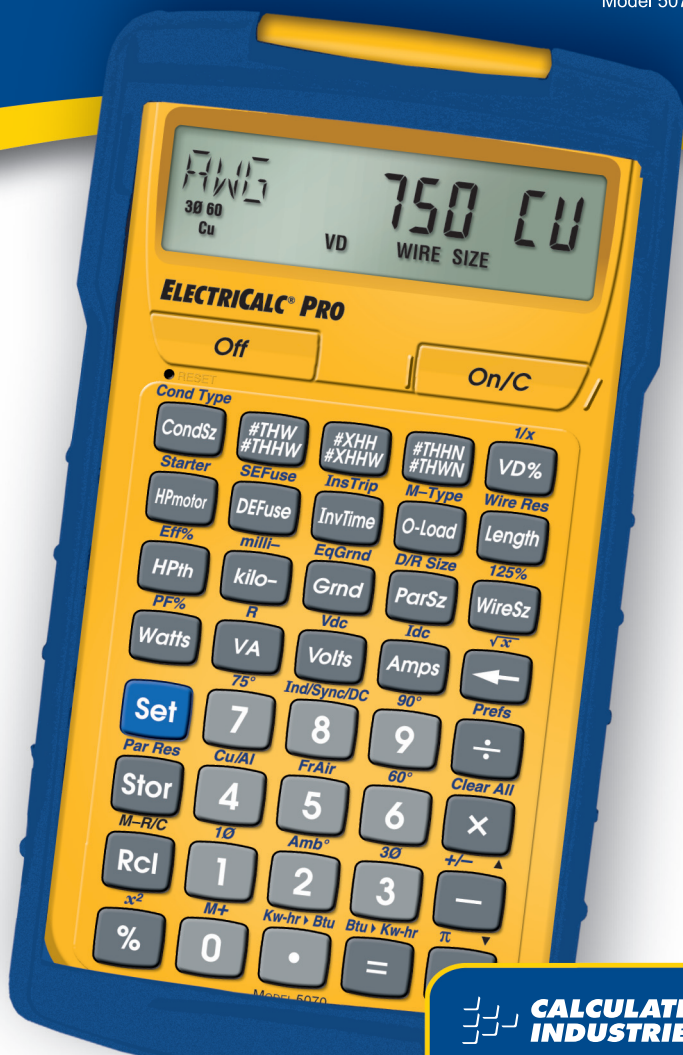


USER'S GUIDE

ELECTRIC[®]ALC[®] PRO

FULLY UPDATEABLE ELECTRICAL CODE CALCULATOR

Model 5070



**CALCULATED
INDUSTRIES[®]**

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ELECTRICALC[®] PRO

The *ElectriCalc[®] Pro* is an invaluable calculator for today's busy electrical professional. Unlike a regular calculator, it has intuitively labeled "electrical keys" and conforms to the 2014 (and 2011, 2008, 2005, 2002, 1999, 1996) and future National Electrical Codes, allowing you to solve Code-related problems quickly and accurately. The most common NEC tables are now at your fingertips!

An important feature of the *ElectriCalc[®] Pro* is that it is programmed to accept future NEC changes, allowing you to conveniently install future Code editions in a few simple steps.

The *ElectriCalc[®] Pro* instantly solves for:

- Kirchhoff's Law
- Ohm's Law
- Volts, Amps, Volt-Amps, Watts, kVA, kW, PF%, EFF%, and Resistance
- Copper and Aluminum Wire Sizes
- Parallel and Derated Wire Sizes
- Voltage Drop Wire Sizes, % and Actual Voltage Drops, Voltage Drop Distances and Wire Resistances
- Kilowatt hours and BTU's
- Parallel Resistance
- Grounding Conductors Sizes
- Motor Full-Load Amps
- Overload Protection Sizes
- NEMA Starter Sizes
- Conduit Sizes
- And much more!

GETTING STARTED

You may want to practice getting a feel for your calculator keys by reading through the key definitions and learning how to enter data, how to store values, etc., before proceeding to the examples.

KEY DEFINITIONS

Basic Function Keys

On/C

On/Clear Key — Turns on power. Pressing once clears the last entry and the display. Pressing twice clears all temporary values.

Off

Off — Turns all power off. Clears all non-permanent values.

**+ - X
÷ =**

Arithmetic operation keys.

**0 - 9
and ●**

Keys used for entering numbers.

Set

Second Function — Used with other keys to access secondary functions.

Stor

Store — Used for storing values.

Stor

1 - 9

Storage Registers M1 through M9 — Used to store values in Memory registers 1 through 9.

