument list.

Example: z = maxi(x)
 X = [9, 7, 2, 8, 12, 3, 5]
 maxi(x) = 12

Mini

returns the smallest value of the argument list.

Example: z = mini(x)
 X = [9, 7, 2, 8, 12, 3, 5]
 mini(x) = 2

Patt

fills the data field of the first argument with the pattern of the second argument.

Example:
x = patt([1..10], [1,1,2])=1 1 2 1 1 2 1 1 2 1

Rows

returns the number of rows of a two dimensional data field.

Example: x = [1..4; 12..15]
 r = rows(x) = 2

2.5 Matrix Functions

Det returns the determinant of a 2x2 or 3x3 matrixes. More information of determinants can be found at:

Example: `d = det(A)`

Invx inverse a 2x2 or 3x3 matrix. If the matrix is not invertible, **RedCrab** displayed an error message.

Example: `A1 = invx(A)`

Mulx **Mulx** is an operator for multiplication of matrices. Multiplication of two matrices with **Mulx** is possible only if the number of columns of the left matrix is the same as the number of rows of the right matrix.

Example:
$$\mathbf{x} = \begin{bmatrix} 1, 2, 3 \\ 4, 5, 6 \\ 7, 8, 9 \end{bmatrix} \text{ mulx } \begin{bmatrix} 2, 4 \\ 3, 5 \\ 6, 8 \end{bmatrix} \quad \begin{bmatrix} 26 & 38 \\ 59 & 89 \\ 92 & 140 \end{bmatrix}$$

The result is a matrix whose entries are given by dot product of the corresponding row of the left operand and the corresponding column of the right operand:

$$\begin{array}{ll} (1*2 + 2*3 + 3*6) & (1*4 + 2*5 + 3*8) \\ (4*2 + 5*3 + 6*6) & (4*4 + 5*5 + 6*8) \\ (7*2 + 8*3 + 9*6) & (7*4 + 8*5 + 9*8) \end{array}$$

Trans producing the transpose of a matrix A^T , which is computed by swapping columns for rows in the matrix **X**.

Example:
$$\mathbf{x} = \begin{bmatrix} 1, 2, 3 \\ 4, 5, 6 \\ 7, 8, 9 \end{bmatrix}$$

$$\text{Trans}(\mathbf{x}) = \begin{bmatrix} 1 & 4 & 7 \\ 2 & 5 & 8 \\ 3 & 6 & 9 \end{bmatrix}$$

7.6 Statistics Functions

CuSum returns the calculation of a cumulative sum of one- dimensional fields.

Example: `z = cusum(x)`
 `cusum([2,4,7,3,9]) = -3 -4 -2 -4 0`

DSort sorts field elements from high to low values (sort descending). Complex fields are sorted based on first row values. For *sort ascending* see ***Sort*** below.

Example: `z = dsort(x)`

LQuart returns the value of the first quartile (lower quartile) of a sorted list. In the following example in a field of 10 elements, the position of the first quartile is $(10 \times \frac{1}{4}) = 2.5$, rounded up to 3.

Example:
`lquart([3,6,7,8,8,10,13,15,16,20]) = 7`

See ***UQuart*** and ***QRan*** below.

Mean returns the mean value of fields. In multidimensional fields the result is the mean of all elements.

Example: `z = mean(x)`

Median returns the median value of fields. In multidimensional fields the result is the median of all elements.

Example: `z = median(x)`

Prod returns the product of all elements of fields.

Example: `z = prod(x)`
 `x = [9,7,2,8,12,3,5]`
 `prod(x) = 181440`

QRan results the area from the first to 3rd quartiles of a sorted list. The following example shows the result of a field with 10 elements.

Example:

```
qran([3,6,7,8,8,10,13,15,16,20])=7 8 8 10 13 15
```

Sort sorts field elements from low to high values (sort ascending). Complex fields are sorted based on first row values.

For *sort descending* see ***DSort*** above.

Example: `z = sort(x)`

SStDev returns the standard deviation of values in one-dimensional fields. Use ***SStDev*** if the field contains sample data. If the field contains all evaluated data, see ***StDev*** below.

Example: `z = sstdev(x)`

StDev returns the standard deviation of values in one-dimensional fields. Use ***StDev*** if the field contains all evaluated data. If the field contains samples, see ***SStDev*** above.

