ELECTRICAL ENGINEERING CALCULATOR

VOLTA-814

FOR MICROSOFT® WINDOWS™ 7/8

USER MANUAL

VERSION 8.14.0.3

REVISED: 01/08/2019

By: William Yap
https://williamyaps.github.io

Document is subject to change without notice. All information is provided on 'AI' basis without warranty of any kind. All sample screenshots are provided for demo purpose only and may be slightly different from the actual layout.

KEY FEATURES

- ELECTRICAL ENGINEERING CALCULATOR FOR WINDOWS™ 7/8
- DESKTOP PC AND MOBILE PLATFORMS COMPATIBLE
- INTUITIVE LAYOUT AND ERGONOMIC DESIGN
- DUAL PC MOUSE AND TOUCH-SCREEN OPERATIONAL MODE
- ON-SCREEN MEMORY REGISTER FOR BETTER USER EXPERIENCE
- ARITHMETIC AND PERCENTAGE CALCULATION
- ALGEBRAIC FUNCTIONS
- LOGARITHMS AND EXPONENTS
- TRIGONOMETRIC AND HYPERBOLIC FUNCTIONS
- USEFUL CONSTANTS INCLUDING "SIGMA" VALUES
- ELECTRICAL ENGINEERING (EE) FUNCTIONS ○ E6...E192 REFERENCE TABLES (EE)
- UNIQUE "BEST FIT" COMPUTATION (EE)
- TEXT AND IMAGE ROTATOR (UPDATES DAILY)

FIGURE 1: ENGINEERING CALCULATOR VOLTA-814, SAMPLE SCREENSHOT[1]

[1] Actual layout may be slightly different from the sample screenshots

CONTENTS

OVERVIEW

Electrical Engineering **Calculator VOLTA-814** (hereinafter – **CALCU LATOR VOLTA**) in a context of this User Manual refers to the productivity application software package for Microsoft® Windows™ operating system (OS) versions 7 or 8.

Target audiences for **CALCULATOR VOLTA** include high-school, college and university students, educators and engineering professionals (in particular, EE/CS and electronic design). Feature matrix, HW/OS requirements and edition availability information is presented in the following table:

Feature/Edition	**VOLTA-814T**[2]	**VOLTA-814**	**VOLTA-814P**[3]
Edition	**Trial**	**Standard**	Professional
Form factor (PC)	**Desktop** **Notebook** **Tablet**	**Desktop** **Notebook** **Tablet**	Desktop Notebook Tablet
OS	**Windows 7 or 8**	**Windows 7 or 8**	Windows 7 or 8
Screen Size	**7" and up**	**7" and up**	7" and up
Screen Resolution	**> 1024 x 600**	**> 1024 x 600**	> 1024 x 600
Touch screen supported	**YES**	**YES**	YES
Arithmetic operations	**YES**	**YES**	YES
Scientific Functions	**YES**	**YES**	YES
Engineering Functions	**YES**	**YES**	YES
E-Series Tables (RLC)	**YES**	**YES**	NO
Calculation log[4]	**NO**	**NO**	YES
Availability	**YES**	**YES**	**NO**

OS BACKWARD COMPATIBILITY

CALCU LATOR VOLTA-814 is built on a leading-edge technology set corresponding to Microsoft .NET 4.0 framework. It is optimized to run on WINDOWS 7/8 (INCLUDING 8.1), and is also backward compatible with previous OS versions (e.g. WINDOWS VISTA), though it may require certain NET 4.0 components to be installed on User's PC.

OPTIONAL INTERNET CONNECTIVITY

CALCU LATOR VOLTA -814 can operate completely autonomously in a stand-alone mode without any Internet connection. However, Internet connectivity may extend User Experience, providing access to some optional online resources.

[2] Has expiration date

[3] Under development: tentatively scheduled for Y2015

[4] Calculation history log feature: planned for Pro edition only

SETUP / UNINSTALL

INSTALL

CALCU LATOR V OL T A setup procedure should typically take less that couple minutes. It can be completed using standardized Windows installer in several simple steps:

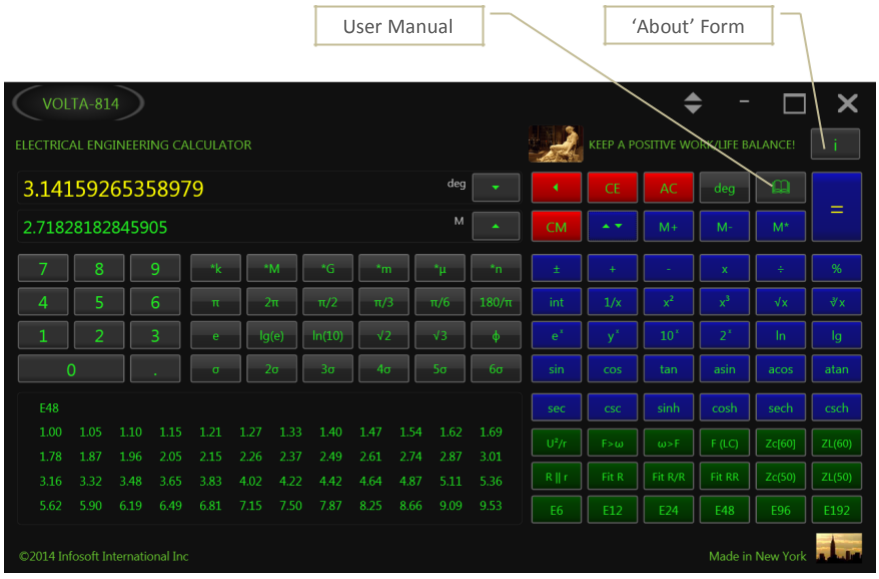
- Copy the content of installation package into any PC directory
- Locate and run setup.exe file
- Follow the on-screen instructions; the on-screen dialogs provide basic ReadMe information, offer some setup customization options and also may require the user to accept the EULA.
- Upon successful installation, the shortcut icon (see Fig.2) linked to the application should appear on PC desktop. Similar icon of smaller size should also appear in Program Menu (**Start** button ->**All Programs**)

FIGURE 2: SHORTCUT DESKTOP ICON LINKED TO CALCULATOR VOLTA-814 APPLICATION

UNINSTALL

In order to **UNINSTALL** this software use "**Programs and Features**" option in MICROSOFT WINDOWS "**Control Panel**"; double click the item titled 'Calculator Volta-814".

BASIC INFO



DESCRIPTION

CALCU LATOR V OL T A has intuitive Graphical User Interface (GUI) comprised of Input Box, Memory Register and multiple on-screen virtual buttons grouped into several functional areas as shown in the following sample screenshot (see Fig 3).

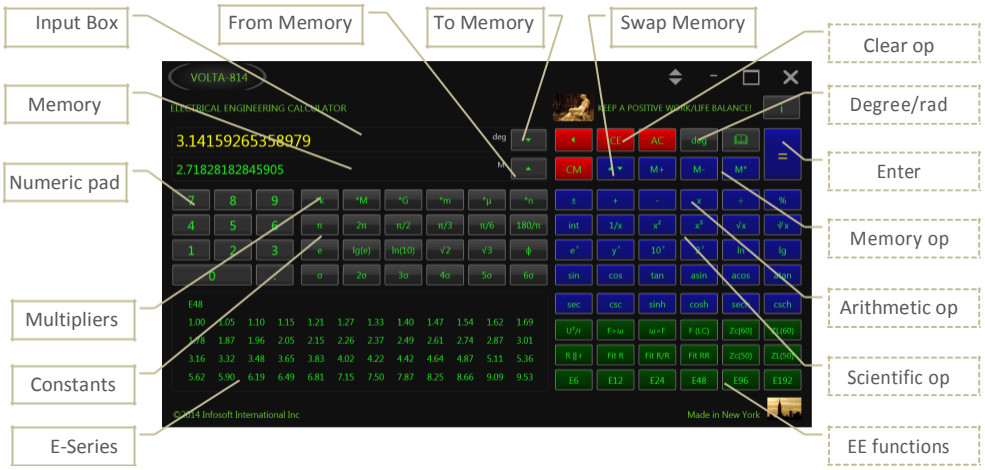


FIGURE 3: CALCULATOR VOLTA-814 SAMPLE SCREENSHOT

Input Box located under the main title; in this sample screenshot it displays number **π** rounded to 14 decimal digits. Text/Image rotator located to the right main title updates daily, adding some "spice" to the user experience (warning: some humor included! Possible side effect – LOL/ROFL, even LMAO :-).

Memory register marked with label M resides under Input Box. In this sample it displays the value of number e (base of the natural logarithm) rounded to 14 decimal digits.

On-screen buttons are grouped into several virtual keypads with distinctive color-coding corresponding to their functional area:

Numeric buttons **0 …9** and the decimal point button have dark-color background.