Rcl

Recall — Used with other keys to recall stored values and settings.

Rcl Rcl

Memory Clear — Clears Accumulative Memory and displays total.

Stor 0

Accumulative Memory — Adds displayed value to Accumulative Memory.

Rcl 0

Memory Recall — Displays the value saved in the Accumulative Memory register.

Set **Rcl**

Memory Clear (M-R/C) — Clears Accumulative Memory without changing current display.

%

Percentage — Used to find a given percent of a number.

Set **%**

x^2 — Squares the value on the display.

←

Backspace Function — Used to delete entries one keystroke at a time (unlike the **On/C** function, which deletes the entire entry).

Set **←**

Square Root ($\sqrt{x}$) — Calculates the Square Root of the number on the display.

Set **VD%**

Reciprocal ($1/x$) — Finds the Reciprocal of a number (e.g., **8** **Set** **VD%** **= 0.125**).

Set **X**

Clear All — Returns all stored values to the default settings. Does not affect Preference Settings.

Set **—**

Change Sign (+/-) — Toggle displayed value between negative and positive value.

Set **+**

Pi — Displays value of π (3.1415927).

Mode Set-up Keys

Set **÷**

Preference Settings (Prefs) — Use to define calculator modes (see **Preference Settings** section).

Set **1**

Single-Phase (1Ø) — Sets calculator to Single-Phase mode.

Set **3**

Three-Phase (3Ø) — Sets calculator to Three-Phase mode. This is the default setting.

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Set **2**

Ambient Temperature (Amb°) — Permanently enters ambient temperature for determining ampacity-derived Wire Sizes. Ambient temperature will only change when entering a new value or by resetting the calculator. Defaults to 30°C (86°F). **Amb** will display when the Ambient Temperature is other than 30°C (86°F).

Note: The temperature units can be displayed in Celsius (°C) or Fahrenheit (°F) by changing the Preference Setting (see **Preference Settings** section).

Set **4**

Copper/Aluminum (Cu/Al) — Used to toggle between Copper (default) and Aluminum Wire Types. When the Wire Type is revised, any calculated Wire Size will be re-calculated automatically. If a Wire Size is entered with the wrong Wire Type, pressing **Set** **4** will change the material type without changing the size.

Set **5**

Free Air (FrAir) — Sets calculator to Free Air mode, which refers to NEC Table 310.15(B)(17) for Wire Size calculations.

Set **6**

60°C Wire Insulation — Sets calculator to 60°C Wire Insulation Type for Wire Size calculations. This is the default setting.

Set **7**

75°C Wire Insulation — Sets calculator to 75°C Wire Insulation Type for Wire Size calculations.

Set **9**

90°C Wire Insulation — Sets calculator to 90°C Wire Insulation Type for Wire Size calculations.

Electrical Keys

kilo-

kilo- — Used with Watts, Amps, Volts, and Volt-Amps keys to identify “kilo-” values.

Set **kilo-**

milli- — Used with Watts, Amps, Volts, and Volt-Amps keys to identify “milli-” values.

Amps

Amps — Enters or calculates Amps (using Volts and VA or Watts).

Volts

Volts — Enters or calculates Volts (using Amps, HPth, and VA or Watts). Default value is 240 Volts.

VA

Volt-Amps — Enters or calculates Volt-Amps (using Amps, Volts and Horsepower or Watts).

Watts

Watts — Enters or calculates Watts (using Amps, Volts, and VA or Horsepower).

Set **Amps**

DC Amps (Idc) — Enters or calculates DC Amps (using DC Volts and Resistance).

Set **Volts**

DC Volts (Vdc) — Enters or calculates DC Volts (using DC Amps and Resistance).

Set **VA**

DC Resistance (R) — Calculates and displays DC Resistance in Ohms (using DC Volts and DC Amps).

Set **Watts**

Power Factor (PF%) — Enters or calculates Power Factor percentage (based on Watts and VA). Default value is 100%. Entered or calculated Power Factors greater than 100% will result in an error.

HPth

Theoretical Horsepower — Enters or calculates Theoretical Horsepower (based on Amps, VA, Watts, Efficiency%, PF%, and/or Volts). 1.0 HPth correlates to 746 Watts at 100% Efficiency.

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Set **HPth**

Efficiency (Eff %) — Enters or calculates the percent ratio between real power (Watts) and Theoretical Horsepower. Default value is 100%. Entered or calculated Efficiencies greater than 100% will result in an error.

