RedCrab

Math V

User Manual

RedCrab Math V

Version 5.0

Copyright

Exclusion of liability

An absolute accuracy of the software cannot be guaranteed even with the most careful and extensive testing. In this respect, it assumes no liability for any errors or inaccuracies in the software or the manual.

User license

The program may be used for private use per license in a household up to 3 computers. It may also be used for commercial use per license by one person on two computers.

System requirement

Minimum Pentium P4 and 2 GB RAM.
Operating system: ***Microsoft Windows*** **Vista, W7, W8, W10**
.NET Framework 4.5

No installation of the software is required. RedCrab can also be launched from external devices, e.g. USB stick.

Calculation range and accuracy:

Floating point

Accuracy:	15 – 16 digits
Calculation range:	$\pm 5 \times 10^{-324}$ to $\pm 1.7 \times 10^{308}$

Floating point is due to the large range of values suitable for engineering and scientific calculations.

Decimal

Accuracy: 28-29 digits
Calculation range: -79,228,162,514,264,337,593,543,950,335
to 79,228,162,514,264,337,593,543,950,335

Is approximate -7.9×10^{28} to 7.9×10^{28}

Decimal is suitable due to the small rounding error for financial and monetary calculations.

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RedCrab Math

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.

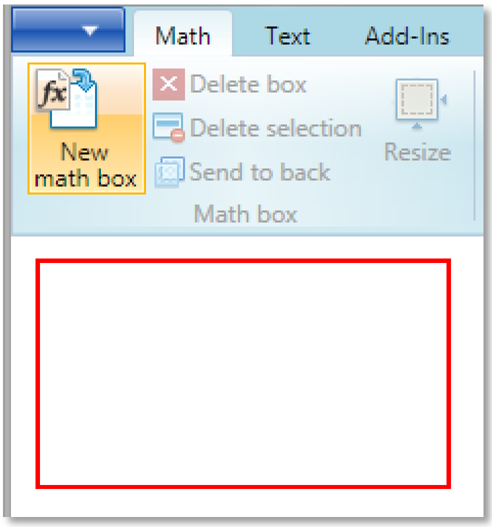
The handling of the basic functions is just like a conventional calculator. No training is required. Whoever can operate a pocket calculator can also use ***RedCrab*** without studying the manual.

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.

1.0 Math Box



To input a mathematical expression, open a calculation sheet (math box) by double-click with the left mouse button on the desired position. It opens a small calculation field that increases automatically when you input the formula.

Alternatively you can open a larger math box. To do this, select an area on the worksheet with the left mouse button and click the New math box button.

With the mouse you can change the math boxes position and size. With the keyboard, you can enlarge the math box if you move the cursor beyond the edge of the box. If you move the cursor from the edge inward while holding down CTRL button, the box is reduced accordingly.

You can write multiple mathematical expressions on one math box, or you can apply separate math boxes for each formula. Each math box has separate settings for input options and output formatting.

The Math box group contains some additional buttons for math box handling.

Delete box deletes the activated box. ***Delete selection*** clears the selected range. ***Send to back*** send the box to the back when it is displayed in front of another box.

To open a math box select an area on the worksheet with the left mouse button and click the ***New math box*** button.

The ***Resize*** button minimizes the math box. To do this, the empty columns on the right and the empty rows at the bottom are removed.

1.1 Mathematical Expressions

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
```

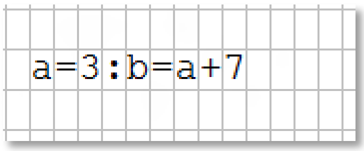
You can write several mathematical expressions on one worksheet. The expressions result displays only if terminated with equal sign.

Example 1:

```
a+b        =108
a=27+9
8*4        =32
b=12*6     =72
```

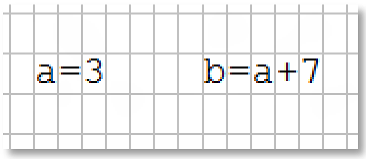
Several mathematical expressions can be written per row. Between each mathematical expression, there must either a minimum number at blank columns (defined in ***Menu Options.Column Space***) or a colon must be set.

Example 1:

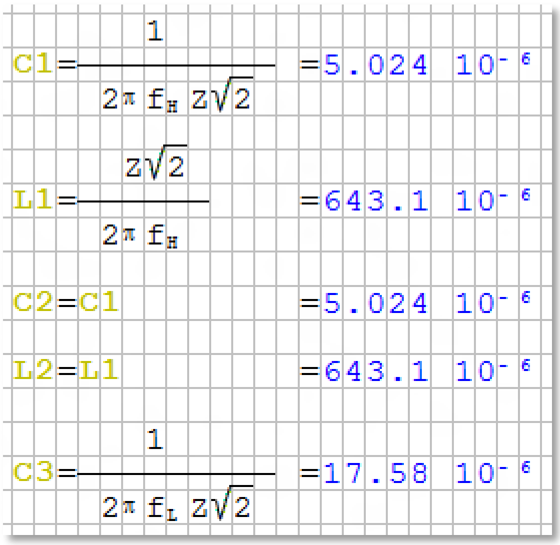


```
a=3:b=a+7
```

Example 2:



```
a=3     b=a+7
```



$$C1=\frac{1}{2\pi\ f_H\ z\sqrt{2}}=5.024\ 10^{-6}$$

$$L1=\frac{z\sqrt{2}}{2\pi\ f_H}=643.1\ 10^{-6}$$

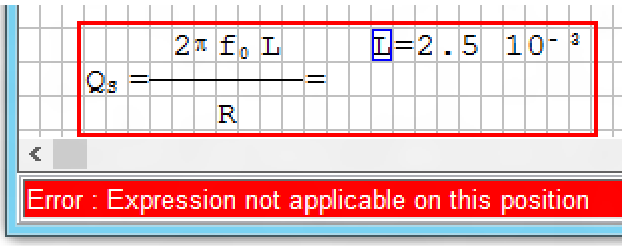
$$C2=C1=5.024\ 10^{-6}$$

$$L2=L1=643.1\ 10^{-6}$$

$$C3=\frac{1}{2\pi\ f_L\ z\sqrt{2}}=17.58\ 10^{-6}$$

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.

Close proximity can caused unexpected errors. For error localization ***RedCrab*** marked 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.



$$Q_S=\frac{2\pi\ f_0\ L}{R}=\ L=2.5\ 10^{-3}$$

Error : Expression not applicable on this position

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. Alternative 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

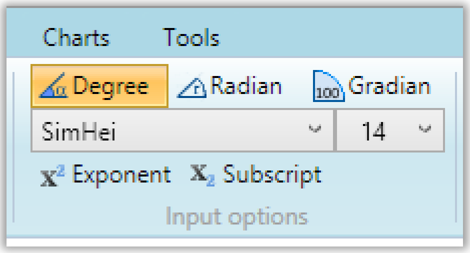
The expression: $c = a^2 + 4^2$.

1. Enter the expression: c = a ***Ctr+2*** + 4 ***Ctr+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 ***Exponent*** Button in the ***Input options*** group on the ***Math*** menu ribbon to enter the ***Superscript*** mode. Then enter the exponent value. Press ***Ctrl+6*** or ***Enter*** or click the ***Exponent*** Button to leave the ***Superscript*** 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: $X_L = 2 * 628$

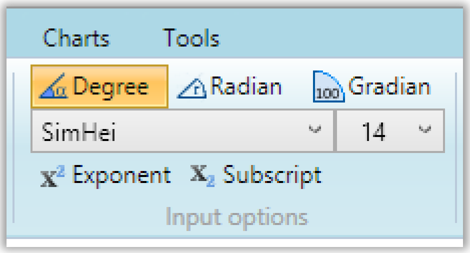
Press the keys: X ***Ctrl+_*** L ***Enter*** = 2 * 6 2 8 =

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 in the group ***Input option*** on the ***Math*** menu ribbon.

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 keys ***CTRL+/*** (Ctrl + Slash) and a three-character fraction bar will be displayed. By repeatedly pressing the keys the fraction bar is extended by one character forward. 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.

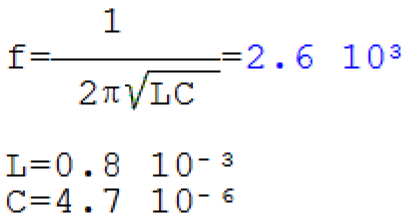
! The fraction bar must exceed at least 1 character front and rear.

Examples:

