



# Using LectriCalc™

Version 5

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***Electrical Calculation Software for Windows, Palm OS, and Windows Mobile***

<http://www.arkansoft.com>

[sales@arkansoft.com](mailto:sales@arkansoft.com) [support@arkansoft.com](mailto:support@arkansoft.com)

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For LectriCalc download and purchase details and hardware purchase recommendations, visit <http://www.arkansoft.com/LectriCalc.html>  
*(Be sure to check this LectriCalc web page occasionally for upgrade information.  
We often post minor upgrades with enhancements that are free  
to registered users of LectriCalc 5.x.)*

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## Installation

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### Windows Version Only

- If you don't need the handheld computer companion version, you can get just the Windows desktop/laptop version of LectriCalc. Download it at <http://arkansoft.com/Downloads/LectriCalcV5WindowsSetup.exe>
  - Run the setup.exe program and follow the on-screen instructions to complete the installation.
  - *The Windows version of LectriCalc works from a smaller screen than that of most Windows programs. Similar to the Windows Calculator program, the compact program screen lets you tuck LectriCalc in one corner of your Windows desktop as you're working with another program, like a parts spreadsheet or word processor. You can perform calculations in LectriCalc and still see the spreadsheet or other program you are working with.*
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### Palm OS/Windows Version

- If you don't already have it, download the LectriCalc software from: <http://arkansoft.com/Downloads/LectriCalcV5PalmHandheldSetup.exe>
- Unzip the compressed software file to a location on your Windows computer's hard disk.  
*If your computer cannot automatically unzip the compressed "ZIP" file when you double-click it, you can download a free decompression tool such as Stuffit Expander to do the job for you. <http://www.stuffit.com/win/expander/>*
- After unzipping the file, run LectriCalcPalmSetup.exe to perform the installation. Follow the setup program's on-screen instructions to install both the Palm OS version to your handheld computer, and to install the companion Windows desktop version of LectriCalc.

### Installing to an Expansion Memory Card

LectriCalc **must** be installed to regular RAM memory, and LectriCalc must be run, at least once, from regular RAM in order to create the data files needed by the program. After the software has been run from regular RAM, you can, if desired, move the LectriCalc program file to your memory card to free up RAM on your device. You must, however, always have sufficient free RAM to hold the LectriCalc program file (about 600kb) since the program file must be moved from the card to regular RAM when you use it.

If you have enough room in RAM, and you plan to use LectriCalc often, you should leave it in RAM all the time, since this will speed up time required for the program to start up.

### Palm OS Version Only

- If you don't need the Windows companion version, you can get just the Palm OS handheld version of LectriCalc. Download it at <http://arkansoft.com/Downloads/LectriCalcV5Install.prc>
  - Install the downloaded PRC file to your handheld in your usual method. Generally this just involves double-clicking the PRC file to set it up for installation onto your handheld at your next HotSync.
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### Windows Mobile/Windows Version

- If you don't already have it, download the LectriCalc software from: <http://arkansoft.com/Downloads/LectriCalcV5WMHandheldSetup.exe>
- Unzip the compressed software file to a location on your Windows computer's hard disk.  
*If your computer cannot automatically unzip the compressed "ZIP" file when you double-click it, you can download a free decompression tool such as Stuffit Expander to do the job for you.*  
<http://www.stuffit.com/win/expander/>
- After unzipping the file, run LectriCalcWMSetup.exe to perform the installation. Follow the setup program's on-screen instructions to install both the Windows Mobile version to your handheld computer, and to install the companion Windows desktop version of LectriCalc.

## Un-Installation

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***Note: If you plan to remove LectriCalc from both your handheld and desktop/laptop computer, remove it from the handheld computer first, then remove it from the desktop or laptop computer***

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Removing LectriCalc from your Palm OS handheld computer:

- From your handheld's "desktop", drop down the menu at the top of the screen and select Delete...
  - Locate LectriCalc on the list of installed software, tap to select LectriCalc on the list, then select Delete... at the bottom of the screen.
- 

Removing LectriCalc from your Windows Mobile handheld computer:

- Put your handheld onto its sync cradle
  - Open ActiveSync on the desktop computer and select Add/Remove Programs... from the Tools menu.
- 

Removing LectriCalc from your Windows desktop or laptop computer:

- Click the Windows Start button, select All Programs, then locate the LectriCalc program group.
- In the LectriCalc program group, select Uninstall LectriCalc for Windows, then follow the on-screen instructions.

## Registration

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LectriCalc installs as a free trial version. You will enter a registration key to unlock the trial version and convert it to registered, fully functional software.

Your registration key is provided in an e-mail you'll receive after making your purchase. This purchase confirmation e-mail generally arrives within 24 hours of purchase time.

***Be sure to your anti-virus and anti-spam software includes the [sales@arkansoft.com](mailto:sales@arkansoft.com) and [support@arkansoft.com](mailto:support@arkansoft.com) e-mail addresses on your "friends" list so your purchase confirmation e-mail can get through to you.***

When you start LectriCalc, you'll see a "trial version" announcement screen. On the handheld, you will see two buttons at the bottom of the screen. Select the [Register] button to go to the Registration screen. *(In the Windows version, click [Continue] to go to the Registration screen.)*

### **HANDHELD VERSION REGISTRATION:**

On the Registration screen, tap the number buttons on the screen to enter your five-digit registration key. If you have the correct key for your device and if you enter the key correctly you will get a "registration successful" message after entering the fifth digit. Otherwise, you'll get a help message telling what you can do to enter a correct key.

### **WINDOWS VERSION REGISTRATION:**

When you purchased your registration key, you also provided either your handheld computer's "device name" or your e-mail address, and your registration key was created to work with this information.

To register LectriCalc for Windows, you will first enter on the Registration screen your handheld's device name, or your e-mail address, exactly as you entered it when you purchased your registration key. Then use the number buttons on the registration screen to enter your registration key. If you have the correct key for your device and if you enter the key and your device name/e-mail address correctly, you will get a "registration successful" message. Otherwise, you'll get a help message telling what you can do to enter a correct key.

For more information and helpful graphic images on using Arkansoft registration keys, visit our website Help Pages:

<http://www.arkansoft.com/FAQRegistration.html>

<http://www.arkansoft.com/FAQInvalidCode.html>

## Upgrading From Previous Versions of LectriCalc

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If you are upgrading from a previous version of LectriCalc, it's not necessary to uninstall your previous version before installing your upgrade.

### **Special notes about upgrades from LectriCalc Version 3 and earlier:**

The first thing users of LectriCalc version 3 will notice are the larger screen fonts. In almost all cases, LectriCalc now uses larger fonts, making the small screens easier to read.

Also, we've cut back on the graphic images to give the product a cleaner, more "down to business" appearance.

All the calculators now remember the last settings you had. So if you exit LectriCalc then return tomorrow, when you return to a calculator it will still have the settings you last used. You can turn this feature off if you don't want it to save data settings when you exit. To turn it off, drop down the Top Menu in any of the calculators and select Prefs>Save state on exit.

On Palm OS devices with a keyboard, like a Treo smartphone, you can use the number keys on the telephone keypad to enter numbers into the LectriCalc calculators. Other uses can open their on-screen numeric keyboard or use Graffiti handwriting recognition software.

We've pretty much done away with the [Calculate] buttons on the calculator screens. In the previous version, you entered your numbers then tapped [Calculate] to do the calculation and display the result. Now, as soon as you've entered enough data to make a calculation, LectriCalc displays a result, and the result changes each time you enter more data.

**Power Factor Note:** *LectriCalc has changed the format in which users will enter power factor. Power factor is now entered as a percent. For example, if you entered power factor as "1" in the previous version of LectriCalc, you will now enter it as "100". Likewise, if you entered a power factor of "0.8" in the previous version, that power factor would now be entered as "80".*



## Before You Start

The LectriCalc software, particularly when used in conjunction with the Master Bender software, also available from the Arkansoft website, will permit all types of electricians, including residential, commercial, industrial, construction, and maintenance, to do many popular everyday calculations and information lookup in seconds. Architects, engineers and contractors will also find this information useful.

Most LectriCalc calculators use pull down number selections for quicker use. The need is greatly reduced for a separate fractional calculator, trigonometric/scientific calculator, pocket references, charts and tables.

Should you need information or a calculator not now included in LectriCalc, please make your suggestion known at <http://www.arkansoft.com/Suggestions.html>.

Make Arkansoft Software your one-stop site for all of your electrical needs. Many of the features in the LectriCalc series cannot be found with other software vendors or even multiple vendor sites.

Design and build many of the raceway systems found today. Bend conduit, support raceways (where to support from boxes and open length runs) ,drill holes, fill conduit, fill boxes, determine wire ampacity, voltage drop, grounding size, motor data and more.

You can find many of the standard size breakers, fuses, jboxes, gutters, wireways, disconnects, panelboards and other information. LectriCalc is educational and much of the information can be used for contractor licensing, electrical certification, electrical inspector compliance and other related exams or inspections.

## What's New

LectriCalc Version 5 includes new calculators, enhancements to calculators previously available, and updates to reflect changes in the 2008 National Electrical Code.

### **NEW: IEEE 141 Exact Voltage Drop calculation in a new Impedance calculator.**

This engineering-grade voltage drop formula is used for 3 phase circuits and calculates:

- IEEE 141 Voltage Drop
- Resistance
- Reactance
- Effective Z (Impedance)

### **NEW: Single Phase, Three Phase Delta and Wye Transformer calculators**

- These new calculators can make 30 different transformer calculations

### **NEW: Wire Cost calculator**

- Easily calculate the value of copper and aluminum wire to see how much the waste is costing you.