Set 

Kilowatt-Hours to BTU (Kw-hr ► Btu) — Calculates BTU (British Thermal Unit) based on an entered Kilowatt-Hour value.

Set **=**

BTU to Kilowatt-Hours (Btu ► Kw-hr) — Calculates Kilowatt-Hours based on an entered BTU (British Thermal Unit) value.

Set **Stor**

Parallel Resistance (Par Res) — Calculates total Resistance based on an entered series of Parallel Resistor values.

Motor Keys

The *ElectriCalc Pro* can be used to determine motor Full-Load Current (Amps) based on entries for Motor Horsepower (HPmotor), Phase and Voltage. You can also find an equivalent Motor Horsepower if you have entered Voltage and Full-Load Current values. Only HP Motor and Voltage entries as defined by NEC Tables 430.247, 430.248 and 430.250 can be used to determine motor loads.

Set **8**

Induction/Synchronous/DC Motor Toggle (Ind/Sync/DC) — Toggles between Induction, Synchronous, and Direct Current Motor Types.

HPmotor

Motor Horsepower — Enters or calculates Motor Horsepower.

Set **HPmotor**

Starter Size (Starter) — Displays the Starter Size (from NEMA publication ICS 2-1988 Tables 2-327-1 and 2-327-2) based on the Phase, Voltage, and Motor Horsepower settings.

Note: Horsepower values not identified in NEMA tables will cause the calculator to round up to the next larger Starter Size in the table.

Wire Sizing Keys

The *ElectriCalc Pro* uses NEC Table 310.15(B)(16) (310.15(B)(17) for Free Air) to find Wire Sizes and Ampacity ratings of wires. The calculator uses the following data to calculate Wire Size:

- 1) Insulation temperature rating (60°C, 75°C and 90°C)
- 2) Wire material (Copper or Aluminum)
- 3) Ambient Temperature

Standard AWG Wire Sizes and Circular Mils are used by the *ElectriCalc Pro*. Wire Size entries less than or equal to 2,000 are accepted as AWG Wire Sizes; entries greater than 2,000 are accepted as Circular Mil entries and display the corresponding AWG Wire Size. Entries must match the standard Wire Sizes or Circular Mils; otherwise, **nonE** will be displayed (invalid entry).

Note: 1/0, 2/0, 3/0 and 4/0 wires are entered using the **0** key (e.g., 0, 00, 000 and 0000).

WireSz

Wire Size/Ampacity — Enters or calculates Wire Size based on Ampacity and Voltage Drop, if a Voltage Drop Length has been entered.

◆ **First Press**

If a Wire Length has been entered, the first press will show the larger of the Ampacity or Voltage Drop derived Wire Size. The calculator will use the larger value when calculations require a Wire Size. If no Voltage Drop Length has been entered, the calculator will display the calculated Ampacity-rated Wire Size.

◆ **Second Press**

If a Wire Length has been entered, the second press displays the smaller of the two Wire Sizes. If not solving for Voltage Drop Wire Size, then displays the maximum Ampacity.

◆ **Third Press**

Displays the Wire Size in Circular Mils.

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◆ **Fourth Press**

If a Wire Length has been entered, displays the minimum Wire Ampacity rating. If no Wire Length has been entered, displays the NEC table referenced for the calculation.

Set WireSz

125% Ampacity — Used for Motor Wire Sizing when the Wire must not exceed 80% of its rated Ampacity (125%A). This keystroke calculates Wire Size based on 125% of the entered or calculated Amps value.

ParSz

Parallel Size — Used to find the size of parallel conductors using Amperage and an entered quantity of Wires. Parallel Wire Size calculations smaller than 1/0 will display **nonE**, as the NEC does not allow Parallel Wire runs smaller than 1/0.

◆ **First Press**

When preceded by a number, calculates the applicable Wire Size for that quantity of Wires in parallel.

◆ **Second Press**

Displays the maximum adjusted Ampacity of the calculated Parallel Wire Size.

Note: No adjustments are made for deration.

Set ParSz

Derated Wire Size (D/R Size) — Used to calculate Derated Wire Sizes and allowable Ampacity based on the entered quantity of wires, NEC Table 310.15(B)(16) and NEC Table 310.15(B)(3)(a). Derated Wire Sizes are not calculated when there are less than four Wires, or when the unit is in Free Air mode.

◆ **First Press**

Calculates the Derated Wire Size, if you have entered the number of Wires.

◆ **Second Press**

Displays the maximum adjusted Ampacity of the Derated Wire Size.

◆ **Third Press**

Displays the Derated Adjustment Factor per the NEC Table 310.15(B)(3)(a).