```
123   wrong
---
abc
```

```
 123  correct
-----
 Abc
```

The display shows:



$$f=\frac{1}{2\pi\sqrt{LC}}=2.6\ 10^{3}$$

$L=0.8\ 10^{-3}$

$C=4.7\ 10^{-6}$

1.8 Root

Set the root character with the keys ***CTRL+1*** 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+1***.
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+1***.
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.

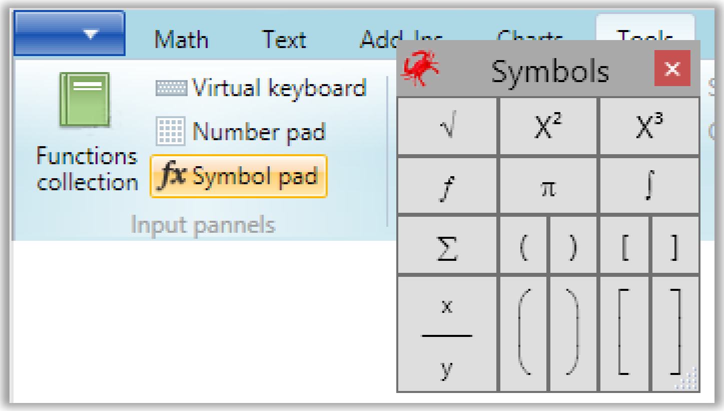
In order to highlight the area, it is sufficient if the last column under the root is marked.

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***. The length is limited to 20 characters.

Example: `$oct3721`

A binary number is marked with the dollar symbol and the letters ***bin***. The length is limited to 20 characters.

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.

Results can be displayed as hexadecimal, octal or binary number in result boxes. Read below ***Result Box / Format Commands***.

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*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`

1.16 Constants

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  5  10  15  20`

`x = [0..5]/5 = 0  0.2  0.4  0.6  0.8  1`

`x = 5/[1..5] = 5  2.5  1.67  1.25  1`

`x = 2[5..0] = 10  8  6  4  2  0`

Example 2: `x = [2..5:0.75] = 2 2.75 3.5 4.25 5`

Series, individual values and variables can be combined.

Example: `x = [1,5..8,12,15] = 1  5  6  7  8  12  15`

Example:
`a = 3`
`b = 12`
`x = [1,a..5,b] = 1  3  4  5  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  14  17` (2+10 4+10 7+10)

Example: **`sin`**`([30,60,90])= 0.5  0.87  1`

Example: `[12,18,36,44]` **`mod`** `10 = 2  8  6  4`

Example:
`C = 4.6 10-6`
`f = [1200,1600,2000,2600]`

$$X_C = \frac{1}{2\pi fC} = 28.2 \quad 21.2 \quad 16{,}9 \quad 13$$

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] = 11  14  16  17  18
```

1.14 Multidimensional Fields

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

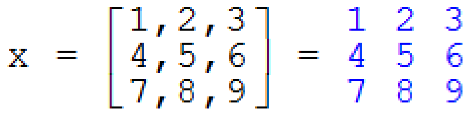
Example:
```
x=[1,2,3;4,5,6]= 1  2  3
                 4  5  6
```

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

Example:
```
x = [1..5;2,4,6;3..9]= 1  2  3  4  5  0  0
                       2  4  6  0  0  0  0
                       3  4  5  6  7  8  9
```

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 =  12 14 16 18   (2+10  3+11  4+12  5+13)
```

Example:

```
a = [2,3,4,5]
b = [10,11,12,13,14,15]
c = a + b =  12 14 16 18
```

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

Example:

```
a = [2..5; 20..23]
b = [10..13; 30..33]
c = a + b =  12 14 16 18
             50 52 54 56
```

Example:

```
a = [2..5; 20..23]
b = [10..13; 30..33; 40,44,45,48]
c = a + b =  12 14 16 18
             50 52 54 56
```

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] = 12 14 16 18
                 60 65 67 71
```

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 =  12 13 14   (10+2 10+3 10+4)
                  17 18 19   (15+2 15+3 15+4)
```

Example:
```
a = [3..6]
b = [11..15]
             33 36 39 42 45
c[] = ab =  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[] = ab
              99 108 117 126 135
d[] = ac = 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:
```
        132 144 156 168 180
d[2] = 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]`

1.16 Units of Measurement

A feature of RedCrab Math is the ability to calculate with units of measurement. Any numbers can be allocated to a unit. RedCrab has a number of predefined units, which are allocated in groups.

Units of a group and the same dimension can be added and subtracted. Multiplication and division is unrestricted, as long as a meaningful result is calculated.

Not meaningful is hectares * hectares or if a dimension <1 is to be calculated (3km / 2km). Correct is 3 km / 2 = 1.5 km.

Example:

3km + 2km = 5km	(kilometre + kilometre)
3km + 245m = 3245m	(kilometre + metre)
12m + 5yd = 18.123yd	(metre + yard)
5yd + 12m = 16.572m	(metre + yard)
4m * 5m = $20m^2$	(metre * metre)
2ha + $950m^2$ = $20950m^2$	(hectare + square metre)
650km / 5.5h = 118.18km/h	(kilometre / hour)

The result is displayed in the unit of measurement of the right operand. In the unit input box on the math menu band, you can input a preferred unit of measurement, which will be shown instead. The preferred unit of measure is ignored if the result is incompatible.

New units can be derived from the predefined units of measurement.

Example: dm = 0.1m
3dm + 25cm = 55cm

The names of the units can be overloaded by assigning a value to them.

Example: m = 15

In the example above, m is defined as a normal variable which represents a value of 15. In this case the name m cannot be used as a unit of measurement.

1.17 List of Units of Measurement

Group Dimensions

Length

µm	Micrometre	0.000001
mm	Millimetre	0.001
cm	Centimetre	0.01
m	Metre	1
km	Kilometre	1000
in	Inches	0.0254
ft	Feet	0.3048
yd	Yards	0.9144
ftm	Fathom	1.8288
mi	Miles	1609.344
nmi	Nautical mile	1852
au	Astronomical unit	149598550000

Area

ac	Acres	4046.8564224
ha	Hectares	10000

Volume

L	Litre	0.001
Impgal	ImperialGallon	0.00454609
USliqgal	USLiquidGallon	0.003785411784
USdrygal	USDryGallon	0.00440488377086

Group Weight

mg	Milligram	0.001
g	Gram	1
kg	Kilogram	1000
t	Tonne	1000000
kt	Kilotonne	1000000000
Mt	Megatonne	1000000000000

Gt	Gigatonne	1000000000000000
oz	Ounce	28.349523
lb	Pound	453.59237
tnsh	Short tonne	907184.74
tnlts	Long tonne	1016046.909

Group Temperature

K	Kelvin	-273.15

Group Pressure

Bar	Bar	100000
Pa	Pascal	1
kPa	Kilopascal	1000
mmHg	Millimetre of Mercury	133.322387415
atm	Atmospheres	101325
psi	Pound Per Square Inch,	6894.757

Group Energie

J	Joules,	1
kJ	Kilojoules,	1000
cal	Calories	4.1868
kcal	Kilocalories	4186.8
BTU	British thermal unit	1055.056
eV	Electron Volts	$1.60217653 * 10^{-19}$

Group Power

W	Watts	1
kW	Kilowatts	1000
hp	Horse Power	745.699872
PS	Pferde Staerke	735.49875

Group Time

ps	Pico Second	0.000000000001
ns	Nano Second	0.000000001

µs	Micro Second	0.000001
ms	Milli Second	0.001
s	Second	1
h	Hour	3600
d	Day	86400

Groupe Force

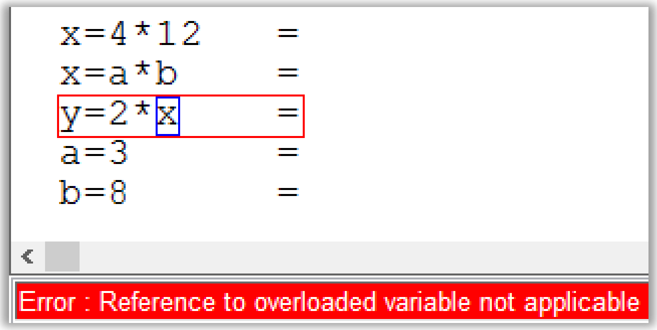
N	Newton	1
lbf	Pound Force	4.4482216152606

1.18 Calculate Selected Formulas

On worksheets which contain a collection of formulas, you can select one or more of them. The following calculation considers the selected formulas only. This can be useful when a worksheet contains different formulas for the same result.

Select the formulas with a click of the right mouse button. The selected formulas are marked with a red frame.

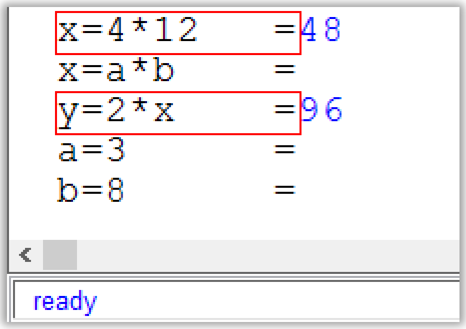
The example on the right shows an error message because the reference variable ***x*** has two different definitions.