Example: `z = stdev(x)`

Sum returns the sum of the elements in fields. The function can be called by the Greek letter Σ .

Example: `z = sum(x)`
 `X = [9,7,2,8,12,3,5]`
 `sum(x) = 46`

SVari returns the variance of values in one-dimensional fields. Use ***SVari*** if the field contains sample data. If the field contains all evaluated data, see ***Vari*** below.

Example: `z = svari(x)`

UQuart returns the value of the third quartile (upper quartile) of a sorted list. In the following example, in a field of 10 elements the position of the third quartile is $(10 \times \frac{3}{4}) = 7.5$, rounded up to 8.

Example: `UQuart([3,6,7,8,8,10,13,15,16,20])=15`

See Lquart and QRan above.

Vari returns the variance of values in one-dimensional fields. Use ***Vari*** if the field contains all evaluated data. For samples see ***SVari*** above.

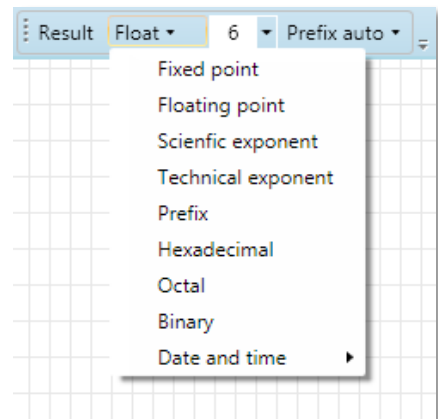
Example: `z = vari(x)`

3.0 Result Formatting

The tool bar ***Result*** contains the settings for the result format.



The first menu button on the top row sets the display format. You can choose between fix point, floating point, scientific exponent, technical exponent, prefix, hexadecimal, octal, binary or date time.



3.1 Result Mode Prefix

In ***Prefix*** mode the math boxes used SI prefixes instead of exponents. For example, an electrical current of 0.001ampere, or 10^{-3} of an ampere, is written by using the SI-prefix ***m*** (mill) as 1 mill ampere or 1mA. The SI prefixes are standardized by the International Bureau of Weights and Measures (IBWM).

The list below shows the prefixes which RedCrab used.

Y	Yotta	10^{24}	1.000.000.000.000.000.000.000.000	Quadrillion
Z	Zetta	10^{21}	1.000.000.000.000.000.000.000	Trilliarde
E	Exa	10^{18}	1.000.000.000.000.000.000	Trillion

P	Peta	10^{15}	1.000.000.000.000.000	Billiarde
T	Tera	10^{12}	1.000.000.000.000	Billion
G	Giga	10^9	1.000.000.000	Milliarde
M	Mega	10^6	1.000.000	Million
k	Kilo	10^3	1000	Tausend
x	-	-	1	Eins
m	Milli	10^{-3}	0,001	Tausendstel
μ	Mikro	10^{-6}	0,000.001	Millionstel
n	Nano	10^{-9}	0,000.000.001	Milliardstel
p	Piko	10^{-12}	0,000.000.000.001	Billionstel
f	Femto	10^{-15}	0,000.000.000.000.001	Billiardstel
a	Atto	10^{-18}	0,000.000.000.000.000.001	Trillionstel
z	Zepto	10^{-21}	0,000.000.000.000.000.000.001	Trilliarstel
y	Yokto	10^{-24}	0,000.000.000.000.000.000.000.001	Quadrillionstel

3.2 Specification of a Prefix

If the result of an expression is the distance between two points, the control symbols, #m' displays the result in meters (m).

Examples:

Result: 365	Display: 365m
Result: 3600	Display: 3 . 6km
Result: 3650000	Display: 3 . 65Gm

The displayed result: 3.65Gm (Giga meter) is correct, but unusual. Therefore, in **RedCrab** you can preset certain prefixes with the **Prefix** menu. For example, if you choose the prefix k (kilo) the result is displayed as below.

Examples:

Result: 365	Display: 0 . 365km
Result: 3600	Display: 3 . 6km
Result: 3650000	Display: 3650km

RedCrab also has the option to select a group of prefixes or to determine an upper or lower limit. To do this, press the **Ctrl** key and select the lower limit in the **Prefix** menu. Then hold the **Ctrl** key and select the upper limit in the **Prefix** menu. The example below shows results with the limits m (mill) and k (kilo).