### **ENHANCED Motor Data Calculator**

- Added multi-motor calculation capability
- Added locked rotor current calculation

### **ENHANCED Ampacity Calculator**

- Added UP/DOWN button beside Conductor Size in lower right corner. Selecting this button pops up a wire size selector that lets user pick a wire size and see its ampacity, using the current screen settings
- Added "Par." checkbox to allow for calculation of Parallel Ampacity.
- Added metric Wire Size output
- Added rooftop ambient temperature correction factor to Ampacity calculator, per NEC 2008 change

### **ENHANCED Conduit Fill Calculator**

- Added UP button beside recommended conduit in lower right corner. Selecting this button displays information about using the current wire fill in a larger conduit than is really needed.
- Added RMC Hazardous Seal and GRC Hazardous Seal to conduit types list
- Added Metal and Non-Metal Auxiliary Gutter fill calculations to conduit types list
- Added Metal Cable Tray fill calculations for conductor sizes 1/0 and larger
- Added Conduit Body information for conductors size 6 and smaller
- Added Wire-Bending Space allowance table for sizes 8 and larger
- Conduit Fill Calculator now displays information about the currently selected conductor: Area in mm<sup>2</sup> and in<sup>2</sup> and Diameter in mm and inches.

### **ENHANCED Voltage Drop Calculator**

- Modified Voltage Drop Calculator to offer both the previous, advanced version that considers copper/aluminum, solid/strand, and temperature, and also a basic calculator that does not consider wire type or temperature. Some state regulations mandate use only of a basic calculator. Also see new IEEE 141 Exact Voltage Drop calculation available in the new Impedance calculator. This engineering-grade voltage drop formula is used for 3 phase circuits.

### **ENHANCED GEC Calculator**

- This calculator now shows GEC for both copper and aluminum.

### **ENHANCED Reference Section**

- Added nearly 200 electrical symbols
- Added conduit weights table
- Added a [Cancel] button in case user enters wire type "Other..." but does not know area in sq. in.
- Added tables on Pressure Twist-On Wire Connector color information based on the mix of conductors being connected

Also, 5-way button navigation is now available for use on top menus on Palm OS handhelds equipped with a 5-way navigator.

## Beaming LectriCalc From One Palm OS Handheld Computer to Another

The LectriCalc/Master Bender install package can be “beamed” easily and quickly, via built-in infrared capability, from one Palm OS handheld to another Palm OS handheld. The software beams as a free trial version. To convert the trial version to registered, registration keys can be purchased and free user’s manuals downloaded at [www.arkansoft.com](http://www.arkansoft.com)

***To beam LectriCalc, you must keep the “Install LCalc Trial” installer program on your Palm OS handheld computer.*** You can store the installer on a memory card if your handheld supports memory cards (i.e. SD cards).

To beam the installer to someone else, follow these steps:

1. From your Palm’s main menu, tap the upper left corner of the screen to drop down the “Top Menu”.
2. From the menu that appears, tap “Beam” on the App menu.  
*If the LCalc Trial installer is on your handheld’s expansion memory card, set the dropdown at the top of the Beam screen to Beam from Card.*
3. When the list of programs on your handheld appears, scroll down as necessary to find LCalc Trial. *Be careful to locate LCalc Trial, the installer, and not LectriCalc, the program.*
4. Tap LCalc Trial to highlight it.
5. Make sure the receiving Palm is on and ready to receive beamed files, put the two Palms “head-to-head” about a foot apart, and tap the [Beam] button at the bottom of the screen.
6. Once the file is finished beaming, tap the [Done] button at the bottom of the screen to exit the beaming function.

**NOTE:** On many LectriCalc screens you will see **drop-down selectors** that let you quickly pick a choice from a pre-defined list. In most cases use of the drop-down list is optional. If the list doesn't have the choice you need, just enter the information directly in the text area the way you would in any program.

In some cases, you *are* limited to only picking a choice from the pre-defined list, but in most cases you are free to enter any number you wish.


## The LectriCalc Main Menu


When you select the LectriCalc icon on your device menu, the program takes a moment to load, then you see the LectriCalc Main Menu.

*(If you have not yet registered your copy of LectriCalc, you start with a Trial Version screen. See the previous section on registering LectriCalc.)*

Just select any item from the menu to open that part of the program.

Note: If you have both LectriCalc and Master Bender-Computer Aided Bending installed on your device, a Master Bender button will appear on your LectriCalc Main Menu letting you switch directly to Master Bender without having to go through the device main menu first.

LectriCalc 5.0 	
Ampacity	Amps From...
Box Size	Conduit Fill
Energy Cost	Find KW/HP
Footcandles	Ground Cond.
Impedance	Motor Data
Transformers	Wattage/KVA
Reference	Wire Cost
<input type="checkbox"/> L	
Voltage Drop	Code-A-Day™

LectriCalc 5.0 	
Ampacity	Amps From...
Box Size	Conduit Fill
Energy Cost	Find KW/HP
Footcandles	Ground Cond.
Impedance	Motor Data
Transformers	Wattage/KVA
Reference	Wire Cost
<input type="checkbox"/> L	Master Bender-CAB
Voltage Drop	Code-A-Day™

## Ampacity

To perform an ampacity calculation you must enter Continuous and/or Non-continuous amps at the top of the screen.

LectriCalc finds ampacity of wire with optional termination, and derating inputs (wire bundling adjustment and temperature correction). The result is minimum wire size and maximum overcurrent protection device.

**Ampacity** CF RESET ◀

Continuous 40 ☐ 100%  
 Non-cont. 20 ☐ Branch  
 ▼ Raceway ☒ CU ☐ AL  
 Ambient ▼ 26-30C/78-86F  
 # Conductors ▼ 1-3 ☐ Par.  
 ▼ THHN(90) Terminal temp ▼ 60C

---

**Derated** 95.00 **Max** 95  
**OCPD Min** 70 **Max** 100  
**Wire Size** 4 (25 mm²) ⚡

If you indicate a rooftop raceway, LectriCalc calculates ampacity based on a higher ambient temperature than the one you enter, as specified by NEC 2008 Table 310.15(B)(2)(c). The number of degrees C your ambient entry will be increased for calculation purposes will be displayed to the right of your ambient temperature setting on rooftop raceway calculations.

### Using the checkboxes in the Ampacity calculator:

Mark the 100% checkbox if the overcurrent protection device (OCPD) being used is rated for use at 100% continuous load. This is used in calculating the "low load overcurrent protection device" from NEC Section 240 (Overcurrent Protection). If the OCPD is rated for use at 100 per cent continuous load, LectriCalc adds the Continuous load to the Noncontinuous load to arrive at the Low Load. If the OCPD is not rated for use at 100 per cent continuous load, LectriCalc adds the noncontinuous load to 125 per cent of the continuous load to arrive at the Low Load. Once Low Load is calculated, it comes into play in the final selection of the proper OCPD.

Mark the Branch checkbox if the circuit we're calculating for is a branch circuit supplying multiple receptacles and outlets. If we are calculating for a branch circuit, NEC Section 240 says the OCPD is selected by "sizing down" the OCPD so that the OCPD selected is equal to or less than the derated conductor ampacity. If we are not calculating for a branch circuit, the OCPD is selected by "sizing up" the OCPD so that the OCPD selected is equal to or greater than the derated conductor ampacity.

Ampacity for THHN(90) Copper	
With current settings for Size 3/0:	
Derated:	225.00
Maximum:	225.00
All Size 3/0 Copper Insulation Values:	
60C Derated:	165.00
60C Maximum:	165.00
75C Derated:	200.00
75C Maximum:	200.00
90C Derated:	225.00
90C Maximum:	225.00

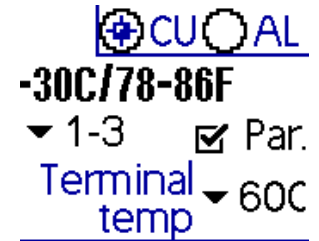
### Using the UP/DOWN button in the Ampacity calculator:

In the Ampacity calculator, beside Wire Size in lower right corner, an UP/DOWN arrow allows the user to pick any wire size and see its ampacity, using the current screen settings. The resulting display, as in the example to the right for 3/0 copper, shows derated and maximum ampacity, based on the current Ampacity screen settings, for different wire insulation temperatures.

### Parallel Ampacity in the Ampacity calculator:


Marking the “Par.” checkbox on the Ampacity screen causes the current ampacity calculation to be based on parallel conductors.

Most other items in this calculator should be obvious to the user. Select the “dropdown” lists to change settings as needed.



*Palm OS Version Only:*


*At the top of the screen, selecting [CF] brings up a Celsius/Fahrenheit Temperature Conversion utility.*

Select the  “back button” in the upper right corner of the screen to return to the LectriCalc Main Menu.

## Amps From...

This calculator lets you find amps from a combination of volts and: watts or kVA or KW or HP.

Just select the item you need using the radio buttons at the top of the screen, then supply the needed information and the result will appear in the lower portion of the screen.

Select the  "back button" in the upper right corner of the screen to return to the LectriCalc Main Menu. NOTE: to run the Amps From... calculator, we must swap some parts of LectriCalc out of device memory. When you exit the Amps From... calculator, there is a brief delay while LectriCalc re-loads into device memory.

Find amps from volts and... 

☐ watts ☐ KVA ☒ KW ☐ HP

Volts: 230 .....

KW: 2.8 .....

Power Factor: 80 .....

**Current      Amps**

DC: 12.17

AC, single phase: 15.22

AC, 3-phase: 8.80



## Box Size

The Box Size calculator supports wire sizes from size 6 to size 16. Use the drop down selectors under each wire size to indicate how many of each size will go into the box. For example, in the screen to the right, the box will hold four Size 12 wires and two Size 16 wires, plus clamps, studs, and two devices.