◆ **Fourth Press**

Displays the NEC table referenced for the calculation.

Voltage Drop Keys

The *ElectriCalc Pro* will calculate maximum Lengths, minimum Wire Sizes or actual Voltage Drops given the other two values. Voltage Drop solutions are based on the DC Resistance values found in NEC Chapter 9, Table 8.

Note: *Voltage Drop solutions may vary slightly from actual AC circuit values as the calculator does not incorporate factors such as inductive reactance, skin effect, raceway material, etc.*

VD%

Percent Voltage Drop — Used to enter or calculate Voltage Drop. The default Voltage Drop is 3%. If Wire Size or Wire Length values are not available, **nonE** will display, since the Voltage Drop cannot be found.

◆ **First Press**

Enters a maximum allowable Voltage Drop percentage or calculates actual Voltage Drop.

◆ **Second Press**

Calculates actual percent Voltage Drop.

Length

Length — Enters or calculates the Length of a run for Voltage Drop calculation.

Note: *Units of Length can be set to Feet or Meters by changing the Preference Setting (see Preference Settings section).*

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Set Length

Wire Resistance (Wire Res) — Displays the actual Resistance per 1,000 Feet of the Wire Size in **WireSz** based on NEC Chapter 9, Table 8.

Grounding Conductor Keys

Grnd

Ground — Used to find the Grounding electrode conductor size for AC systems based on NEC Table 250.66 and an entered or calculated service-entrance conductor (largest size). Only actual Wire Sizes are considered valid entries.

◆ **First Press**

Calculates the copper Grounding electrode conductor size if you have entered a valid Wire Size.

◆ **Second Press**

Displays the aluminum Grounding electrode conductor size.

◆ **Third Press**

Displays the Circular Mil area used to calculate the Grounding electrode conductor size.

◆ **Fourth Press**

Displays the NEC table referenced for the calculation.

Set Grnd

Equipment Ground (EqGrnd) — This function uses NEC Table 250.122 to calculate the minimum equipment Grounding conductor size, given an entered Amperage rating or setting for an over-current device up line.

Note: This function deviates from the NEC Table 250.122 in that 1250 MCM AL is used instead of 1200 as specified in NEC Table 250.122.

◆ **First Press**

Displays the copper Grounding conductor size for the entered Amp rating.

◆ **Second Press**

Displays the aluminum Grounding conductor size.

◆ **Third Press**

Displays the NEC table referenced for the calculation.

Fuse/Breaker Keys

The *ElectriCalc Pro* has special keys that automatically calculate the Amp ratings of the following over-current protection devices: Dual Element Fuses (Time Delay), Single Element Fuses (Non-Time Delay), Instantaneous Trip Breakers (Type 1), Inverse Time Breakers (Type 2), and Overload Protection Devices.

These Fuse and Circuit Breaker sizes are derived using the “Percent of Full-Load Current” multipliers listed in NEC Table 430.52.

If a parameter is missing or invalid, the calculator will display **nonE**.

O-Load

Overload Protection —

◆ **First Press**

Displays the Overload Amperage requirement based on the Full-Load Current shown on the motor nameplate. Multiplies the entered motor nameplate Full-Load Current (stored in the **Amps** register) by 115% or the value you enter.

Conforms to NEC Section 430.32(A)(1) value of 115%, unless you enter another value. For example, entering 125 **O-Load** would calculate Overload protection based on 125% of the entered Amperage.

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◆ **Second Press**

Displays the Full-Load Current percent multiplier value used to determine the Overload current protection size. Subsequent presses of **O-Load** repeat the cycle.

Set **O-Load**

Motor Type (M-Type) — Based on NEC Table 430.52, this function selects the Motor Type used to define the percent factors for Breakers/Fuses. Once set, the Motor Type remains fixed until you change it or perform a Clear All (**Set** **X**).

◆ **First Press**

Displays the current Motor Type. Note there is no Motor Type in Single-Phase mode.

◆ **Second Press**

In Three-Phase mode only, subsequent presses of **O-Load** will select and display the next Motor Type from this list: **SQ-C non-b** (Squirrel Cage, non-Design B), **SQ-C b** (Squirrel Cage, Design B), **SYNC no code** (Synchronous), **WND no code** (Wound Rotor).

DEFuse

Dual Element Fuse —

◆ **First Press**

Calculates the minimum Amp rating for a Dual Element Fuse.

◆ **Second Press**

Displays the Full-Load Current percent multiplier used to determine Fuse size.