```
x=4*12    =
x=a*b     =
y=2*x     =
a=3       =
b=8       =
```

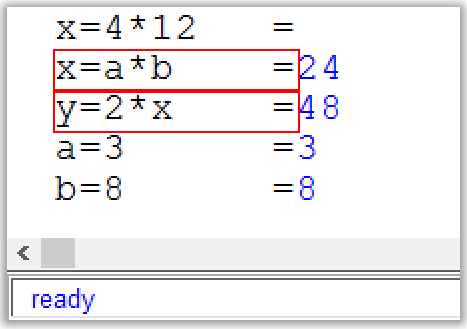
Error : Reference to overloaded variable not applicable

In the examples below, the variable ***y*** is calculated with one of the values of ***x***, controlled by the selection.



```
x=4*12    =48
x=a*b     =
y=2*x     =96
a=3       =
b=8       =
```

ready



```
x=4*12    =
x=a*b     =24
y=2*x     =48
a=3       =3
b=8       =8
```

ready

The selection is available for the imminent calculation and will be reset when the calculation terminates.

Result boxes work with selected formulas as well. When in the example above the variable ***x*** has a reference to a result box, the result box displays the result of the selected formula.

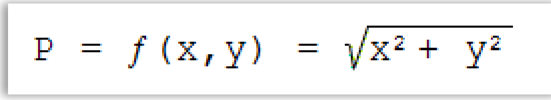
When a slider is inserted in the worksheet, the slider works only imminently after a calculation which was executed with the ***Enter*** key or button. After a change on the worksheet, the selection is invalid.

Tutor video: http://www.redchillicrab.com/en/redcrab/tutor/selected_range.html

1.19 Define a Function

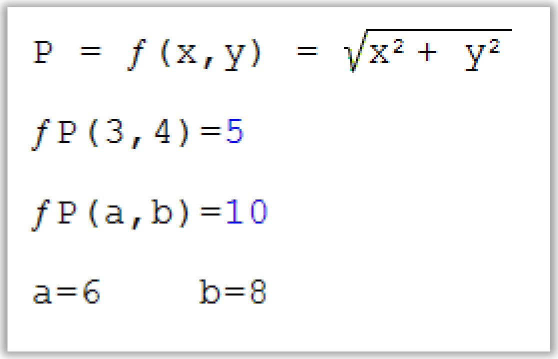
In ***RedCrab*** you can define your own functions. The function definition begins with the name on the left, like a definition of a variable. The function symbol and the formal parameter list are in the middle, and the expression is on the right. To get the function symbol, press the keys ***Ctrl* + *5***.

Example:



$P = ƒ(x,y) = \sqrt{x^2 + y^2}$

The example below shows how to call a function that returns the result of an expression. A call of a self-defined function must be marked with the function symbol left of the function name.



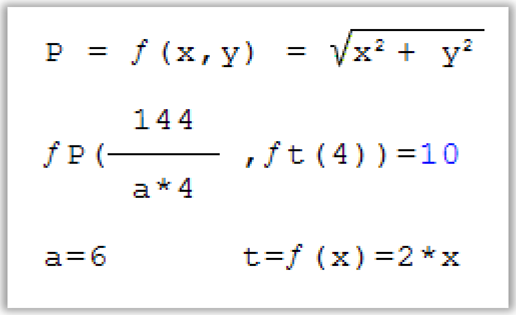
$P = ƒ(x,y) = \sqrt{x^2 + y^2}$

$ƒP(3,4)=5$

$ƒP(a,b)=10$

$a=6$ $b=8$

The arguments can be values, variable names, another function or any expressions.



$$P = ƒ(x,y) = \sqrt{x^2 + y^2}$$

$$ƒP\left(\frac{144}{a*4}, ƒt(4)\right)=10$$

$a=6$ $t=ƒ(x)=2*x$

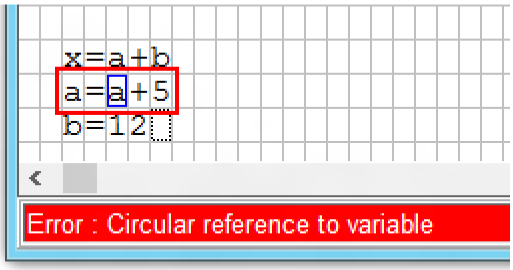
1.20 Scope of Function Parameters

The variables, defined as formal parameter, have own scope inside the function. They can referenced in the function only and not outside their function. It is allowed and makes no difference, if the same names in the argument list are defined and used elsewhere in the worksheet.

Inside the function you can use in addition to the parameter all other variables, which are defined elsewhere in the worksheet.

1.22 Error Messages

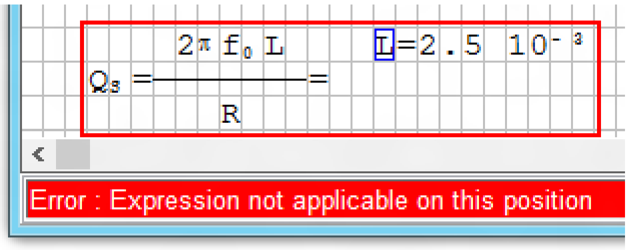
For error location RedCrab marks the cell in where an error is detected with a blue frame. It also marks the incorrect formula with a red frame.