If your box contains one or more clamps, select to mark the Clamps checkbox. Do the same if your box contains one or more hickeyes, studs, grounds (GNDS), and/or insulated grounds (IG).

Use the dropdown selector to select the number of devices contained in the box.

As you make selections to indicate the box fill, the results at the bottom of the screen will change. The “Cubic in.” readout will tell you the current cumulative total cubic inches of space required by the wires, clamps, etc. you have indicated to go in the box. The scrollable list at the bottom of the screen will show all the standard boxes that will hold the currently indicated fill. Best matches are marked with “\*”.

Box Fill

RESET

CF

Opt: Desired box in<sup>3</sup>

#6

#8

#10

#12

#14

#16

▼0

▼0

▼0

▼4

▼0

▼2

Clamps

Hickeyes

Studs

GNDS

IG

Devices

OK boxes:

Cubic in.

26.00

\*4-11/16 x 1-1/2 in.

(square)=29.5 in<sup>3</sup>

(120 x 38 mm 484 cm<sup>3</sup>)

Optionally, you can indicate a box you have on hand and LectriCalc will help you determine if your desired fill will fit in the box. To indicate a box on hand, select the dropdown list at the top of the screen to the right of “Opt: Desired box”. You will be presented with a scrollable list of standard boxes. Find the box you want to use and select it.

Box Fill

RESET

CF

Opt: Desired box 29.5 in<sup>3</sup>

OK

#6

#8

#10

#12

#14

#16

▼0

▼0

▼0

▼4

▼0

▼2

Clamps

Hickeyes

Studs

GNDS

IG

Devices

OK boxes:

Cubic in.

26.00

\*4-11/16 x 1-1/2 in.

(square)=29.5 in<sup>3</sup>

(120 x 38 mm 484 cm<sup>3</sup>)

Once you select a box from the list, the box’s size (cubic inches) will be plugged in at the top of the screen. Note in the example to the left that [OK] has appeared in the upper right area of the screen. This indicates that the current fill will fit in the box you have selected (you selected a 29.5 cu. in. box, shown near the top of the screen, and your current fill only needs 26 cu. in., shown near the bottom of the screen).

4-11/16 x 1-1/4 in. (square)

4-11/16 x 1-1/2 in. (square)

4-11/16 x 2-1/8 in. (square)

4 x 1-1/4 in. (round/oct)

4 x 1-1/2 in. (round/oct)

4 x 2-1/8 in. (round/oct)

4 x 1-1/4 in. (square)

4 x 1-1/2 in. (square)

4 x 2-1/8 in. (square)

3 x 2 x 1-1/2 in. (device)

3 x 2 x 2 in. (device)

Selecting a box on hand.

If the current fill will NOT fit into the box you selected, [NO] will appear in the upper right area of the screen, rather than [OK], as in the example to the right, where desired box will take 29.5 cu. in., but the fill currently totals 30 cu. in. In a case where [NO] appears, you can, if desired, select the [NO] button and see what size extension ring or cover you can use to make additional space for your desired fill.

**Box Fill** **RESET** **CF** **◀**  
 Opt: Desired box ▼ 29.5 in<sup>3</sup> **NO**  
 #6 #8 #10 #12 #14 #16  
 ▼ 0 ▼ 0 ▼ 0 ▼ 4 ▼ 2 ▼ 2  
 Clamps ☒ Hickeys ☐ Studs ☒  
 GNDS ☐ IG ☐ Devices ▼ 2  
**OK boxes:** **i** **Cubic in.** 30.00  
 \*4 x 2-1/8 in. (square)=30.3 in<sup>3</sup>  
 (100 x 54 mm=497 cm<sup>3</sup>)

**Box Fill** **RESET** **CF** **◀**  
 Opt: Desired box ▼ 29.5 in<sup>3</sup> **NO**  
 #6 #8 #10 #12 #14 #16  
 ▼ 0 ▼ 0 ▼ 0 ▼ 4 ▼ 2 ▼ 2

**EXTENSION TYPE**  
**SELECT EXTENSION TYPE...**

**RING** **COVER** **CANCEL**

When you select [NO] you'll be asked to select the type extension you want to use, Ring or Cover (left). When you make your selection, you will be shown what size extensions will work to hold the balance of your desired fill (right).

**Addnl. cu. in. needed: 0.5**  
 Extensions marked \* are OK:  
 \*1-1/2 in ext. ring (+20.5)  
 \*2-1/4 in ext. ring (+40.2)

**Clamps** ☒ **Hickeys** ☐ **Studs** ☒  
**GNDS** ☐ **IG** ☐ **Devices** ▼ 2  
**OK boxes:** **i** **Cubic in.** 30.00  
 \*4 x 2-1/8 in. (square)=30.3 in<sup>3</sup>  
 (100 x 54 mm=497 cm<sup>3</sup>)

**Box Fill** **RESET** **i** **CF** **◀**  
 Opt: Desired box ▼ 29.5 in<sup>3</sup> **NO**  
 #6 #8 #10 #12 #14 #16  
 ▼ 0 ▼ 0 ▼ 0 ▼ 4 ▼ 2 ▼ 2  
 Clamps ☒ Hickeys ☐ Studs ☒  
 GNDS ☐ IG ☐ Devices ▼ 2  
**OK boxes:** **i** **Cubic in.** 30.00  
 \*4 x 2-1/8 in. (square)=30.3 in<sup>3</sup>  
 (100 x 54 mm=497 cm<sup>3</sup>)

### One final note on Box Size...

When you select a box, at the top of the screen, an (i) information button appears above the desired box's cubic inches (see image to the left...the information button is between [Reset] and [CF] at the top of the screen).

When you select this information button you will see a help screen showing how many conductors the desired box can hold (if only wires are in the box).

4-11/16 x 1-1/2 in. (square) can take the following no. of conductors if the box has no other clamps, hickeys, studs, grounds, or devices:

Conductor Size	# cond.
16	16
14	14
12	13
10	11
8	9

*Palm OS Version Only:*

*At the top of the screen, selecting [CF] brings up a Celsius/Fahrenheit Temperature Conversion utility.*

Select the **◀** "back button" in the upper right corner of the screen to return to the LectriCalc Main Menu.

## Code-A-Day™

Code-A-Day Questions & Answers are copyright © 2007 by Lewis Hinkle

### ***Stay Sharp On National Electrical Code® and Trade Practices***

The definition of an Electrical Journeyman is “an electrical workman who knows his trade.” In most localities, becoming an electrician requires passage of a recognized exam. Besides being familiar with NEC® rules and regulations, one must know how to calculate and/or understand, often quickly, simple to complex problems, from simple distance fractional additions to complex motor parameters and conduit fills or amp capacities with derating.

Code-A-Day was developed as a handy way to let you review and enhance your knowledge of electrical code regulations, and to learn more about using the features of LectriCalc to help you find the answers.

LectriCalc and Master Bender can do the majority of calculations and information lookup for most types of electricians. Many more question sets will be released soon. A Code-A-Day keeps the inspector at bay!

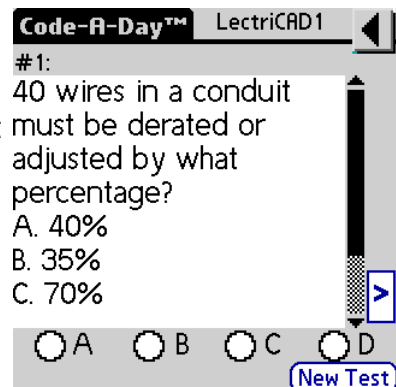
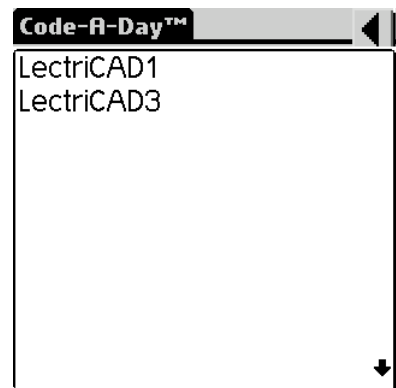
To start Code-A-Day, select the button in the lower right corner of the LectriCalc main menu.

The first time you run Code-A-Day, it presents a list of all "test sets" currently installed on your computer. The test sets have names like LectriCAD1 and LectriCAD2. In the future as we release more test sets and you install them, they will appear on the list also.

Select one of the test sets listed to open the set of questions. Code-A-Day will then start, and question 1 will appear, along with four possible answers. If it all won't fit in the display box, a scroll bar on the right will let you scroll down to see all the answers.

Note the [>] button near the lower right corner of the screen. This button lets you scroll forward to Question 2 and up. When question 2 appears, a [<] button will also appear to let you scroll back to Question 1. So the program lets you skip a question then return to it later.

Along the bottom of the screen are "radio buttons" that let you select your answer, A, B, C, or D. By default, there is no sound when selecting an answer. If you'd like, you can

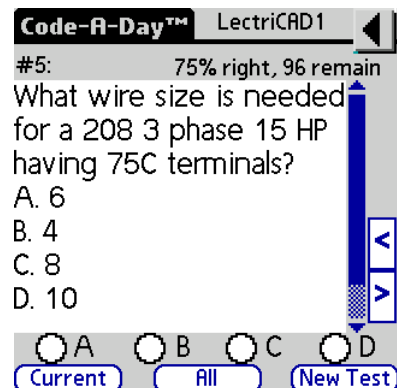


turn on a beep sound that will play each time you select a wrong answer. To active this sound, select Prefs from the menu at the top of the screen on Palm OS handhelds, or from the menu at the bottom of the screen on Windows Mobile handhelds. Also on the Prefs menu is an option to have your current "score", and the number of remaining unanswered questions, displayed near the top of the main Code-A-Day screen (registered version only).