Multipliers button group with dark-color gradient background include:

- **k** (kilo) x1,000
- **M** (Mega) x1,000,000
- **G** (Giga) x1,000,000,000
- **m** (mini) 1/1,000
- **μ** (micro) 1/1,000,000
- **n** (nano) 1/1,000,000,000

Useful Constants area comprised of the buttons with dark-gradient background; its functionality is intuitively clear with probably only exception for the value φ representing so-called "golden ratio": **(√5 +1) /2** (refer to [2] for detailed explanation).

1σ…6σ group (aka "*Sigma*" group) corresponds to the defects rate (or, more accurately, probability of defects normalized on scale 0…1). The group is located below constants area, and is also marked with dark-gradient background.

Reference Tables E6…E192 in this particular screenshot displays 48 numbers corresponding to the selected E48 standard series [3].

Memory Move To/From on-screen buttons marked as ˅ and ^ with dark-gray background reside within Input and Memory boxes, correspondingly.

Memory operations group contains buttons with dark-blue color gradient background.

Arithmetic operations buttons also have dark-blue color gradient background.

Scientific functions buttons have dark-blue color gradient background, as well.

Clear operation buttons, namely:

- ← Backspace
- CE Clear Entry
- AC All Clear
- CM Clear Memory

are all marked with dark-red color gradient background.

Electrical Engineering (EE) functional area contains on-screen buttons with dark-green color gradient background.

TIP: MOVE THE CURSOR OVER ANY ON-SCREEN BUTTON TO POP-UP ITS CORRESPONDING TOOLTIP

ON-SCREEN MEMORY REGISTER

CALCU LATOR VOLTA implements on-screen Memory register as an additional convenience feature, providing the ability to see the values in the input box and memory register simultaneously.

UNARY AND BINARY OPERATIONS

On a conceptual/abstract level, all functionality implemented in **CALCULATOR VOLTA** is represented by two major types of operations, namely: Unary and Binary operations.

As implied by name, Unary operations take a single number and return a single result. Mathematically speaking, they represent the functions accepting a single argument (or no argument at all pertinent to the case of entering constant values). Examples of Unary operations include: inverse operation **1 / x**), square (**x^2**), majority of trigonometric, hyperbolic, exponential and logarithmic functions. In a practical aspect, all these operations can be completed by a single button click.

Binary operations are performed on two numbers. From mathematical point of view, they represent functions of 2 arguments, which include:

4 BASIC ARITHMETIC OPERATIONS:

- Add +
- Subtract -
- Multiply x
- Divide ÷

PERCENTAGE OPERATIONS (%)

RAISING TO POWER OPERATION (y_x)

Specific Electrical Engineering (EE) functions of Unary/Binary types are discussed in the next sub-chapter.

ELECTRICAL ENGINEERING (EE) UNARY FUNCTIONS

As mentioned before, EE functions can be of either Unary or Binary operations. The following list refers to the Unary EE operations:

- **ZC(60)**Capacitive Impedance (**C**) corresponding to **60** Hz/AC (USA)
- **ZL(60)**Inductive Impedance (**L**) corresponding to **60** Hz/AC (USA)
- **ZC(50)**Capacitive Impedance (**C**) corresponding to **50** Hz/AC (Europe)
- **ZL(50)**Inductive Impedance (**L**) corresponding to **50** Hz/AC (Europe)
- **F > ω**Ordinary (cyclic) to Angular (radian) Frequency conversion
- **ω > F**Angular (radian) to Ordinary (cyclic) Frequency conversion
- **Fit(R)**Best Fit Resistance: returns single value from E-Series
- **Fit(R/R)**Best Fit Ratio: returns 2 E-Series values
- **Fit(RR)** Best Fit Resistance2: returns 1 or 2 E-Series value(s), circuit topology

Listed below are EE Binary operations implemented in **CALCULATOR V O LT A**

ELECTRICAL ENGINEERING (EE) BINARY OPERATIONS:

- Electrical Power $\mathbf{U^2/R}$
- Equivalent resistance of 2 Resistors in parallel circuit **R||r**
- Resonant Frequency of LC circuit **F(LC)**

STANDARD E-SERIES REFERENCE TABLES[5]

- **E6** (20% tolerance; rarely used)
- **E12** (10% tolerance)
- **E24** (5% tolerance; frequently used)
- **E48** (2% tolerance)
- **E96** (1% tolerance)
- **E192** (better than 0.5% tolerance)

[5] For more information on standard E-Series refer to Reference section [3]

SAMPLE COMPUTATIONS

Following samples demonstrate some non-trivial computation technique.