Example:

Result: 3650000	Display: 3 650 km
Result: 36500	Display: 36.5 km
Result: 365	Display: 365 m
Result: 3.65	Display: 3.65 m
Result: 0.0365	Display: 36.5 mm
Result: 0.000365	Display: 0.365 mm

3.3 Number of Decimal Places



The combo box **digit** determines the number of decimal places to display. In fixed-point mode the combo box sets the number of decimal places to the right of the point. When floating point values are displayed, the setting determines the number of digits without exponents.

3.4 Display Tables

Like all results, tables are displayed to the right of the equal sign. If necessary, the worksheet will automatically enlarge. If the required space on the worksheet is not empty, the table in a separate box is displayed which is placed on the worksheet.

The separate Box has a slightly offset and a border is displayed when you click on the table. The separate box has a popup menu which you can use to display the table in a separate scrollable window.

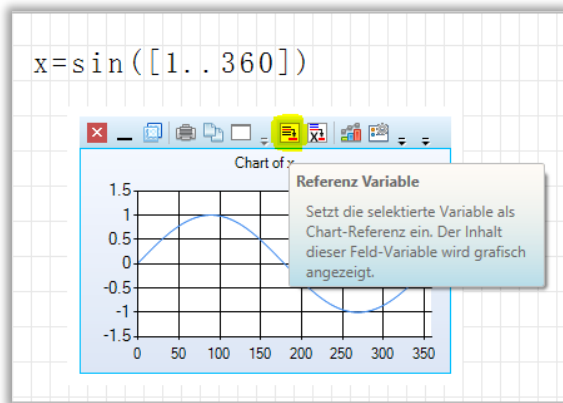
For large tables, the display in a separate box with a new window is preferred. You can force the display in a separate box by writing a colon following the equal sign.

4.1 Display Results Graphically with Charts



RedCrab provides chart boxes to display results graphically. To open a chart box, select a range on the worksheet with the mouse pointer and click the **New Chart box** button. Later you can change the size and the position of the box with the mouse pointer.

To make a reference to a variable, position the cursor per mouse click on the variable; then click the button **Reference variable** (RedCrab^{PLUS} only) or click the item on the chart popup menu.



5.2 Chart Options

To choose the following chart options, use the chart box popup menu or the tool bar buttons by RedCrab^{PLUS}.

Show legend switches the legend to the state show or hide.

3D chart area displays the chart area in 3D-design

Show labels shows labels with decimal values

Show axis switches the axis in show or hide mode

Background selects the chart box background

Flat displays the chart box with a white background without frame

Single border displays the chart box with a white background and a small frame

Color displays the chart box with a single-colored background and a small frame

Default displays the chart box with default color background and a small frame

Undocked displays the chart box in a separate window

4.2 Text Box

RedCrab provides inserting of text into your worksheet. To create a text box, first select a range on the worksheet and click the button **New text box** on the **Insert** tool bar. The procedure is identical to the creation chart box.



If you want to load a text file to your worksheet, click the **Open text file** button. **RedCrab** create automatically a new text box to display the file.



4.3 Insert Pictures

For complex technical calculations, it might be useful to include pictures to mathematical formulas. **RedCrab** supports insert of images in any position on the worksheet.

Click the button **Image from clipboard** to paste an image from the clipboard.



Alternate you can load image files into the worksheet. To do this, open the image file browser with a click on **Open image file** button. Then select the image file. **RedCrab** can import the image formats Windows Bitmap (*. *bmp*) *.*jpg*, *.*gif*, *.*png* and *.*tif*.



4.4 Insert Label

RedCrab supports the creation and formatting of labels. Labels can be positioned in chart and image boxes. They can display text or results of calculations. Labels can display single values, but not data fields.