Note the [New Test] button in the lower right corner of the screen. This pops up the "test sets" list, so you could switch to LectriCAD2 or LectriCAD3 or other installed test sets if you want to, or you can restart the same test you're currently using. If you start a new test, the previous test is closed. When you re-start a test you've taken before, the order of the questions will be randomly mixed up, so you never take the same test, in the same order, twice.

Once you answer at least one question, a [Current] button will appear in the lower left corner of the screen that lets you check your answers and test score for the current test (more on this later). If you're running the trial version of LectriCalc it will let you see all the questions, but answers to only 5 questions will be displayed on the current test results screen.

Each time you tap A, B, C, or D to answer a question, your answer is saved and the next question appears instantly. If you have registered your software, your current score will appear in the upper right area of the screen, such as the "75% right" score shown in the accompanying image. The number of questions remaining unanswered is also displayed. You can use the scroll buttons on the right to go back and change an answer or give an answer to a question you skipped earlier.



When you tap the [Current] button in the lower left corner of the screen, a grid appears showing the question number, the question, the answer you gave (under the column headed "?") and the correct answer (the column on the right, headed "+"). At the bottom of the screen it gives your score: the number of correct

Results, This Test				
#	Question	?	+	
1	What is the wattage of a circuit with 240 volts and 30 amps?	B	B	
2	What saw hole size is needed for 3/4 EMT?	A	A	
3	Many residential panelboards have what temperature terminal	B	A	
Correct: 6		Incorrect: 2		
Answered: 8		Score: 75%		

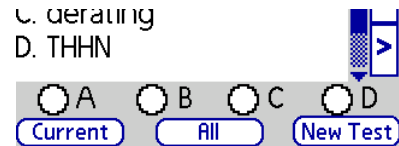
answers, the number of incorrect answers, the total number of questions you have answered so far, and your grade as a percent of 100.

Once you've answered all questions in the question set, your score for this test is saved. If you have sound turned on...see Sound on the top menu (Palm OS handhelds) or the bottom menu (Win Mobile handhelds)...a sound will play when you have completed all questions.

*NOTE: if you answer the last question and the test results screen does not display, it means you have not answered all questions yet.*

*You've missed one along the way. Use the Current results button in the lower left corner of the screen to scan through the question numbers and see which one(s) you've missed, or use the [<] scroll button on the right side of the screen to scan backward through the questions and see which one(s) you've not answered yet.*

Once a test set has been completed, either by answering all questions in the set, or by abandoning a set you've started and opening a new test, an [All] button appears in the center, bottom of the [Code-A-Day] screen. Tapping the All button brings up a history of all the tests you've finished so far, listing the date you finished the test, the question set involved, and your score. The date is given in year/month/day format. The trash can button to the right of each record lets you delete any that record. If more tests have been taken that will fit on the All screen, a scroll bar appears on the right to let you scroll and see all tests.



Results, All Tests			
Date	Question Set	Score	
07/04/08 ...	LectriCAD1	75%	
07/04/08 ...	LectriCAD3	80%	

When done, tapping the [<] button in the upper right corner takes you back to the LectriCalc main menu. The number of

	Amps From...	5
Reference	Code-A-Day™	

the most recently viewed Code-A-Day question will appear just above the Code-A-Day button on the LectriCalc main menu, as a reminder of where you are in the test. In the example

to the left it shows that the current question is "5".

Next time you return to Code-A-Day, you come back to the same place where you left off last time.

In LectriCalc you can go to any of the modules (Motor Data, Box Size, etc.) then open the menu at the top of the screen and look on the Prefs menu. Select "Code-A-Day question" there and it will show you the current question. So you can read a question in Code-A-Day, then go to LectriCalc and work on finding the answer and use the menu at the top of the screen to refresh your memory on what the question was. In some cases there's not room to display all the question in the message box, but enough should fit to refresh the user's memory on what the question was asking.

## Conduit Fill

The Conduit Fill calculator will calculate what size conduit is required for the wires you have to put in it. General conductors, fixture wires and switchboard wires are listed. To use the calculator, use the two dropdown selectors at the top of the screen to select the conduit type and wire type you're dealing with (you can put more than one wire type in the same conduit). If you are calculating for a Nipple rather than for a regular conduit, mark the Nipple checkbox in the lower right area of the screen.

Once conduit type and wire type are selected, use the Size selector on the right to indicate what size(s) of the currently selected wire you plan to put in the conduit. Each time you select a wire size, that wire is added to the cumulative total of wires in the conduit. The list of available sizes changes, depending on the current wire type setting (most wires don't come in all sizes).

As you add more wires to the conduit, the data shown in the lower area of the screen will change to reflect the cumulative total for all wires you've put in the conduit so far. At the very bottom of the screen you will find the smallest conduit size that will hold the current fill you have indicated (metric conduit size is shown in parenthesis).

To check all the wires you have currently selected, select the [Show Current Fill] button in the middle of the screen. After viewing current fill, return to the calculator by selecting the [Hide Current Fill] button at the top of the screen.

As mentioned above, you can place several different wire types in the same conduit, if desired. Just use the wire type dropdown selector near the top of the screen to select different wire types, then indicate the sizes of each wire type the conduit will contain.



### Conduit Fill Calculator (CF)

▼ EMT Electrical Metallic Tubing  
 ▼ THHN  
 Show Conduit Fill [Max]  
 # Cables: 3 (Max)  
 Area: 0.15210  
 Allowed: 0.21328  
 Actual: 28.5%  
 Allowed: 40%  
 Conduit: 3/4 (21)

One special function contained in the Conduit Fill calculator

is the ability to tell you how many wires (all of the same type and size) can be put in a given conduit. For example, if the fill of your conduit will be twelve size 6 wires, all the same size, you don't have to "select" size 6 twelve times (see example to the left). Just select size 6 three times and a [Max]

Max. Allowed If All Size 6 (3+ conductors in conduit)			
Size Allowed		Size Allowed	
1/2		2-1/2	46
3/4	4	3	69
1	7	3-1/2	91
1-1/4	11	4	116
1-1/2	16		
2	26		

button will appear to the right of the "# Cables" area in the center of the screen. Selecting this [Max] button will bring up a help screen showing how many size 6 wires will fit in different conduit sizes.

Conduit: 3/4 (21) Inches (Metric)

### Calculation for Auxiliary Gutters and Wireways in the Conduit Fill Calculator:

Set the conduit type selector at the top of the Conduit Fill calculator screen to use a metal or non-metal gutter or wireway, then select insulation type (THHN, etc.) and select a conductor size. The smallest acceptable gutter/wireway size will be displayed at the bottom of the screen. Below the gutter/wireway size LectriCalc displays the amount of space that can be used for splices.

### Conduit Fill Calculator (CF)

▼ Gutter, Aux Non-metal  
 ▼ THHN  
 Show Conduit Fill [Max]  
 # Cables: 4  
 Area: 0.29420  
 Allowed: 1.25000  
 Actual: 4.7%  
 Allowed: 20%  
 Gutter: 2.5x2.5 (6)

If you want to use a larger than necessary gutter/wireway, select the UP arrow in the lower right corner of the screen to see information about using the currently selected fill in a larger gutter/wireway.

Spices? 75% = 4.69 in<sup>2</sup> (30 cm<sup>2</sup>)

### Calculation for Cable Trays in the Conduit Fill Calculator:

Set the conduit type selector at the top of the Conduit Fill calculator screen to use a Cable Tray, then select insulation type and conductor size as usual. Only conductors size 1/0 and above are supported. The appropriate tray size is displayed at the bottom of the screen. If the tray fill includes any conductors size 1/0 to 4/0, tray fill is calculated on total diameter of the cables, rather than cable area, per code requirements.

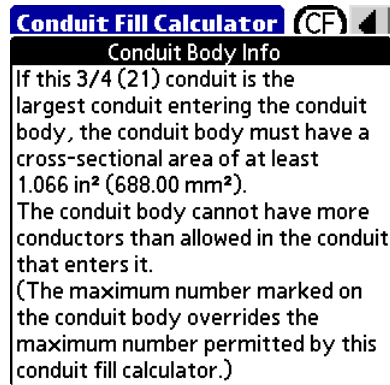
### Display of conductor size information in the Conduit Fill Calculator:

Any time you select a conductor size in the conduit fill calculator, an [A/D] button will appear beside the size selector. Selecting this button will display the area and diameter of the currently selected conductor.

Size A/D  
 6  
 4

## Display of Wire Bending Radius



Minimum wire-bending space at terminals and minimum width of wiring Gutters, auxiliary gutters, conduit bodies, panelboards, j-boxes, pull boxes, etc. can be displayed for conductor sizes larger than size 10. Select the [WBR] button to display the radius information.




0.09420 6  
15.2% WBR  
31% CB Nipple

## Display of Conduit Body Information


For conductor sizes smaller than size 4, conduit body can be displayed using the [CB] button.

The Conduit Fill calculator includes a  “backspace” button below the wire size selector that lets you back up, one wire at a time, up to 4 times. For example, if you have entered several wire sizes, then realize you made a mistake, it’s not necessary to clear the calculator and start over. Just select the  “backspace” button to remove the last wire size from the list. Each time you select the button, it will remove another wire from the fill, up to four times.

To the right of the “backspace” button is a  Reset button. Selecting this button will clear the calculator and return it to its initial state, ready to start a new calculation.

*Palm OS Version Only:*

*At the top of the screen, selecting [CF] brings up a Celsius/Fahrenheit Temperature Conversion utility.*

Select the  “back button” in the upper right corner of the screen to return to the LectriCalc Main Menu.