```
x=a+b
a=a+5
b=12
```

Error : Circular reference to variable

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.



Error : Expression not applicable on this position

1.23 Programming

RedCrab supports programming of functions with its own program language.

Worksheet formulas have access to all functions of *RedCrab* programs. From *RedCrab* program, you can call all functions in other *RedCrab* program modules.

The command language is easy to learn, especially for users without programming experience. The syntax of the interpreter is an extension of the worksheets syntax. That means, all the mathematical functions of the worksheet are also available. Likewise, the definition of variables and data fields is identical with the worksheet.

In addition, the editor contains commands for programming functions, conditional branching (*If, Elseif, Else*) and loops (*While*). For more information about programming read the separate programmer manual.

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.

2.1 Standard Functions

Abs

Abs returns the absolute value of numbers and fields.

Example:

```
x = Abs(y)

X = abs(4.56) = 4.56
X = abs(-4.56) = 4.56
```

Ceil

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

Example:

```
ceil(-2.3) = -1
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 = dtime([Y, M, D, h, m, s])`

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

Example: `current = dtime(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 `dtimef(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 <= X <= 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.

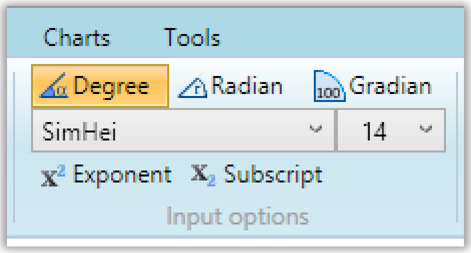
Example:

```
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 group ***Input options*** on the ***Math*** menu ribbon determine whether the parameters of trigonometric functions be specified in degrees, radian or grads.



ACos	inverse cosine
ASin	inverse sine
ATan	inverse tangent
Cos	cosine
Cosh	hyperbolic cosine
Cot	cotangent
Deg	converts radian in degrees
Exp	exponent to Euler's constant: 2.7182818284590452...
Ln	natural logarithms to base e (2.7182818284590452...)
Log	logarithms base 10

Log2	logarithms base 2
Log8	logarithms base 8
Log16	logarithms base 16
Rad	convert degrees in radians
Sin	sine
Sinh	hyperbolic sine
Tan	tangent
Tanh	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 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   div 3   = 3
11.2 div 3.9 = 3
```

Excl

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

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

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

Example: `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`

2.4 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:

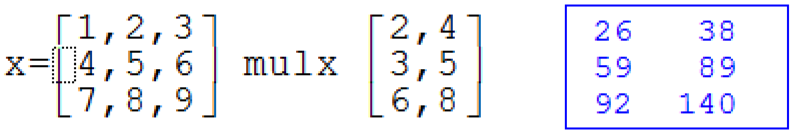
Example: `d = det(A)`

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:



$$x=\begin{bmatrix}1,2,3\\4,5,6\\7,8,9\end{bmatrix}\ \mathrm{mulx}\ \begin{bmatrix}2,4\\3,5\\6,8\end{bmatrix}$$

```
26    38
59    89
92   140
```

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:

```
(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)
```

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

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

```
           1  4  7
trans(x) = 2  5  8
           3  6  9
```

2.6 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 × ¼) = 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 × ¾) = 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)`

2.7 Financial Functions

FDDB returns a value specifying the depreciation of an asset for a specific time period using the double-declining balance method or some other method you specify.

Syntax: fddb (Cost, Salvage, Life, Period)

Optional: fddb (Cost, Salvage, Life, Period, Factor)

Parameter:

Cost	specifying initial cost of the asset.
Salvage	specifying value of the asset at the end of its useful life.
Life	specifying length of useful life of the asset.
Period	specifying period for which asset depreciation is calculated.
Factor	specifying rate at which the balance declines. If omitted, 2 (double-declining method) is assumed.

FFV

returns the future value of an annuity based on periodic, fixed payments and a fixed interest rate.

Syntax: ffv (Rate, NPer, Pmt)

Optional: ffv (Rate, NPer, Pmt, PV)
ffv (Rate, NPer, Pmt, PV, Due)

Parameters:

Rate	is the interest rate per period. For example, if you get an annual percentage rate (APR) of 6 percent and make monthly payments, the rate per period is 6/12, or 0.5.
NPer	specifies the total number of payment periods in the annuity. For example, if you make monthly payments, you have a total of 4 × 12 (or 48) payment periods.
Pmt	specifying payment to be made each period. Payments usually contain principal and interest that doesn't change over the life of the annuity.
PV	optional specifying present value (start value) of a series of future payments. If omitted, 0 is assumed.
Due	optional specifying when payments are due. This argument must be either 0, if payments are due at the end of the payment period, or 1, if payments are due at the beginning of the period. If omitted, 0 assumed.

FIPmt

specifying the interest payment for a given period of an annuity based on periodic fixed payments and a fixed interest rate.

Syntax: fipmt (Rate, Per, NPer, PV,)

Optional: fipmt (Rate, Per, NPer, PV, FV)
fipmt (Rate, Per, NPer, PV, FV, Due)

Parameters:

Rate	is the interest rate per period. For example, if you get a car loan at an annual percentage rate (APR) of 6 percent and make monthly payments, the rate per period is 6/12, or 0.5.
Per	specifies the payment period in the range 1 through NPer.
NPer	specifies the total number of payment periods in the annuity. For example, if you make monthly payments on a four-year car loan, your loan has a total of 4 × 12 (or 48) payment periods.
PV	is the present value (or lump sum). For example, when you borrow money to buy a car, the loan amount is the present value.
FV	optional specifying future value or cash balance you want after you have made the final payment. For example, the future value of a loan is $0 because that is its value after the final payment. However, if you want to save $50,000 during 18 years for your child's education, then $50,000 is the future value. If omitted, 0 is assumed.
Due	optional specifies when payments are due. This argument must be either 0, if payments are due at the end of the payment period, or 1, if payments are due at the beginning of the period. If omitted, 0 assumed

FIRR

returns the internal rate of return for a series of periodic cash flows (payments and receipts).

Syntax: firr (ValueArray)

Optional: firr (ValueArray, Guess)

Parameter:

ValueArray is an array of cash flow values. The array must contain at least one negative value (a payment) and one positive value (a receipt).

Guess optional specifying value you estimate will be returned by FIRR. If omitted, Guess is 10 percent

FMIRR

returns the modified internal rate of return for a series of periodic cash flows (payments and receipts).

Syntax: fmirr (ValueArray, FinanceRate, ReinvestRate)

Parameter:

ValueArray is an array of cash flow values. The array must contain at least one negative value (a payment) and one positive value (a receipt).

FinanceRate specifying interest rate paid as the cost of financing.

ReinvestRate specifying interest rate received on gains from cash reinvestment

FNPer

returns the number of periods for an annuity based on periodic fixed payments and a fixed interest rate.

Syntax: fnper (Rate, Pmt, PV)

Optional: fnper (Rate, Pmt, PV, FV)
fnper (Rate, Pmt, PV, FV, Due)

Parameters:

Rate	is the interest rate per period. For example, if you get a car loan at an annual percentage rate (APR) of 6 percent and make monthly payments, the rate per period is 6/12, or 0.5.
Pmt	specifying payment to be made each period. Payments usually contain principal and interest that does not change over the life of the annuity.
PV	is the present value (or lump sum). For example, when you borrow money to buy a car, the loan amount is the present value.
FV	optional specifying future value or cash balance you want after you have made the final payment. For example, the future value of a loan is $0 because that is its value after the final payment. However, if you want to save $50,000 during 18 years for your child's education, then $50,000 is the future value. If omitted, 0 is assumed.
Due	optional specifies when payments are due. This argument must be either 0, if payments are due at the end of the payment period, or 1, if payments are due at the beginning of the period. If omitted, 0 assumed

FNPV

returns the net present value of an investment based on a series of periodic cash flows (payments and receipts) and a discount rate.

Syntax: fnpv (Rate, ValueArray)

Parameter:

Rate	the discount rate over the length of the period.
ValueArray	is an array of specifying cash flow values. The array must contain at least one negative value (a payment) and one positive value (a receipt

FPmt specifying the payment for an annuity based on periodic, fixed payments and a fixed interest rate.