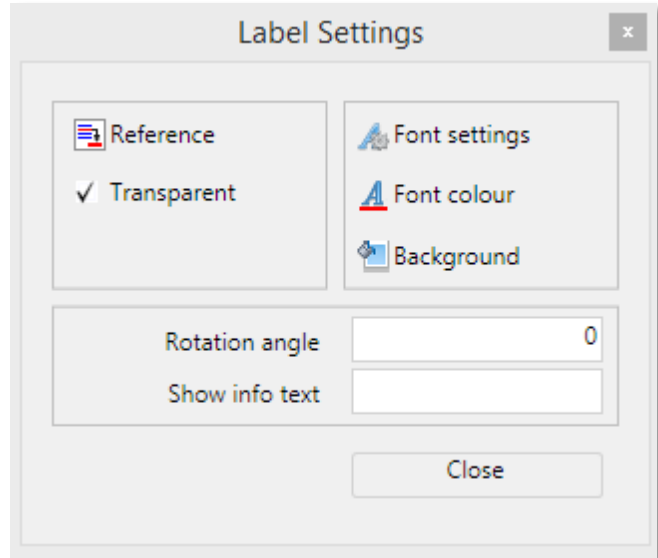


To create a label, first choose the target chart or image box with a mouse click. Then click the button **New Label**. Finally drag the label with the mouse to the desired position.

Double click the label to open a dialog window to enter label settings.

If you want to display a text label, write the text in the editor row next to **Show info text**. Terminate the text with **Enter**. The size of the label automatically adapts to the content.

If the label is to display the result of a calculation, you must connect the desired variable to the label. Place the cursor on the reference variable. Then click the **Reference** button.



Additional settings

Transparent displays the background transparent

Background opens a dialog box to choose the background colour

Font settings open a dialog box for font settings

Font colour opens a dialog box to choose the font colour

Rotate rotates the label. Input the rotation in degree to the editor box beside **Rotation angle**.

5.0 Toolbar

5.1 Page Lock

Page Lock blocks the editor's page for additional entries. This function protects unintentional changes made. For data input, cells can be unlocked with **Unlock Cell**.



5.2 Cell Unlock

The **Cell unlock** button unlocks cells in a locked page for data entry. Select the cells by mouse, and then click **Unlock Cell**. The unlocked fields are marked with an underscore.

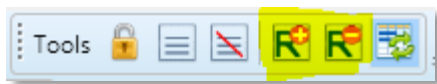
Reset the remark function above with the **Reset Cell** button by using the same step



5.3 Remark

With the **Set remark** (R+) button mark selected text in the worksheet as a comment. This function can be performed with the function key F2. Comments are ignored by the calculator. The selected data is displayed in green.

The button **Clear remark** (R-) undoes the remark function above by using the same step.



5.4 Autocalc

If **Autocalc** option is set, the calculator start a new calculation if you enter an equal symbol

5.5 Tooltip Language

The Item **Tooltip language** in the menu **Tools** chooses the tool tips language. The language English and German is in **RedCrab** installed. Additional languages can be added with language files.

5.6 Keyboard Settings

With the Item **Keyboard settings** in the menu **Tools** you can select the keyboard.

The keyboard inputs in this description refer to an English keyboard in the country's setting *English-US*. When using another keyboard or regional setting, some functions are acquired with other key combinations.

Attached you will find images about key codes of the alternative keyboards and the occupancy of the *Ctrl* functions.

6.0 View Menu (Toolbar)

Function panel	displays a window that contains the implemented functions.
Number pad	opens a virtual number pad on the display.
Symbol pad	displays a window with a symbol pad.
Virtual keyboard	opens a virtual keyboard.
Show grid	draws a grid on the worksheet.
Show border	draws a border line on all boxes.
Toolbox size	changes the size of the toolbox buttons.

Attachment

Keyboard short cuts

The keyboard inputs in this description correspond to the English keyboard and Windows regional and language option English-US. When using a non-English keyboard or language, some functions are acquired with other key combinations. This concern most of the **Ctrl** key functions. In the attachment of this manual you will find pictures about key codes of different keyboards. Read the description below about keyboard configurations.

You can type in letter of the alternative font by pressing the **Ctrl** key. Example: press **Ctrl+P** to write the character π or **Ctrl+L** to write the letter λ .