## Energy Cost

The Energy Cost calculator can quickly display cost to run lights (or other appliances) per day, week, month and year. Enter the total wattage of lights and other appliances, local kilowatt cost, and estimated hours per day the lights/appliances will run. The cost estimates will appear in the lower portion of the screen.

### KWH Cost Calculator

Use this optional calculator to find your kilowatt-hour cost of power based on data you enter from a recent electric bill.


KWH used: 96

Amount of electric bill: 15.67

**Insert KWH Cost**

**Cancel**

Optionally, you can select the small calculator icon to the right of the kilowatt cost field to bring up a special calculator to help determine the kilowatt cost using data from a recent electric bill. Enter number of kilowatt-hours on the bill and the amount of the electric bill (including taxes and other fees) then select the [Insert KWH Cost] button to plug the kilowatt cost into the Energy Cost Calculator.

Select the  "back button" in the upper right corner of the screen to return to the LectriCalc Main Menu.

### Energy Cost Calculator

Total Watts: 1000

Kilowatt Cost: 0.163

Hours Per Day: 10

**RESET**

#### Total Energy Cost:

Per Day: 1.63


Per Week: 11.41


Per Month: 49.61

Per Year: 595.36

## Find KW/HP

The Kilowatts/Horsepower calculator is self-explanatory. Just enter amps, voltage, efficiency, and power factor and the software will display the results in the lower area of the screen.

Select the  “back button” in the upper right corner of the screen to return to the LectriCalc Main Menu.

**Kilowatts, Horsepower** 

**RESET**    Amps: 35 .....

Voltage: 240 .....

Efficiency: 1 .....

Power Factor: 100 .....

Current	KW	HP
DC:	8.40	11.26
AC, single ph:	8.40	11.26
AC, 3 ph:	14.53	19.48


## Foot-candles


The Foot-candles calculator helps you determine the size light source needed to produce desired lighting at a given distance.

The lamp output you enter is assumed to be in candle power. If the lamp output is rated in lumens, mark the checkbox near the top of the screen.

You can enter distance, lamp to object in either feet or meters.

Once needed information is entered, the calculated light brightness at the distance you entered is displayed at the bottom of the screen in foot-candles and in lux.

Select the  "back button" in the upper right corner of the screen to return to the LectriCalc Main Menu.

**Foot Candle Calculator** 

Lamp output: 1500.....

Output in candle power. If output is in  
☐ lumens, check box to left.

Distance lamp  
to object: 10..... ft or  
3.0..... meters

**RESET**

Light falling on object...

15.00 ft-candles, 161.40 Lux


(Full moon = approx. 0.05 foot candle)

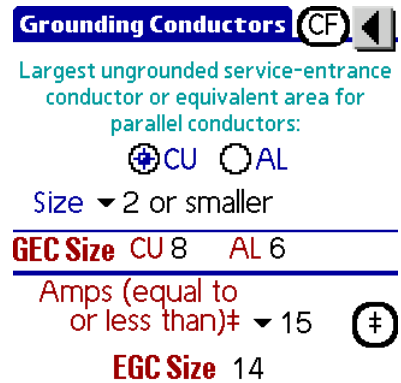
## Grounding Conductors


The Grounding Conductors calculator is for the most part self-explanatory. Making a selection from either the Size dropdown selector or the Amps dropdown selector will cause the GEC and EGC calculations to be updated.

*Palm OS Version Only:*

*At the top of the screen, selecting [CF] brings up a Celsius/Fahrenheit Temperature Conversion utility.*

Select the  “back button” in the upper right corner of the screen to return to the LectriCalc Main Menu.



**Grounding Conductors** CF 


Largest ungrounded service-entrance conductor or equivalent area for parallel conductors:

☒ CU ☐ AL

Size ▼ 2 or smaller

---

**GEC Size** CU 8 AL 6

Amps (equal to or less than)† ▼ 15 

**EGC Size** 14

## Impedance/ IEEE 141 Exact Voltage Drop

The Impedance calculator is mostly self-explanatory. Entering Amps and Volts to perform the IEEE 141 voltage drop calculation is optional.

Set up the calculation by selecting AC or DC current, copper or aluminum, then entering the length of wire you are calculating for. If you enter the length in feet, the result is displayed, based on standard USA calculations. If you enter the length in meters, the calculation will display metric results.

Enter temperature in either Fahrenheit or Celsius and select wire size. Optionally, beside the wire size selector, change number of wires from 1 to the number of wires in your situation to perform a parallel resistance calculation.

Finally, enter power factor (PF) and indicate the type of conduit you are using. Once you have entered all the necessary information the calculation will be performed automatically.

**Impedance** **RESET**

Amps  V  IEEE 141 vdr:

☐ DC ☒ AC ☒ CU ☐ AL

Length  ft  m ⓘ

Temperature  167 F  75 C

ⓘ Size  14 #  1 PF  85

Conduit: ☐ PVC ☒ Steel ☐ AL

(Ohms) ⓘ (NOTE)

Resistance  
Reactance  
Effective Z

**Impedance** **RESET**

Amps  V  IEEE 141 vdr:

☐ DC ☒ AC ☒ CU ☐ AL

Length  140 ft  43 m ⓘ

Temperature  167 F  75 C

ⓘ Size  14 #  1 PF  85

Conduit: ☒ PVC ☐ Steel ☐ AL

(Ohms) ⓘ (NOTE)

Resistance 0.434  
Reactance 0.008  
Effective Z 0.373

*USA Calculation*

**Impedance** **RESET**

Amps  V  IEEE 141 vdr:

☐ DC ☒ AC ☒ CU ☐ AL

Length  164 ft  50 m ⓘ

Temperature  167 F  75 C

ⓘ Size  14 #  1 PF  85

Conduit: ☒ PVC ☐ Steel ☐ AL

(Ohms) (Metric) ⓘ (NOTE)

Resistance 0.508  
Reactance 0.010  
Effective Z 0.437

*Metric Calculation*

**Impedance** **RESET**

Amps  V  IEEE 141 vdr:

☐ DC ☒ AC ☒ CU ☐ AL

Length  1500 ft  457 m ⓘ

Temperature  167 F  75 C

ⓘ Size  1/0 #  3 PF  85

Conduit: ☐ PVC ☒ Steel ☐ AL

(Ohms) ⓘ (NOTE)

Resistance 0.180 Parallel  
Reactance 0.083 Resistance  
Effective Z 0.196 0.060

*Parallel Resistance  
Calculation*

Optionally, the Impedance calculation features an IEEE standard 141 Exact Voltage Drop calculation. This engineering-grade voltage drop formula is used for 3-phase circuits, though it can also do 1-phase calculations, as in the example below, using the small radio buttons at the top of the screen. In addition to setting up the other data fields on the screen to perform an impedance calculation, you can also enter amps and volts in the center of the screen to see voltage drop amount and percent.

**Impedance** ☒ 1Ø ☒ 3Ø **RESET**

Amps  80 V  240 IEEE 141 vdr: 15.7v 6.5%

☐ DC ☒ AC ☒ CU ☐ AL

Length  1500 ft  457 m ⓘ

Temperature  167 F  75 C

ⓘ Size  1/0 #  3 PF  85

Conduit: ☐ PVC ☒ Steel ☐ AL

(Ohms) ⓘ (NOTE)

Resistance 0.180 Parallel  
Reactance 0.083 Resistance  
Effective Z 0.196 0.060

Voltage drop is 6.5% (drop of 15.7 volts) for the settings above.

## Motor Data

The Motor Data calculator makes many calculations based on information you enter and set up in the upper area of the screen. Dropdown selectors are available for most items.

**Motor Data** ⓘ **CF** **RESET** ◀

▼ Dual element TD fuse

▼ AC Motor **Phase** ▼ Three

▼ Squir Cage Not Design B EE

**SF** ▼ 1.15+ **FLA** 70 if known

**Volts** ▼ (460) 480 **HP** ▼ 50

---

(Multi) **LR** **FLC** 65.00 **Wire** 4

Ⓡ ⬆ ⬇ **OCP** 125

**Starter** 3 ⓘ **OL fuse** 80

**Disc size** 100a **Heater** 87.50

Optionally, if the motor nameplate lists FLA, you can enter this number in the FLA field near the center of the screen. You must enter FLA if you want the calculator to determine an overload fuse (OL fuse).

While the calculator automatically makes the FLC calculation based on the information you have set up in the upper area of the screen, you can also manually enter FLC and the software will make other calculations based on the number you enter.

Items calculated are:

- FLC
- Wire Size - minimum size permitted
- Overcurrent Protection Device (OCP) - absolute maximum permitted and/or if motor does not start
- NEMA Starter Size
- Overload Fuse (if FLA is entered from the motor plate)
- Disconnect Size
- Heater Size

There are three additional buttons in the center of the results section of the calculator.

If the motor will not start using the calculated OCP, OL fuse and Heater, you can select the ⬆ “UP” arrow to see the next size up OCP, OL fuse and Heater (up to the maximum size allowed). You can keep trying larger sizes (up to maximum allowed) until the motor will start.

Sometimes, you can save some money by using a smaller-sized OCP, OL fuse, or Heater (if the motor will still start with the smaller size device). To see the next size down, select the ⬇ “DOWN” button.

If you need to see the original calculation again (the results as displayed before using the UP and/or DOWN arrows), select the Ⓡ “Recalculate” button.