CHAIN OPERATIONS

Chain operations refer to multiple arithmetic operations to be completed in sequence, as shown in the following Example 1:

EXAMPLE 1: CALCULATE (3.5 X 4 + 7)

- Enter the number **3.5** using on-screen numeric keypad
- Click on the **x** button
- Enter the number **4**
- Click on the **+** button; intermediate result (**14)** will appear
- Enter the number **7**
- Click on the **=** button to get the final result (**21**)

Notice, that chain operations continue until **=** button is pressed, which works as a "chain operations terminator".

PERCENTAGE CALCULATIONS

EXAMPLE 2: CALCULATE 4% OF 6.95

- Enter the number **6.95** using on-screen numeric keypad
- Click on the Multiply (**x**) button
- Enter the number **4** using on-screen numeric keypad
- Click on Percentage (**%**) button to get the result: **0.278**

EXAMPLE 3: INCREASE THE VALUE OF 6.95 BY 4%

- Enter the number **6.95** using on-screen numeric keypad
- Click on the **+** button
- Enter the number **4** using on-screen numeric keypad
- Click on Percentage (**%**) button to get the result: **7.228**

Example 3 actually calculates the value of **6.95 x (1+0.04)**; it demonstrates the "shortcut" technique as an alternative to the trivial "long way" solution, which implies storing the number **6.95** in Memory, then finding **4%** of **6.95** as described in Example 2, and then adding that intermediate result (**0.278**) to the value stored in Memory in order to get the final result (**7.228)**.

Electrical Engineering Computations

Example 4: Calculate equivalent resistance of 2kOhm and 3kOhm resistors, connected in parallel circuit

- Enter the number **2** using the on-screen numeric keypad
- Click on multiplier *** K** resulting in the value shown as: **2000**
- Click on the button **R | | R**
- Enter the second Resistor's value **3**
- Click on multiplier button *** K** (the number **3000** should appear)
- Finally, click on the button **=** to get the result: **1200** (corresponding to **1.2kOhm** as per normal EE notation)

Example 5: Calculate the AC impedance of 1.5uF capacitor connected to 60 Hz AC

- Enter the number **1.5** using the on-screen numeric keypad
- Click on multiplier ***μ** button to convert the value to **0.0000015** (or **1.5E-06**)
- Click on the button **Zc(60)** to get the results in Ohm: **1768.38825657662**
- Optionally, click on the button ***m** to get result in kOhm (**1.76838825657662**)

Example 6: Calculate resonant frequency of parallel LC circuit provided that: L=2mH, C=3nF

- Enter the number 2 using the on-screen numeric keypad
- Click on multiplier ***m** so the value should become: **0.002**
- Click on **F(LC)** button
- Enter number 3
- Click on the button ***n** so the value should become: **3E-9**
- Click on the button **=** to get the result: **64974.7334361397** Hz
- Optionally, click on the button ***m** to get result in kHz (**64.9747334361397**)

Example 7: Calculate electric power dissipated by 2 Ohm Resistor connected to 5V Voltage source

- Enter the number **5** for Voltage using the on-screen numeric keypad
- Click on **U^2/R** button
- Enter the Resistor's value in Ohm, namely: **2**
- Click on the button **=** to get the result: **12.5 W**

Tip: if Current is given instead of voltage, then simply calculate Voltage V by applying Ohm's law (**V=I x R**), then use the technique described above

Example 8: Calculate electric power dissipated by 2 Ohm Resistor corresponding to current through of 2.5 A

- Enter the number **2** for Resistance (in Ohm)
- Click on "To Memory" button v
- Click on "multiply" button x
- Enter the number **2.5** for Current (in A)
- Click on U^2/R button
- Click on "from Memory" button ^
- Click on the button = to get the result: **12.5 W**

Example 9: Find Best Fit value for **31.4159265359879** Ohm Resistance from E48 standard series[6]

- Enter target value normalized on 1…10 scale, i.e. **3.14169265359879**

Tip: In this example, you can just press the key **π**

- Click on E48 button; E-Series table should display corresponding values
- Click on **Fit(R)** button to get normalized result in Memory box formatted as: |E48| R=**3.16** (Err=0.586%)
- De-normalize result to get the actual best fit value of: **31.6** Ohm