Enter	Exit escape mode Exit Superscript Exit Subscript Moves the cursor from end of the fraction bar to numerators first column. Moves the cursor from numerator to denominators first column. Moves the cursor from denominator to end of fraction bar.
Enter + Ctrl	Start calculation and display results.
Enter + Shift	Line feed- return : move the cursor to the first used column in the next row
Alt + Ctrl + O	Open an existing document
Alt + Ctrl + R	Reload the recent file
Alt + Ctrl + S	Save the active worksheet
Alt + Ctrl + Y	Redo - Repeats the last action
Alt + Ctrl + Z	Undo - Reverses the last action
Ctrl + , Ctrl + _	Toggle on / off Subscript
Ctrl + Shift + ,	
Ctrl + 6	Toggle on / off Superscript (exponent)
Ctrl + 9	large round bracket open
Ctrl + 0	large round bracket close
Ctrl + [large square bracket open

Ctrl +]	large square bracket close
Ctrl + Shift + {	large curly bracket open
Ctrl + Shift + }	large curly bracket close
Ctrl + /	fraction line Or //
Ctrl + 1	root
Ctrl + 2	Exponent 2
Ctrl + 3	Exponent 3
Ctrl + 4	Integral Formula
Ctrl + Shift + 4	Integral Symbol
Ctrl + 5	Function Symbol
Insert	Change from overwrite to insert mode
Insert + Ctrl	Inserts a space at the cursor position
Insert + Shift	Inserts a row at the cursor position
Delete	Deletes the character at cursor position If a range is selected, the selected range are deleted
Delete + Shift	Deletes a row at the cursor position
Home	Moves the cursor to the first used column Moves the cursor to the first column
End	Moves the cursor to the last used column Moves the cursor to the last column
Ctrl + Csr left	Reduce box size, deletes the column at the right edge
Ctrl + Csr right	Reduce box size, deletes the column at the left edge
Ctrl + Csr up	Reduce box size; deletes the row at the bottom edge
Ctrl+Csr down	Reduce box size, deletes the row at the top edge
F2	Mark the selected range as remark
F2 + Ctrl	Resets the selected range as remark

F3	Enables or disables the Superscript mode
F4	Enables or disables the Subscript mode
F6	Clears all
F7	Clears the output of the calculator
F8	Starts the calculator

		Shift	Additional functions	
Ctrl + A	α	A	Alpha	
Ctrl + B	β	B	Beta	
Ctrl + C	χ	X	Chi	Copied the selected area *
Ctrl + D	δ	Δ	Delta	
Ctrl + E	ε	E	Epsilon	
Ctrl + F	ϕ	Φ	Phi	
Ctrl + G	γ	Γ	Gamma	
Ctrl + H	η	H	Eta	
Ctrl + I	ι	I	Iota	
Ctrl + J	φ		Phi (alt.)	
Ctrl + J		θ	Theta (alt.)	
Ctrl + K	κ	K	Kappa	
Ctrl + L	λ	Λ	Lambda	
Ctrl + M	μ	M	Mu	
Ctrl + N	ν	N	Nu	
Ctrl + O	\omicron	O	Omicron	
Ctrl + P	π	Π	Pi	
Ctrl + Q	θ	Θ	Theta	
Ctrl + R	ρ	P	Rho	

Ctrl + S	σ	Σ	Sigma	
Ctrl + T	τ	T	Tau	
Ctrl + U	υ	Y	Upsilon	
Ctrl + V	ϖ		Pi (alt.)	Insert text from clipboard **
Ctrl + V		ς	Sigma (alt.)	
Ctrl + W	ω	Ω	Omega	
Ctrl + X	ξ	Ξ	Xi	Cut and copies the selected area *
Ctrl + Y	ψ	Ψ	Psi	
Ctrl + Z	ζ	Z	Zeta	
Decimal key	The decimal key on the numeric keypad produces a decimal point always, regardless of the country setting.			

*) **Ctrl + C** copies the selected area to clipboard. **Ctrl + X** cuts the selected area and copies it to the clipboard. If no area is selected, the corresponding Greek letter is written.

) **Ctrl + V writes the text from the clipboard to the cursor position if, immediately before a text with **Ctrl + C / X** was copied, otherwise the corresponding Greek letter is written.

Text box short cuts

For editing of text the following table shows a list of keyboard instructions.