### Multi-motor calculation in Motor Data calculator:

This feature lets you calculate feeder conductor size and

**Motor Data** ⓘ **CF** **RESET** ◀

▼ Dual element TD fuse

▼ AC Motor **Phase** ▼ Three

▼ Squir Cage Not Design B EE

**SF** ▼ 1.15+ **FLA** if known

**Volts** ▼ (460) 480 **HP** ▼ 50

---

(Multi) **LR** **FLC** 65.00 **Wire** 4

Ⓡ ⬆ ⬇ **OCP** 125

**Starter** 3 ⓘ **OL fuse** Plate FLA?

**Disc size** 100a **Heater** 74.75

**Motor Data** ⓘ **CF** **RESET** ◀

▼ Dual element TD fuse

▼ AC Motor **Phase** ▼ Three

▼ Squir Cage Not Design B EE

**SF** ▼ 1.15+ **FLA** 70 if known

**Volts** ▼ (460) 480 **HP** ▼ 50

---

**FLC (amps)** 65.00 **Wire** 4

225%mx Ⓡ ⬆ ⬇ **OCP** 125

**Starter** 3 ⓘ **OL fuse** 90

**Disc size** 100a **Heater** 98.00

**Volts** ▼ (460) 480 **HP** ▼ 50

---

(Multi) **LR** **FLC** 65.00 **Wire** 4

feeder protection for multiple motors. To perform the multi-motor calculation, set up the Motor Data screen and perform a standard motor data calculation for the first motor in the group, save the data for that motor (details below), then set up and calculate for the next motor, save that, and so on for all the motors in the group. When done adding motors to the list you will perform a group calculation.

Once you have done the first motor data calculation in the group, select the [Multi] button to the left of the FLC result in

**3 motors currently on list**  
Add current motor to list  
Calculate Multi-Motor  
Show motor list  
Clear motor list

the center of the Motor Data screen. The multi-motor control box will appear. Select “Add current motor to list” to add the first motor to the motor list. Then continue in like manner to add as many motors as you wish.

**0 motors currently on list**  
Add current motor to list  
Calculate Multi-Motor  
Show motor list  
Clear motor list

If you forget which motors you have already added to the motor list, use “Show motor list” on the multi-motor control box to display motors currently on the list.

**Multi-Motor Requirements**  
 **Feeder Conductor Size:**  
**400**  
**Feeder Protection: 350A**  
  
**OK**


When all motors have been added to the motor list, select “Calculate Multi-Motor” to perform the calculation, which displays feeder conductor size and feeder protection for the multi-motor group.

**Current Multi-Motor List**  
50 HP AC Motor, FLC 65  
50 HP AC Motor, FLC 65  
50 HP AC Motor, FLC 52  
20 HP AC Motor, FLC 54  
10 HP DC Motor, FLC 76

To reset the multi-motor calculator for a new motor group, select “Clear motor list” in the multi-motor control box.

### Locked Rotor Current calculation in Motor Data calculator:


Beside the [Multi] button on the Motor Data screen is found an [LR] button. First, set up the Motor Data calculator for the conditions of the motor you are working with. Then select the [LR] button to bring up a list of Locked Rotor Code Letters. Select the motor’s locked rotor code to see the locked rotor current for the settings you set up.

**Letter G Locked Rotor Current**  
 **Maximum Locked Rotor Current for these settings is 378.73 Amps**  
  
**OK**

**Select Locked Rotor Code Letter...**  
A  
B  
C  
D  
E  
F  
G  
H  
J  
K  
L  
M  
N  
↓

*Palm OS Version Only:*

*At the top of the screen, selecting [CF] brings up a Celsius/Fahrenheit Temperature Conversion utility.*

Select the  “back button” in the upper right corner of the screen to return to the LectriCalc Main Menu.

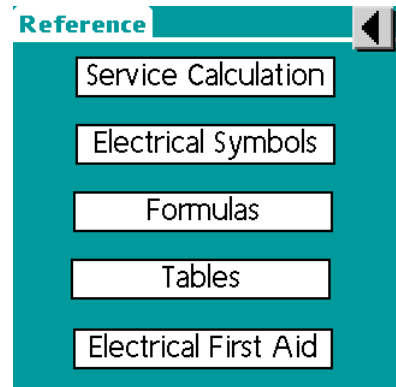


## Reference

The LectriCalc reference section contains numerous tables, formulas and diagrams useful to the electrical professional. Below is a list of information included:

### Service Calculation:

- Dwelling
- Commercial




**Electrical Symbols**...nearly 200 different symbols

### Formulas:

- Power
- Motors
- Ohm's Pie
- Transformers
- Resistance
- Transformer Diagram

### Tables\*:

- Std. Fuse & Breaker Sizes
- Std. Raceway Sizes
- Std. Pull/J Box Sizes
- Std. Gutter & Wireway Sizes
- Std. Switchboard/Switchgears
- Std. Busway or Busduct
- Std. Disc and Panelboard Wiring
- Std. Transformer KVA Ratings
- Bussbar Ampacity
- NEMA Enclosures
- Material Support Distances
- Vertical Conductor Supports
- Support for RMC, RNC, EMT
- Motor & Dist Connections
- Locked Rotor Code Letters
- Motor Enclosure Type
- SEC & GNDS, Riser Size
- Grounding Conductor Table
- Ampacities 310.16/.17 CU
- Messenger Wire 310.20 CU
- Ampacities 310.16/.17 AL Messenger Wire 310.20 AL
- Fraction to Decimal
- AWG <--> Metric Cable
- C to F/F to C
- Wire Type Insulation/Codes
- Fixture Wires
- Pressure Connectors 300 V Max
- Pressure Connectors 600 V Max
- Conduits
- Conduit Weights
- Single Phase Motors
- Three Phase Motors
- Exact K, Coated Copper
- Exact K, Uncoated Copper
- Exact K, Aluminum
- Hazardous Locations
- Locations Definitions
- Electrical First Aid
- Typical Tool List

Select the  "back button" in the upper right corner of the screen to return to the LectriCalc Main Menu.

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# Transformers

RIGHT: Selecting the Transformers button on the LectriCalc main menu displays a selector, letting the user select which transformer calculator is needed: 1-Phase, 3-Phase Delta, or 3-Phase Wye.

LectriCalc 5.0	
Ampacity	Amps From...
Box Size	Conduit Fill
Energy Cost	Find KW/HP
Footcandles	Ground Cond.
Impedance	Motor Data
Transformers	1Ø KVA
Reference	3Ø Delta
	3Ø Wye
□ L	
Voltage Drop	Code-A-Day™

**1Ø Transformers** **RESET**

Input watts .....

Output watts .....

Efficiency % .....

---

Volts **\*P** ..... **\*S** .....

Amps **P** ..... **S** .....

Turns **P** ..... **S** .....

KVA **P** ..... **S** .....

**Ratio**

▼ \*Volts

LEFT: The transformer calculators allow you do perform many calculations by entering the information you already know about the transformer. For example, in the single-phase transformer calculator to the left, you can enter Input watts, Output watts, then select the Efficiency % button to see the efficiency calculation.

Or, you can enter Output watts and Efficiency %, then select the Input watts button to see the calculated input watts.

RIGHT: In the lower section of the screen, “P” stands for Primary and “S” stands for Secondary. Many different calculations can be performed here. For example, you can enter primary volts and primary KVA, then select the Primary Amps button and the program will calculate primary amps.

**1Ø Transformers** **RESET**

Input watts 200

Output watts 100

Efficiency % 50.00

---

Volts **\*P** 240 **\*S** .....

Amps **P** 50 **S** .....

Turns **P** ..... **S** .....

KVA **P** 12 **S** .....

**Ratio**

▼ \*Volts

RIGHT: If you do not know what information a particular calculation requires, just tap the button of the calculation you want to perform and the program will tell you what it needs. For example, if you tap the Secondary Turns button and the program does not have all the information it needs, it will tell you what other data you must enter.

**1Ø Transformers** **RESET**

Input watts 200

Output watts 100

Efficiency % 50.00

---

Volts **\*P** 240 **\*S** .....

Amps **P** ..... **S** .....

Turns **P** ..... **S** .....

KVA **P** 12 **S** .....

**Ratio**

▼ \*Volts

**1Ø Transformers** **RESET**

Input watts 200

Output watts 100

Efficiency % 50.00

---

**This Calculation Requires...**

**P volts, S volts, P turns**  
**OR**  
**P amps, S amps, P turns.**

**OK**

RIGHT: The three-phase delta calculator works much like the single-phase calculator described above. In the upper portion of the screen, enter any two items and tap the button for the third item to perform the calculation.

**3Ø Delta Transform** **RESET** ◀

Input Volts P 120

Output Volts S 400 ⓘ

Phase Volt Ratio 0.3 : 1

---

Line VA (P) (S)

L Volts (P) (S)

L Amps (P) (S)

---

Line Amps (P) (S)

Phase Amps (P) (S)

---

Line1 Amps

Line3 Amps

Neutral A

For example, enter Input Volts Primary and Output Volts Secondary, then select the Phase Volt Ratio button. The phase volt ratio will be displayed.

**3Ø Delta Transform** **RESET** ◀

Input Volts P

Output Volts S ⓘ

Phase Volt Ratio

---

Line VA (P) (S)

L Volts (P) (S)

L Amps (P) (S)

---

Line Amps

Phase Amps

---

Line1 Amps

Line3 Amps

Neutral A

LEFT: There are three more calculators in the lower part of the screen. Enter the information you have, then select the button(s) for the information you want to get back. If the program needs more information to perform a calculation, it will tell you what else it needs to know.

RIGHT: The 3-phase wye calculator can calculate line volts from phase volts, or phase volts from line volts.

In the lower half of the screen, enter line amps 1, 2 and 3 to calculate neutral current.

**3Ø Wye Transform** **RESET** ◀

Line Volts

Phase Volts ⓘ

---

Line Amps 1

Line Amps 2

Line Amps 3

Neutral Current

## Voltage Drop

Lectricalc has 5 voltage drop calculators.