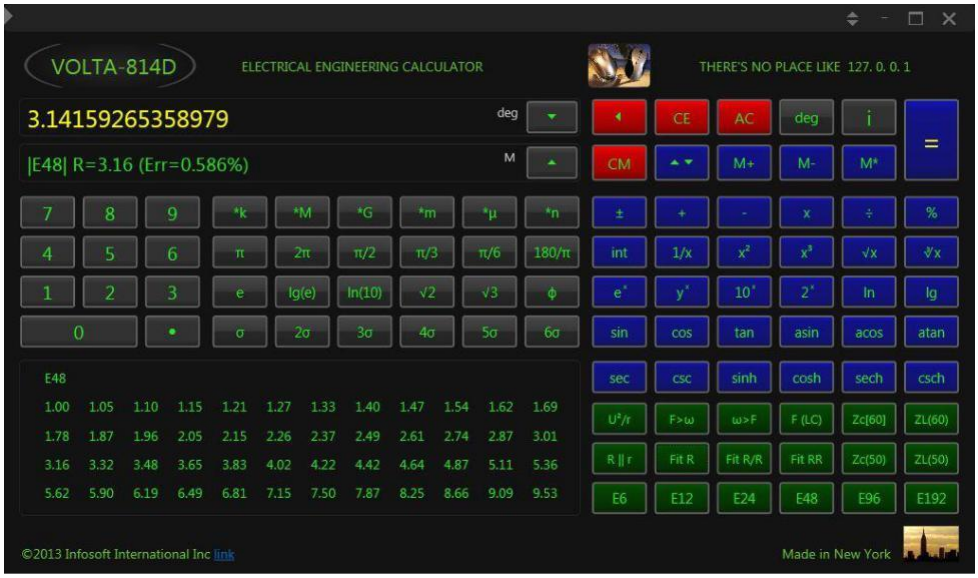


Figure 4: Sample Best Fit R calculation

Tip: Double-click on any value in the E-Series Table to make it appear in the input box

[6] The number may look seemingly weird, but it actually corresponds to 10**π**

EXAMPLE 10: FIND 2 RESITORS FROM E96 TO BEST FIT RATIO OF 5

- Enter the target ratio number: **5**
- Click on E96 button: E-Series table should display corresponding values
- Click on **Fit(R/R)** button to get result in Memory box in the following format: |E96| R1/R2=**6.65/1.33**=5 (Err=0%)

FIGURE 5: SAMPLE BEST FIT RATIO CALCULATION

Result shown in Memory box can be interpreted as a pair of resistance values **6.65** and **1.33** taken from **E96** standard series, providing the best fit to the target ratio of **5** (calculated relative error: 0%).

TIP: DOUBLE-CLICK ON ANY VALUE IN THE E-SERIES TABLE TO MAKE IT APPEAR IN THE INPUT BOX

Example 11: Find Best Fit for 271.828182845905 Ohm Resistance using 1 or 2 E24 Resistors[7]

- Enter the target value normalized on 1…10 scale, i.e. **2.71828182845905**

> Tip: In this example, you can just press the key **e**

- Click on E24 button (E-Series table should display corresponding value set)
- Click on **Fit(RR)** button to get result in Memory box in the following format: |E24 Par| 11.0, 3.6 (R=2.712; Err=-0.219%)

  Note: Result can be interpreted as a pair of Resistors with normalized values of **11** and **3.6** taken from E24 standard series, connected in parallel circuit, providing the best fit to the target Resistance of. Calculated value is **2.712,** relative error: -0.219%. |Par| indicates parallel, |Ser| corresponds to series circuit topology.

- Finally, de-normalize values (multiply both by factor of 100) resulting in: **360** Ohm and **1100** Ohm (**1.1** kOhm)

Figure 6 Best FitRR sample calculation (returns either 1 or 2 Resistors)

Tip: Double-click on any value in the E-Series Table to make it appear in the input box

[7] The number may look seemingly weird, but it actually corresponds to 100**e**

REFERENCES

1. Engineering Calculator VOLTA, product page
2. Golden ratio (wiki)
3. Preferred number (wiki)

LIST OF TERMS AND ACRONYMS

CS	Computer Science
EE	Electrical Engineering
EULA	End-User License Agreement
E6…E192	Standard values for RLC components
GUI	Graphical User Interface
OS	Operating System
PC	Personal Computer
RLC	Resistors, Inductors, Capacitors (electric components)
UI	User Interface
UX	User eXperience