Keys	Operations
Ctrl + Tab	Tab
Ctrl + Number Pad 5	Select all
Ctrl + A	Select all
Ctrl + E	Center alignment
Ctrl + J	Justify alignment
Ctrl + R	Right alignment
Ctrl + L	Left alignment
Ctrl + C	Copy
Ctrl + V	Paste
Ctrl + X	Cut
Ctrl + Z	Undo
Ctrl + Y	Redo
Ctrl + '+'	Superscript
Ctrl + '='	Subscript
Ctrl + 1	Line spacing = 1 line.
Ctrl + 2	Line spacing = 2 lines.
Ctrl + 5	Line spacing = 1.5 lines.
Ctrl + ' (apostrophe)	Accent acute
Ctrl + ` (grave)	Accent grave
Ctrl + ~ (tilde)	Accent tilde
Ctrl + ; (semicolon)	Accent umlaut
Ctrl + Shift+6	Accent caret (circumflex)
Ctrl + , (comma)	Accent cedilla

Ctrl + Shift + ' (apostrophe) Activate smart quotes

Backspace Delete previous character.

Ctrl + Backspace Delete previous word.

F16 Same as Backspace.

Ctrl + Insert Copy

Shift + Insert Paste

Insert Overwrite

Ctrl + Left Arrow Move cursor one word to the left.

Ctrl + Right Arrow Move cursor one word to the right.

Ctrl + Left Shift Left alignment

Ctrl + Right Shift Right alignment

Ctrl + Up Arrow Move to the line above.

Ctrl + Down Arrow Move to the line below.

Ctrl + Home Move to the beginning of the document.

Ctrl + End Move to the end of the document.

Ctrl + Page Up Move one page up.

Ctrl + Page Down Move one page down.

Ctrl + Delete Delete the next word or selected characters.

Shift + Delete Cut the selected characters.

Ctrl + Shift + A Set all caps.

Ctrl + Shift + L Fiddle bullet style.

Ctrl + Shift + Right Arrow increase font size

Ctrl + Shift + Left Arrow decrease font size

Key Code Configuration

US-English

~ `	1 !	2 @	3 #	4 \$	5 %	6 ^	7 &	8 *	9 (0)	- _	+ =	Backspace
Tab	Q	W	E	R	T	Y	U	I	O	P	{ [}]	 _
Caps Lock	A	S	D	F	G	H	J	K	L	:	"	Enter	
Shift	Z	X	C	V	B	N	M	<	>	? /	1 2	Shift	
Ctrl	Win Key	Alt							Alt	Win Key	Menu	Ctrl	

German

° ^	! 1	" 2	§ 3	\$ 4	∫ 5	% f	& 6	$\frac{1}{2}$ 2	/ 7	{ 8	([)]	= 0	? B	{ [}]	←
↔	Q @	W	E €	R	T	Z	U	I	O	P	Ü	* + ~	↵				
↓	A	S	D	F	G	H	J	K	L	Ö	Ä	' #					
↑	> 	Y	X	C	V	B	N	M μ	;	:	- _	X y	↵				
Strg	(Win)	Alt								Alt Gr	(Win)	(Menu)	Strg				

Italian

! \	1 ✓	2 X ²	3 X ³	£	\$ ∫	% €	& f	/ $\frac{1}{2}$	()	=	?	^	X ^y	Backspace
Tab	Q	W	E €	R	T	Y	U	I	O	P	é { }	* }	Enter	
											è []	+]		
Caps Lock	A	S	D	F	G	H	J	K	L	ç	°	\$		
										ò @	à #	ù		
Shift	>	Z	X	C	V	B	N	M	;	:	- X ^y	Shift		
	<								,	.	- X ^y			
Ctrl	Win Key	Alt								Alt Gr	Win Key	Menu	Ctrl	

Brazil (Portuguese)

"	!	@	#	\$	%	^	&	*	()	-	+	←
'	1	2	3	4	5	6	7	8	9	0	=	1/2	Backspace
Tab	Q	W	E	R	T	Y	U	I	O	P	,	{	Enter
	/	?	€								.	[
Caps Lock	A	S	D	F	G	H	J	K	L	Ç	~	}	
	↑										^]	
Shift		Z	X	C	V	B	N	M	<	>	:	?	Shift
	\			€					,	.	;	/	↑
Ctrl	Win Key	Alt								Alt Gr	Win Key	Menu	Ctrl