- The Voltage Drop screen's [Basic] calculator is generally acceptable for DC and single phase AC up to size 1 conductors since inductance (impedance) is negligible. The basic voltage drop calculator uses the formulas  $V_d = 2K \times L \times I/Cm$  for 1-Phase and  $V_d = 1.73K \times L \times I/Cm$  for 3-Phase.
- The Voltage Drop screen's [Adv.] calculator (advanced voltage drop) is weighted for ambient temperature, Power Factor, and solid/stranded wiring.
- Also accessible from the Voltage Drop screen is a special metric calculator. To access this calculator, open the screen menu (top of screen on Palm OS and Windows, bottom of screen on Windows Mobile) and select 'Prefs' then 'Feet or Meters'. When asked, select Meters as your measurement system. A special metric voltage drop calculator will appear. To switch back to the standard voltage drop screen, go back to the screen menu and select Feet as your measurement system.
- The Impedance screen's IEEE 141 Exact Voltage Drop calculator follows standard IEEE 141 and the impedance fine print note in the 2008 NEC codebook. Impedance 3 Phase AC is more accurate for 1/0 wire sizes or larger and uses AC resistance and DC resistance plus Power Factor, conduit type, ambient temperature for calculation. Check with your AHJ-authority having jurisdiction i.e. State or local governments as to the recommended method to be used. NEC fine print notes recommend (not a requirement) that a voltage drop of no more than 5% be used for both the feeder and branch circuit. 3% maximum for either branch or feeder circuit. Use if this calculator is described in the Impedance section of this manual, page 29.
- LectriCalc's fifth voltage drop calculator is used for low voltage, usually for landscape wiring. This calculator is accessed by marking the 'L' checkbox above the Voltage Drop button on the LectriCalc main menu. After marking the 'L', the Voltage Drop button will take you to the low voltage calculator.

The voltage drop calculators do not consider NEC allowed ampacity or derating. Undervoltage for inductive loads can cause overheating inefficiency, and shorter life span for electrical equipment. Examples include TVs, computers, and similar equipment. For motors it's recommended that you not accept a voltage drop over 5%.

See the following sections for more details...

**Voltage Drop** **CF** **RESET**

☐ DC ☒ 1-Phase ☐ 3-Phase

Load (amps @ 100%): 80

Voltage at source: ▼ 240

1-way to load 60 ft 18.3 m

Basic **NOTE** Power factor: 85

☒ CU ☐ AL ☐ Solid ☒ Strand

☐ 77-121F ☒ 122-167F F/C

at =<3% drop Best wire: AWG 6  
(IEC<4%drop) **Show Details**

## Basic and Advanced Voltage Drop Calculator

The Standard Voltage Drop calculator is designed to quickly suggest the best size conductor for the job you're doing. It also offers voltage drop for all other sizes of conductors for comparison. While primarily USA code and wire-based, it provides metric sizes also, and temperature can be entered in Fahrenheit or Celsius.

You can select the [Adv.] button on the left to adjust for ambient temperature, Power Factor, and solid/stranded wiring, or select the [Basic] button to calculate without consideration of these factors.

Use the radio buttons to set current type (DC, 1-Phase, or 3-Phase), material (copper or aluminum), whether the conductor is solid metal or stranded, and the temperature range under which the conductor will operate. You can toggle between Fahrenheit and Celsius by selecting the F/C button to the right of the temperature radio buttons.

Enter the amp load and one-way distance to load manually. You can enter distance in either feet (in the "ft" field) or meters (in the "m" field).

For voltage, you can either use the dropdown selector to select a pre-defined voltage, or you can enter the voltage manually in the text field provided.

**Voltage Drop** **CF** **RESET**

☐ DC ☒ 1-Phase ☐ 3-Phase

Load (amps @ 100%): 80

Voltage at source: ▼ 240

1-way to load: 60 ft 18.3 m

**Basic** **NOTE** Power factor: 85

☒ CU ☐ AL ☐ Solid ☒ Strand

☐ 77-121F ☒ 122-167F **F/C**

at ≤3% drop Best wire: AWG 6  
(IEC <4% drop)

**Show Details**

Once you have supplied load and distance the program will make the voltage drop calculation and display the recommended conductor size in the lower area of the screen.

To see voltage drop, at the current settings, for all other wire sizes, select the [Show Details] button at the bottom of the screen. The results screens that appear next show voltage

drop, percent drop, and final operating voltage for various wire sizes, AWG 20 through kcmil 2000. Use the "next screen/previous screen" buttons in the upper right corner to see other wire sizes. Selecting the "previous screen" button repeatedly will eventually return you to the voltage drop calculator screen where you started.

Two things to note in the results screens: metric wire sizes are shown in parenthesis beside the AWG sizes, and wires with acceptable voltage drop (equal to or less than 3% drop) have their voltage drop shown in bold font. Wires with voltage drop greater than 3% are shown in standard font.

**Voltage Drop Page 1**

AWG (mm²)	Voltage Drop	% Drop	Operating Voltage
<b>20(0.50)</b>	56.94	<b>47.45</b>	<b>63.06</b>
<b>18(0.75)</b>	35.85	<b>29.88</b>	<b>84.15</b>
<b>16(1.50)</b>	22.51	<b>18.76</b>	<b>97.49</b>
<b>14(2.50)</b>	14.13	<b>11.78</b>	<b>105.8</b>
<b>12(4.0)</b>	8.89	<b>7.41</b>	<b>111.1</b>
<b>10(6.0)</b>	5.60	<b>4.66</b>	<b>114.4</b>
<b>8(10)</b>	3.52	<b>2.93</b>	<b>116.4</b>
<b>6(16)</b>	2.21	<b>1.84</b>	<b>117.7</b>

**Voltage Drop** **CF** **RESET**

Cable size ▼ 1.5 mm²

Type ▼ Mineral insulated

Load in watts: 1000

Voltage at source: 240

Distance source to load (meters): 80

## Special Metric Voltage Drop Calculator

LectriCalc also contains a dedicated metric voltage drop

**Calculate**

calculator which some users may prefer to use by default. To use this calculator, go to the standard voltage drop calculator, then open the menu (at the top of the screen in Palm OS and Windows, at the bottom of the screen in Windows Mobile) and select the Prefs menu and “Feet or Meters”. Then, to use the metric calculator, select [Meters] as your measurement system.

Mineral insulated 1000 w				
<b>Cable:</b> 1.5 mm <sup>2</sup>	Single phase p.v.c. sheath	Single phase bare	Three phase p.v.c. sheath	Three phase bare
<b>Length:</b> 60 m				
<b>Voltage Drop</b>	7	8 <b>&gt;3%</b>	6	7
<b>% Drop</b>	2.9	3.2	2.5	2.8
<b>Oper. Voltage</b>	233	232	234	233

The metric voltage drop calculator will appear. Use the selectors to pick cable size and type, then enter the load in watts, voltage, and one-way distance in meters, then select the [Calculate] button at the bottom of the screen to display the results screen. Voltage drops greater than 3% are flagged to be easily seen (see voltage drop under “Single phase bare” to the left).

Your voltage drop calculator preference is remembered the next time you use LectriCalc. You can change your preference between the standard calculator and the special metric calculator at any time, using the Prefs menu as described above.

*Palm OS Version Only:*

*At the top of the standard voltage drop screen, selecting [CF] brings up a Celsius/Fahrenheit Temperature Conversion utility.*

Select the “back button” in the upper right corner of the screen to return to the LectriCalc Main Menu.

### Low Voltage Lighting Voltage Drop Calculator

To access this special calculator, mark the small “L” checkbox above the [Voltage Drop] calculator button on the LectriCalc main menu, then select the Voltage Drop button. This setting will remain in effect for the Voltage Drop button until you change it.

**LV Lighting Voltage Drop**

Total watts: 200

Cable length: 110 ft 33.5 m

☐ most on 1st 1/2 of cable

☒ most on 2nd 1/2 of cable

**i** **Reset**

Voltage Drop for various cable sizes:

Size 18: 18.49      Size 10: 2.14

Size 16: 11.60      Size 8: **1.35**

Size 14: 7.29      Size 6: **0.85**


Size 12: 3.40      **i**


To use the calculator, enter total watts of lighting on the cable, and cable length. Optionally, mark radio buttons if most fixtures are grouped in the first half of the cable, or the last half. If fixtures are mostly evenly spaced along the cable, don’t mark either radio button. The acceptable sizes of cable (4% voltage drop or less) will be shown in bold font.

Find KW/HP
<input checked="" type="checkbox"/> L
Voltage Drop
Energy Cost

## Wattage/KVA

The Wattage/Kilovolt-Amps calculator is self-explanatory. Just enter amps, voltage and power factor and the calculation will appear in the lower section of the screen.

Select the  “back button” in the upper right corner of the screen to return to the LectriCalc Main Menu.

**Wattage, Kilovolt-Amps** 

**RESET**    Amps: 30.....  
Voltage: 240.....  
Power Factor: 100.....

Wattage, single-ph: 7200.0  
Wattage, 3-ph: 12456.0

**Apparent      Kilovolt-  
Power           Amps**

AC, single phase: 7.20  
AC, 3-phase: 12.46



## Wire Cost

When mistakes are made or when the wire is scrapped without weighing the material, the financial cost can be a surprise. The LectriCalc Wire Cost calculator can calculate this cost, plus new wire costs. The program also educates electricians on the cost of material and what can be reclaimed from scrap.

This calculator will calculate the wire weight based on length and gauge of wire in either US standard or metric length, in stranded or solid copper or aluminum. Insulation

**Wire Cost** (RESET)

☒ Stranded ☐ Solid

☒ CU Length 96 ft 29.3 m

☐ AL Size 10 (6 mm<sup>2</sup>)

Cost /ft. OR 3 /lb.