Syntax: fpmt (Rate, NPer, PV)

Optional: fpmt (Rate, NPer, PV, FV)
fpmt (Rate, NPer, PV, FV, Due)

Parameters:

Rate	is the interest rate per period. For example, if you get a car loan at an annual percentage rate (APR) of 6 percent and make monthly payments, the rate per period is 6/12, or 0.5.
NPer	specifies the total number of payment periods in the annuity. For example, if you make monthly payments on a four-year car loan, your loan has a total of 4 × 12 (or 48) payment periods
PV	specifies the present value (or lump sum). For example, when you borrow money to buy a car, the loan amount is the present value
FV	optional specifying future value or cash balance after final payment is made. For example, the future value of a loan is $0 because that is its value after the final payment. However, if you want to save $50,000 during 18 years for your child's education, then $50,000 is the future value. If omitted, 0 is assumed.
Due	optional specifies when payments are due. This argument must be either 0, if payments are due at the end of the payment period, or 1, if payments are due at the beginning of the period. If omitted, 0 assumed.

FPPmt

specifying the principal payment for a given period of an annuity based on periodic fixed payments and a fixed interest rate.

Syntax: fppmt (Rate, Per, NPer, PV,)

Optional: fppmt (Rate, Per, NPer, PV, FV)
fppmt (Rate, Per, NPer, PV, FV, Due)

Parameters:

Rate	is the interest rate per period. For example, if you get a car loan at an annual percentage rate (APR) of 6 percent and make monthly payments, the rate per period is 6/12, or 0.5
Per	specifies the payment period in the range 1 through ***NPer***.
NPer	specifies the total number of payment periods in the annuity. For example, if you make monthly payments on a four-year car loan, your loan has a total of 4 × 12 (or 48) payment periods.
PV	is the present value (or lump sum). For example, when you borrow money to buy a car, the loan amount is the present value.
FV	optional specifying future value or cash balance you want after you have made the final payment. For example, the future value of a loan is $0 because that is its value after the final payment. However, if you want to save $50,000 during 18 years for your child's education, then $50,000 is the future value. If omitted, 0 is assumed.
Due	optional specifies when payments are due. This argument must be either 0, if payments are due at the end of the payment period, or 1, if payments are due at the beginning of the period. If omitted, 0 assumed.

FPV returns the present value of an annuity based on periodic, fixed payments to be paid in the future and a fixed interest rate.

Syntax: fpv (Rate, NPer, Pmt)

Optional: fpv (Rate, NPer, Pmt, FV)
fpv (Rate, NPer, Pmt, FV, Due)

Parameters:

Rate	is the interest rate per period. For example, if you get a car loan at an annual percentage rate (APR) of 6 percent and make monthly payments, the rate per period is 6/12, or 0.5.
NPer	specifies the total number of payment periods in the annuity. For example, if you make monthly payments on a four-year car loan, your loan has a total of 4 × 12 (or 48) payment periods.
Pmt	specifying payment to be made each period. Payments usually contain principal and interest that does not change over the life of the annuity.
FV	optional specifying future value or cash balance you want after you have made the final payment. For example, the future value of a loan is $0 because that is its value after the final payment. However, if you want to save $50,000 during 18 years for your child's education, then $50,000 is the future value. If omitted, 0 is assumed.
Due	optional specifies when payments are due. This argument must be either 0, if payments are due at the end of the payment period, or 1, if payments are due at the beginning of the period. If omitted, 0 assumed

FRate returns the interest rate per period for an annuity.

Syntax: frate (NPer, Pmt, PV)

Optional: frate (NPer, Pmt, PV, FV)
frate (NPer, Pmt, PV, FV, Due)
frate (NPer, Pmt, PV, FV, Due, Guess)

Parameters:

NPer	specifies the total number of payment periods in the annuity. For example, if you make monthly payments on a four-year car loan, your loan has a total of 4 × 12 (or 48) payment periods.
Pmt	specifying payment to be made each period. Payments usually contain principal and interest that does not change over the life of the annuity.
PV	is the present value (or lump sum). For example, when you borrow money to buy a car, the loan amount is the present value.
FV	optional specifying future value or cash balance you want after you have made the final payment. For example, the future value of a loan is $0 because that is its value after the final payment. However, if you want to save $50,000 during 18 years for your child's education, then $50,000 is the future value. If omitted, 0 is assumed.
Due	optional specifies when payments are due. This argument must be either 0, if payments are due at the end of the payment period, or 1, if payments are due at the beginning of the period. If omitted, 0 assumed.
Guess	optional specifying value you estimate will be returned by IRR. If omitted, Guess is 10 percent

FSLN returns a value specifying the depreciation of an asset for a specific time period using the double-declining balance method or some other method you specify.

Syntax: fsln (Cost, Salvage, Life, Period)

Parameter:

Cost	Specifying initial cost of the asset.
Salvage	Specifying value of the asset at the end of its useful life.
Life	Specifying length of useful life of the asset

FSYD returns the sum-of-years digits depreciation of an asset for a specified period.

Syntax: fsyd (Cost, Salvage, Life, Period)

Parameter:

Cost	specifying initial cost of the asset.
Salvage	specifying value of the asset at the end of its useful life.
Life	specifying length of useful life of the asset.
Period	specifying period for which asset depreciation is calculated.

3.0 Keyboard

The keyboard inputs in the following 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
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
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	Insert a column at cursor position
Insert + Shift	Insert a row at cursor position
Delete	Delete a column at cursor position
Delete + Shift	Delete a row at cursor position
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	Marked/Unmarked the selected range or cursor position as remark
F3	Enable or disable Superscript mode.
F4	Enable or disable Subscript mode.
F6	Clear all
F7	Clear 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.)	

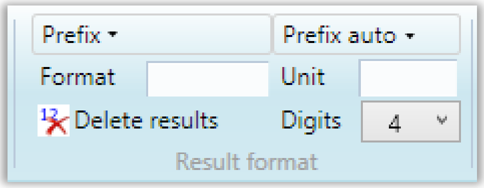
Ctrl + J		ϑ	Theta (alt.)	
Ctrl + K	κ	Κ	Kappa	
Ctrl + L	λ	Λ	Lambda	
Ctrl + M	μ	Μ	Mu	
Ctrl + N	ν	Ν	Nu	
Ctrl + O	ο	Ο	Omicron	
Ctrl + P	π	Π	Pi	
Ctrl + Q	θ	Θ	Theta	
Ctrl + R	ρ	Ρ	Rho	
Ctrl + S	σ	Σ	Sigma	
Ctrl + T	τ	Τ	Tau	
Ctrl + U	υ	Υ	Upsilon	
Ctrl + V	ϖ		Pi (alt.)	Insert text from clipboard **
Ctrl + V		ς	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	Ζ	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.

4.0 Result Formatting

The group ***Result format*** on the Math menu ribbon contains the settings for the result format. The result format is set for each math box separately.



4.1 Result Mode

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.

4.2 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.