**SAVED PRICES** Save Clear Prices


96 ft. at 3 /lb = 9.22

or covered weights are not included in the calculation.

To use the calculator, just enter the information about the wire in the upper part of the screen. You must know the current market cost of the wire, either based on length or weight (for example, cost in dollars per foot or dollars per pound). If you enter the wire length in feet, the cost will be expected to be given in feet or pounds. If you enter the length of the wire in meters, the cost will be expected in meters or kilograms.

In the example to the left, length was entered in feet and cost in pounds. The resulting calculation is shown at the bottom of the screen, indicating that the 96 ft. length of wire costs \$9.22 when the price of copper is \$3 per pound.

The program can also save prices for future use. To save a metal price, first set up the calculator to perform a wire cost calculation, then tap the [Save] button in the center of the screen.

When you save a metal price, the record is stored in the lower section of the screen, by date. The date is displayed in the format year month day (YYYYMMDD) so December 4, 2007 is shown in the example to the right as 20071204. Also saved is the wire type (SO for solid or ST for stranded), copper or aluminum, along with the price, per pound, per foot, per kg, or per meter.

To use a saved price later, just locate the price or date you want to use on the list of saved prices (a scroll bar will appear if needed to let you access prices hidden from view) then tap or click on the price to plug it into the calculator for performing a calculation.

To delete a price from the list, select the trash can icon to the right of the price you want to remove. To erase your whole saved prices list, use the [Clear Prices] button beside

**Wire Cost** (RESET)

☒ Stranded ☐ Solid

☒ CU Length ft m

☐ AL Size 14 (2.50 mm<sup>2</sup>)

Cost /ft. OR /lb.

**SAVED PRICES** Save Clear Prices


**Wire Cost** (RESET)

☒ Stranded ☐ Solid

☒ CU Length 164.1 ft 50 m

☐ AL Size 14 (2.50 mm<sup>2</sup>)

Cost /m OR 1.55 /kg

**SAVED PRICES** Save Clear Prices

20071204	SO	AL	3.25	per pound	
20071204	ST	CU	.09	per foot	
20071204	ST	CU	1.55	per kg	

50 m at 1.55 /kg = 1.50



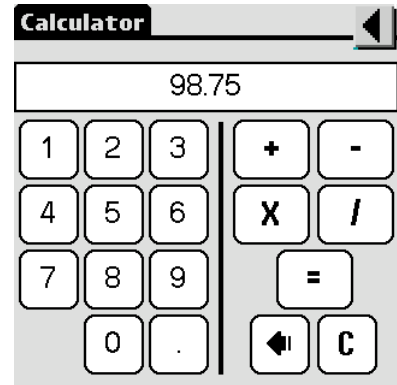
the [Save] button.

To access the LectriCalc simple math calculator at any time, select the small calculator icon in the upper right corner of the Wire Cost screen.

## Arithmetic Calculator


LectriCalc includes a basic arithmetic calculator that lets you add, subtract, multiply and divide without leaving LectriCalc. You can pop this calculator up from most LectriCalc screens, including in Code-A-Day, letting you do quick calculations then return to where you left off in LectriCalc.


To access the calculator, drop down the “top-of-screen” menu on Palm OS handhelds and look for Calc, or select Calc on the bottom-of-the-screen menu on Windows Mobile handhelds.



The calculator is used like a standard Windows or Palm handheld calculator. For example, to add 9 plus 7 then divide that total by 2 you would tap as follows:

[9] [+] [7] [/] [2] [=]

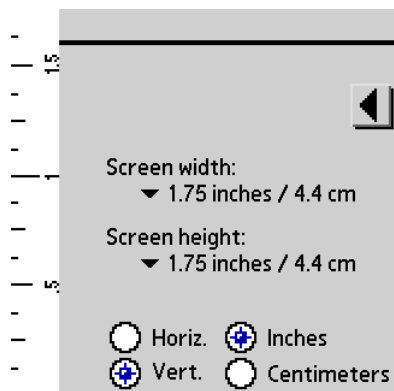
The Backspace key  erases the most recently entered number.

The Clear key  clears/resets the calculator to start a new calculation. Rather than pressing the Clear key, you can also start a new calculation immediately after pressing [=] to complete the previous calculation.

## Screen Ruler (handheld version only)

The handheld version of LectriCalc includes an on-screen ruler that may be of some use in making small measurements when a tape measure isn't handy. The ruler is accessed by tapping the ruler icon in the upper right corner of the LectriCalc Main Menu.

Of course, the handheld computer has a small screen so only small measurements can be made. To set up the ruler for your screen, you'll need to use the dropdown selectors on the ruler screen to identify your particular handheld's screen width and height. We plan to add support for more

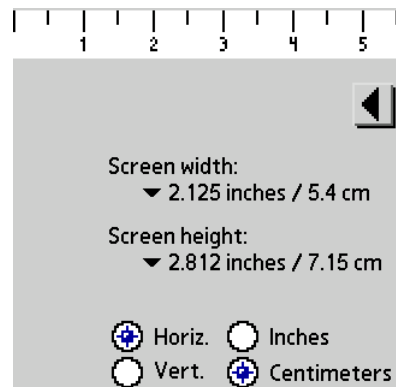


screen sizes as time goes on. If your screen dimensions aren't available on the selectors, please e-mail your screen's exact height and width to [support@arkansoft.com](mailto:support@arkansoft.com) and we'll try to get your device supported soon.

Use the radio buttons in the lower right corner of the ruler screen to set the ruler orientation to your preferences (horizontal or vertical display) and to set the ruler to display inches or centimeters.

Use the "back" button in the upper right area of the screen to return to the LectriCalc Main Menu when you're finished using the ruler.

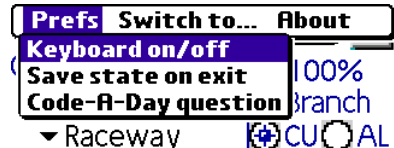
LectriCalc 4.1	
Amp Capacity	Box Fill
Conduit Fill	Ground Cond.
Find KW/HP	Motor Data
Master Bender-CAB	
Voltage Drop	Wattage/KVA
Energy Cost	Footcandles
Amps From...	
Reference	Code-A-Day™



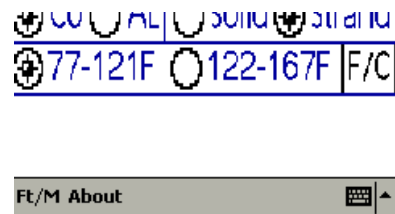
## Options Menus

LectriCalc presents different options menus depending on what screen you're currently viewing, and what platform (Palm OS, Windows Mobile, or Windows) you're running under.

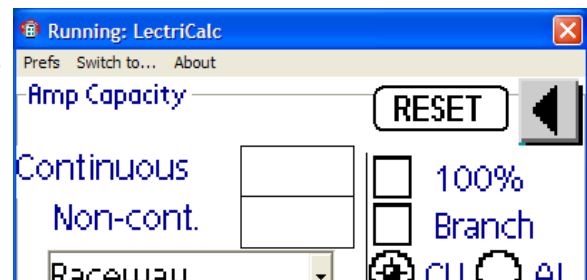
Under Palm OS, you tap the program "titlebar" at the top of the screen and the options menu drops down from the top of the screen.



Under Windows Mobile, the options menu is always visible at the bottom of the screen, as shown on the right, from the voltage drop screen, showing the Ft/M and About menus.



In the Windows desktop/laptop version the options menu is always visible at the top of the screen. In the example to the right the menu choices available are Prefs, Switch to..., and About.



Following are LectriCalc menu options:

- **Main Menu**

- Calc*

- Starts the built-in LectriCalc simple calculator that lets you add, subtract, multiply and divide without leaving the LectriCalc program.

- CAD*

- If you have used the Code-A-Day question/answer module, you can use this menu option to take a quick look at the most recently viewed Code-A-Day question.

- About:*

- Use this menu item to display information on your version of LectriCalc, as well as Arkansoft Software contact information. You can also re-read the LectriCalc disclaimer from the About menu.

- Exit*

- Closes LectriCalc and returns you to your handheld's launcher.

- **Ampacity, Box Size, Conduit Fill, Grounding Conductors, Impedance, Motor Data, Tables, Transformers, Voltage Drop**

*Prefs*

- *Feet or Meters:* this menu option is only available in the Voltage Drop calculator. It lets you access a special metric-only version of the voltage drop calculator. See details on this on page 37, 38.
- *Save state on exit:* By default, LectriCalc saves the current screen settings when you exit LectriCalc, and restores them the next time you use the calculator. You can turn this feature on and off using the Save State menu choice. Turning Save State off will cause the calculators to reset themselves each time you start the program, just as if you had selected Reset on the calculator screen. (This option is not available in the reference section.)
- *Code-A-Day question:* If you have used the Code-A-Day question/answer module, you can use this menu option to take a quick look at the most recently viewed Code-A-Day question.

*About*

- Use this menu item to display information on your version of LectriCalc, as well as Arkansoft Software contact information. You can also re-read the LectriCalc disclaimer from the About menu. In the reference section there is also an option on the About menu to view the special disclaimer related to NEC® tables.

- **Code-A-Day**

*Delete*

- You can use this menu option to delete the currently active question set. You'll then need to select another question set to continue to use Code-A-Day.

*Prefs*

- *Set sound preference* - Use this menu option to turn on and off a "wrong answer" beep and "test complete" tone (registered version only).
- *Set score display* - Use this menu option to turn on and off the display, near the top of the main Code-A-Day screen, of your current score and number of questions remaining (registered version only).

*About:*

- Use this menu item to display information on your version of Code-A-Day.

*Calc*

- Starts the built-in simple arithmetic calculator that lets you add, subtract, multiply and divide without leaving the Code-A-Day program.