	Prefix		**Decimal**	**Short scale**	**Long scale**
Y	yotta	10^{24}	1.000.000.000.000.000.000.000.000	Septillion	Quadrillion
Z	zetta	10^{21}	1.000.000.000.000.000.000.000	Sextillion	Trilliard
E	exa	10^{18}	1.000.000.000.000.000.000	Quintillion	Trillion
P	peta	10^{15}	1.000.000.000.000.000	Quadrillion	Billiard
T	tera	10^{12}	1.000.000.000.000	Trillion	Billion
G	giga	10^{9}	1.000.000.000	Billion	Milliard
M	mega	10^{6}	1.000.000	Million	
k	kilo	10^{3}	1000	Thousand	
h	hecto	10^{2}	100	Hundred	
-	-	-	1	One	
d	deci	10^{-1}	0,1	Tenth	

c	centi	10^{-2}	0,01	Hundredth	
m	milli	10^{-3}	0,001	Thousandth	
µ	micro	10^{-6}	0,000.001	Millionth	
n	nano	10^{-9}	0,000.000.001	Billionth	Milliardth
p	pico	10^{-12}	0,000.000.000.001	Trillionth	Billionth
f	femto	10^{-15}	0,000.000.000.000.001	Quadrillionth	Billiardth
a	atto	10^{-18}	0,000.000.000.000.000.001	Quintillionth	Trillionth
z	zepto	10^{-21}	0,000.000.000.000.000.000.001	Sextillionth	Trilliardth
y	yocto	10^{-24}	0,000.000.000.000.000.000.000.001	Septillionth	Quadrillionth

4.3 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 Math*** 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 Math 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: 3650 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

4.4 Format Result

You can input additional text to the result in the ***Format*** editor row. (Example: #A). The Pound (#) is the replacement character for the result, the ***A*** stand for the measure unit Ampere. The box shows the result: 123A.

The additional text can stand before or after the pound symbol. The table below shows examples with prefixes.

Example:

Result	Format text	Result format
0.012		12m
0.012	#A	12mA
0.012	Strom: # A	Strom: 12 mA
125	US$ #	US$ 125

4.5 Display of Units of Measurement

If you use units of measurement in your calculation, the result is displayed in the unit that was entered on the right in the expression.

Example:
2km + 2mi = 3.24mi
2mi + 2km = 5.22km

In the editor line ***Unit*** you can specify a different unit of measurement that is always displayed when this unit is compatible with the result. The specification is ignored by incompatible results.

4.6 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.

4.7 Menu Group Math Result Tables

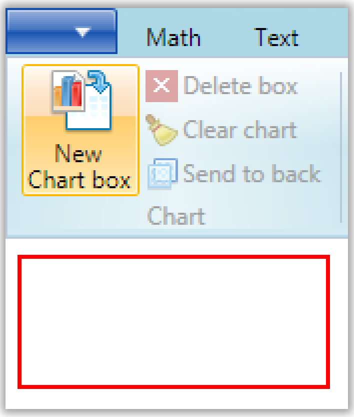
Results are displayed right of the equal sign. If there is not enough space, the math box will automatically enlarge.

To avoid an oversized magnifying of the math box for large tables, you can display the table in a separate box. To do so, click the check box ***Result box***.

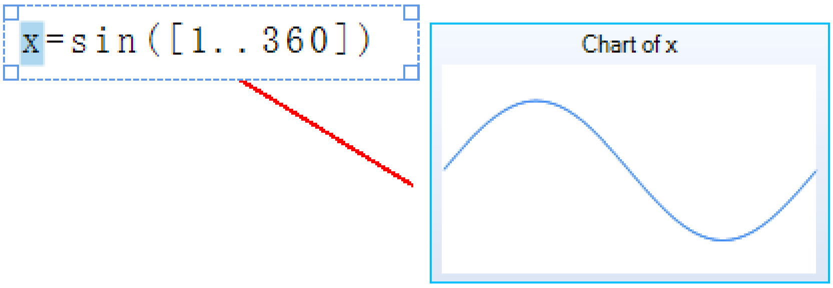
For very large tables, you might want to display the data in a separate window. Put the cursor on the variable that you want to appear and click on ***New frame***. An equal sign behind the formula is not needed here.

5.0 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 Char 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 press the right mouse button and draw a line from the math box to the chart box. The reference is connected now.

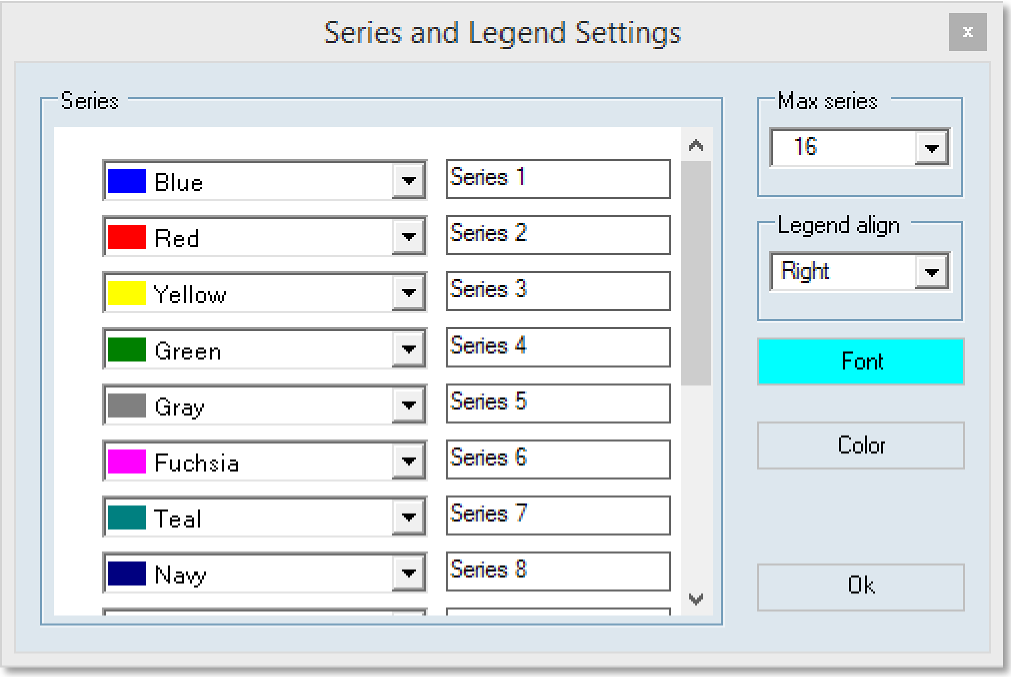


```
x=sin([1..360])
```

5.1 Chart Settings

Chart types	open a dialog box to choose between different chart types. To choose a chart type, first click on the chart box. Then click the chart icon. Do note that different chart types need different data format. All icons show tool tips with notes if the mouse is moved over them.

Legend settings open a dialog window to change the series names, colours and the legend position.



Series and Legend Settings

Series

🟦 Blue	Series 1
🟥 Red	Series 2
🟨 Yellow	Series 3
🟩 Green	Series 4
■ Gray	Series 5
■ Fuchsia	Series 6
■ Teal	Series 7
■ Navy	Series 8

Max series: 16

Legend align: Right

In ***RedCrab*** 16 different colours for drawing of series are presented. If you use more than 16 series in a chart, beginning with series 17, the colours will repeat. The series name is displayed with the word ***Series*** and a current number.

The dialog window contains 16 combo boxes to change the series colours and 16 editor boxes to assign the series name. If you need more than 16 series you can extend the list with the combo box ***Max series***.

Max series does not limited the number of series of a chart box, it only specify the length of the list. If ***Max series*** is set to 16, and you use 20 series in the chart box, ***RedCrab*** uses for series 1 to 16, the dialog box colours and text. The series 17 to 20 uses the preset colour and the name ***Series*** with a current number.

Legend align sets the legend position.

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

5.2 Chart Options

3D chart area	displays the chart area in 3D-design
Show labels	shows labels with decimal values
Axis settings	open a dialog window for input of the axes properties. The picture below shows the Axis dialog window.

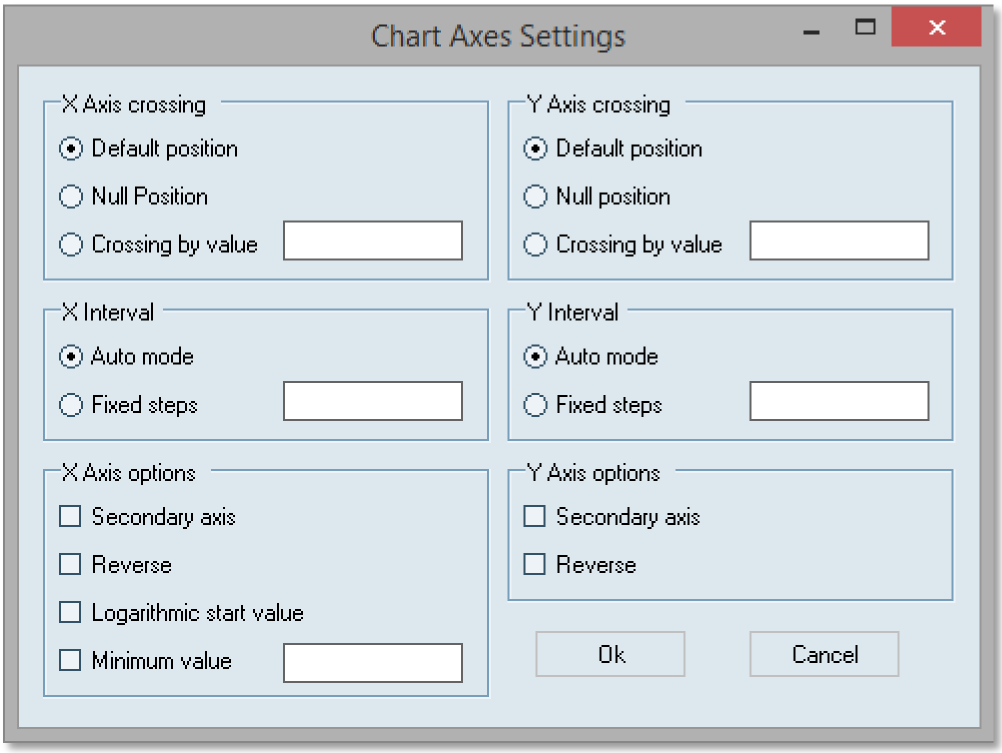


Chart Axes Settings

X Axis crossing
● Default position
○ Null Position
○ Crossing by value

Y Axis crossing
● Default position
○ Null position
○ Crossing by value

X Interval
● Auto mode
○ Fixed steps

Y Interval
● Auto mode
○ Fixed steps

X Axis options
☐ Secondary axis
☐ Reverse
☐ Logarithmic start value
☐ Minimum value

Y Axis options
☐ Secondary axis
☐ Reverse

Axis crossing	sets the axis position. By default setting, the Y axis is always left from the chart and the X axis at the bottom of the chart. Alternate you can position the axis on the null value of the scale or to a manual entered value.
Interval	sets the scale steps on automatic or a manual entered value
Axis options	displays with ***Secondary axis*** an additional axis on the top or on the right side. ***Reverse*** invert the axes scales. The values of the ***X*** axis increase from right to left instead from left to right. The

		values of the ***Y*** axis increase from top to bottom instead from bottom to top.
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	

6.1 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 Text menu ribbon. The procedure is identical to the creation of a math or chart box.

If you want to load a text file to your worksheet, click the applications menus item ***Open*** -> ***Open text*** file. ***RedCrab*** create automatically a new text box to display the file.

The text parts in a text box can have different formatting. Tools for formatting can be found in the Text menu ribbon.

6.2 Program Box

The button ***New program box*** on the ***Text*** menu ribbon opens an editor box for programming of your own functions. For more information read the ***Programmers Manual.***

6.3 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*** on the ***Add-Ins*** menu ribbon 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*** in the applications menu. Then select the image file. ***RedCrab*** can import the image formats Windows Bitmap ***(*. bmp) *.jpg, *.gif, *.png*** and ****.tif.***

You change the image position or resize by dragging the image border. The button ***Maintain ratio*** in the menu group ***Image*** locks the image width to height ratio. The button ***Original size*** resets the size to the original.

6.4 Insert Label

The group ***Labe***l in the ***Add-Ins*** menu ribbon contains button for 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*** in the menu group ***Label***. Finally drag the label with the mouse to the desired position.

If you want to display a text label, write the text in the editor row next to the button ***Show text***. Then click the target label. Finally click the button ***Show text***. 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 draw a line from the math box to the label with the right mouse button.

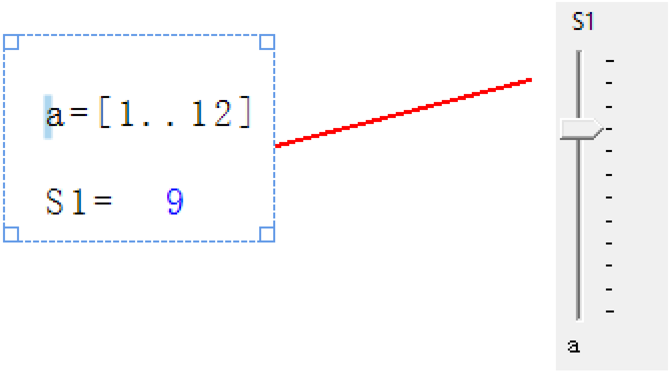
Menu group ***Label***

New Label	creates a new label
Delete	deletes the activated label
Show Text	copies the text from the editor line to the activated label
Transparent	displays the background transparency
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 the button. Then click this button.

6.5 Slider

A slider can be used instead of a variable in a formula or as a parameter of a function. The slider returns the individual value of a series of numbers depending on the position of the slider button. The sequence of numbers is defined as a field variable.

To add the reference to the variable, place the cursor on the variable; then, with the right mouse, you draw a line from the math box to the slider. The name of the reference variable is displayed at the bottom in the slider



a=[1..12]

S1= 9

The name of the sliders is used in the formula instead of a variable, in the example above S1

The name of the slider is automatically assigned. You can change the name by clicking on the name. A text box appears where you can change the name.

7.0 Quick Access Tool Bar

Execute

Execute start the calculator and display the result. It’s equal to the ***F8*** and ***Ctrl + Enter*** keys.

Clear

The ***Clear*** function clears the worksheet.

The ***Clear*** function clears the worksheet without prompting. Instead, data are stored in the startup directory in a file named ***redcrab.his***. If the ***Clear*** button was clicked by mistake, the worksheet can be restored with ***Reopen***.

Reopen

Reopen restores the last worksheet.

Tools Menu Ribbon

7.1 *Input panels*

Function collection	opens a panel which contains buttons for all RedCrab math functions. All Buttons shows tool tips if you move the mouse over
Virtual keyboard	opens a virtual keyboard (English US style)
Number pad	opens a number pad
Symbol pad	opens a panel which contains special symbols

7.2 *View*

System border	displays all boxes with a frame
Mathbox grid	displays a grid on the math boxes background

7.3 *Extras*

Set remark	marks data in a worksheet as a comment. This function can be performed with the function key F2. Comments are ignored by the calculator. To mark the data, first select the range with the mouse, and then click ***Set remark***. The selected data is displayed in green.
.	
Clear remark	undo the remark function above by using the same step
.	
Lock workspace	blocks the editor's page for additional entries. This function protects unintentional changes made. For data input, cells can be unlocked with ***Unlock Cell***.
.	
Unlock Cell	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 Cell	To clear the unlocked cells select the cells by mouse, then click ***Reset Cell***.
Autocalc	start the calculator, if you enter an equal symbol

7.4 *Accuracy*

14 digits	Accuracy: 15 – 16 digits Calculation range: $\pm 5 \times 10^{-324}$ to $\pm 1.7 \times 10^{308}$ Floating point is due to the large range of values suitable for engineering and scientific calculations.

28 digits	Accuracy: 28-29 digits

Calculation range:
From: -79,228,162,514,264,337,593,543,950,335
To: 79,228,162,514,264,337,593,543,950,335

(Is approximate: -7.9×10^{28} to 7.9×10^{28})

Decimal is suitable due to the small rounding error for financial and monetary calculations.

7.5 *Region*

Tips	to choose the tool tips language. The language English and German is in RedCrab implemented. Additional languages can added with language files.
Keyboard	Menu button to select the keyboard.

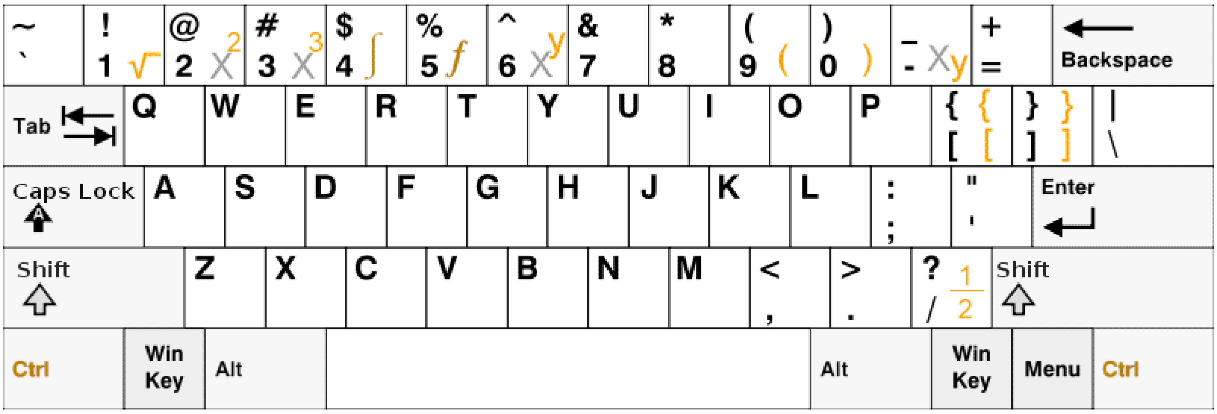
The keyboard inputs in this description refer to an English keyboard in the country's setting English-US. When using another keyboard or regional setting, some functions are acquired with other key combinations.

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

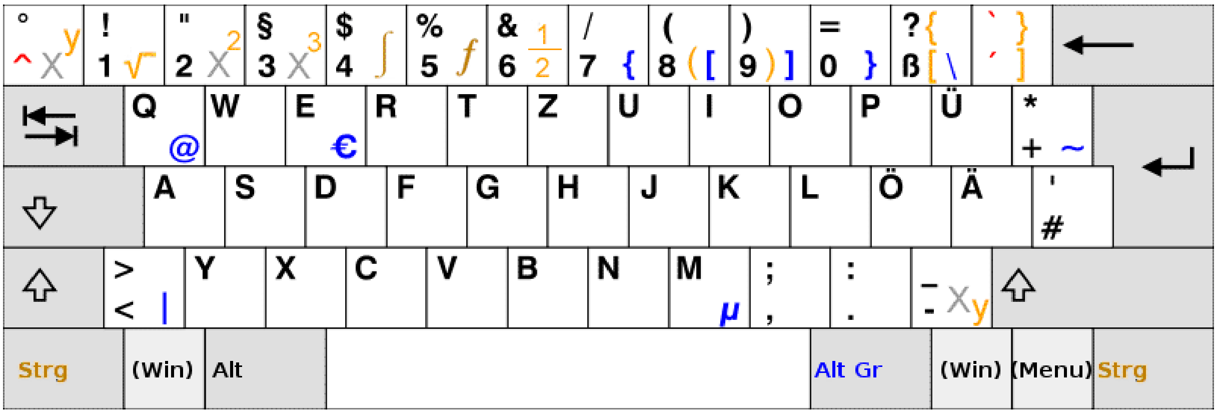
Attachment

Key Code Configuration

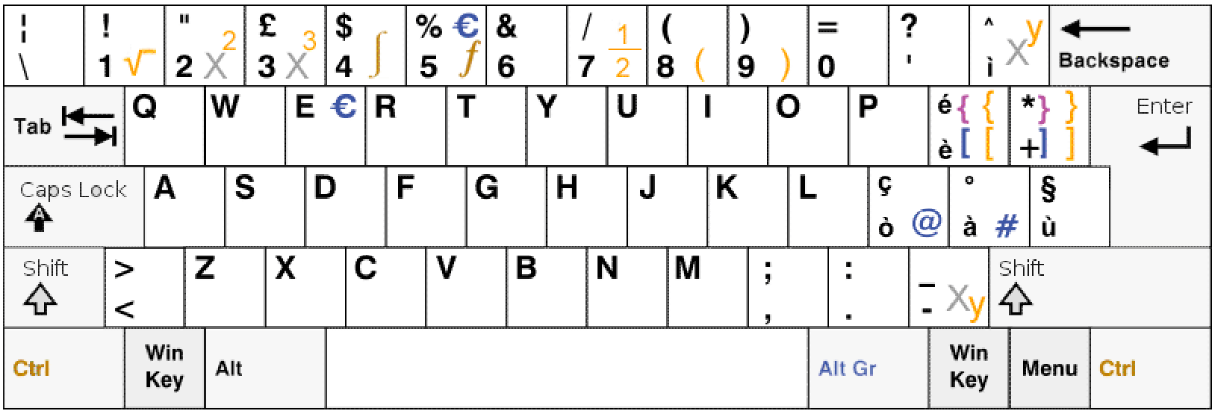
US-English


~ ` ! 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 < , > . ? / Shift
Ctrl Win Key Alt Alt Win Key Menu Ctrl

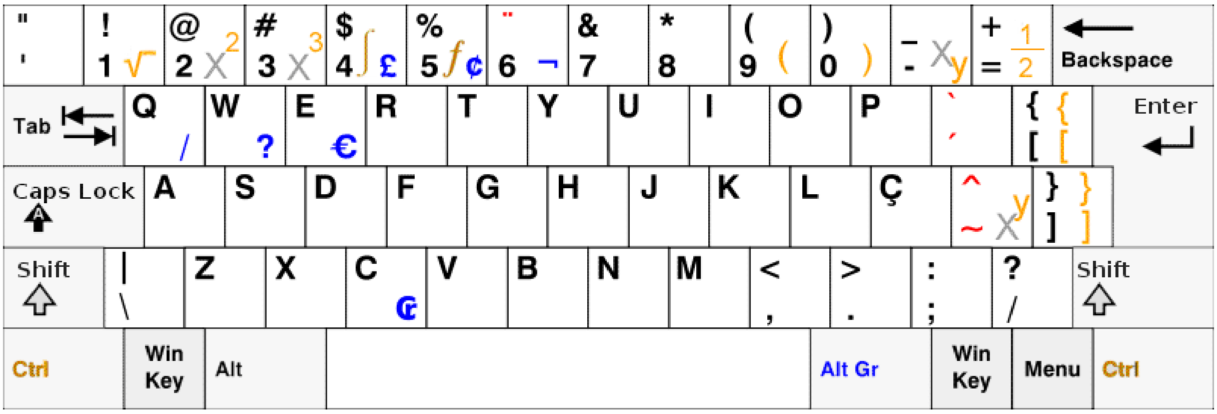
German


° ^ ! 1 " 2 § 3 $ 4 % 5 & 6 / 7 { (8 [ ) 9] = 0 } ? ß \ ` ´
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 ; , : . _ -
Strg (Win) Alt Alt Gr (Win) (Menu) Strg

Italian



Brazil (Portuguese)


" '
! 1 √
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# 3 X^3
$ 4 ∫ £
% 5 ƒ ¢
¨ 6 ¬
& 7
* 8
(9 (
) 0)
_ - X_y
+ = $\frac{1}{2}$
Backspace
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Q /
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Enter
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A
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^ ~ X^y
}] }]
Shift
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C ₢
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? /
Shift
Ctrl
Win Key
Alt
Alt Gr
Win Key
Menu
Ctrl