Set **DEFuse**

Single Element Fuse (SEFuse) —

◆ **First Press**

Displays the minimum Amp rating based on Phase, Motor Type, and Amperage.

◆ **Second Press**

Displays the Full-Load Current percent multiplier value used to determine Fuse size. Subsequent presses repeat this cycle.

InvTime

Inverse Time Breaker —

◆ **First Press**

Displays the minimum Amp rating for an Inverse Time Breaker, based on the Phase, Motor Type, and Amperage.

◆ **Second Press**

Displays the Full-Load Current percent multiplier value used to determine Breaker Size.

Set InvTime

Instantaneous Trip Circuit Breaker (InsTrip) —

◆ **First Press**

Displays the minimum Amp rating for an Instantaneous Trip Circuit Breaker, based on the Phase, Motor Type, and Amperage.

◆ **Second Press**

Displays the Full-Load Current percent multiplier value used to determine Breaker Size.

Conduit Sizing Keys

The *ElectriCalc Pro* calculates Conduit Size using NEC Tables 1, 4 and 5 of Chapter 9 (given Insulation Type, Wire Size, and quantity of Wires). It will also calculate the Number of Wires of a specified Insulation Type and Wire Size that will fit in a defined Conduit Size. Acceptable Conduit Sizes (depending on the type of Conduit used) are as follows: 1/2", 3/4", 1", 1-1/4", 1-1/2", 2", 2-1/2", 3", 3-1/2", 4", 5", and 6". Conduit Sizes are entered using decimal equivalents (e.g., 1-1/2" is entered as 1.5, 3/4" is entered as 0.75, etc.).

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Number of Wires — Used to enter or calculate the Number of Wires in a raceway and calculate cross-sectional Wire Area.

◆ **First Press**

Enters Number of Wires or calculates maximum Number of Wires in Conduit.

◆ **Second Press**

Shows total cross-sectional area for all entered Wires.

◆ **Third Press**

Shows total cross-sectional area of all entered Wires of the selected Wire Insulation.

CondSz

Conduit Size — Used to find Conduit Sizes based on the total area of the entered Wire Types and Wire Sizes (up to 15 at one time). If the quantity and Insulation Type have not been entered, the calculator will assume 2 THHN Wires for Single-Phase or 3 THHN Wires for Three-Phase calculations.

◆ **First Press**

Enters or calculates Conduit Size.

Note: If a Wire Size has not been entered or calculated, or an invalid Conduit Size is entered, the calculator will display nonE.

◆ **Second Press**

Shows Total Number of Wires in the Conduit for calculated Conduit Size. Shows the Conduit internal Area for an entered Conduit.

Note: Third through fifth presses will only be displayed for calculated Conduit Sizes.

◆ **Third Press**

Shows Fill Percentage for the calculated Conduit Size as determined by NEC Table 1, Chapter 9.

◆ **Fourth Press**

Shows the Total Wire Area for all entered Wires.

◆ **Fifth Press**

Shows Remaining Fill Area. This value may be negative if all Wires are the same size due to Note 7 in NEC Chapter 9, Table 1.

Set CondSz

Conduit Type (Cond Type) — Used to select the desired Conduit Type. Pressing these keys with a value between 1 and 12 will select the corresponding Conduit Type, as specified in the list below (i.e., **1 Set CondSz** selects the EMT Conduit). Continuous presses of **Set CondSz** toggle through the available Conduit Types.

◆ **First Press**

Displays the currently selected Conduit Type.

- 1) EMT
- 2) ENT
- 3) FMC
- 4) IMC
- 5) LFNB
- 6) LFNA
- 7) LFMC
- 8) RMC
- 9) P-80
- 10) P-40
- 11) P-A
- 12) P-EB

PREFERENCE SETTINGS

Press **Set**, then **÷** to access the Preferences menu. Continue pressing **÷** to toggle through different Preferences. Press **+** or **-** keys to toggle between options of the different Preferences. Press **On/C** to exit Preferences. Your calculator will keep your Preference Settings until a Full Reset alters your settings to the default values (see **Appendix** for more information).

KEYSTROKE	DISPLAY
Set ÷ (<i>Prefs</i>)	
(<i>NEC Code</i>)	2014
+	1996
+	1999
+	2002
+	2005
+	2008
+	2011
+ (<i>repeats options</i>)	2014
Second press of ÷ : (<i>Ambient Temperature Units</i>)	AMB° 30. °C*
+	AMB° 86. °C*
+ (<i>repeats options</i>)	AMB° 30. °C*
* These values will differ if you have changed the Ambient Temperature.	
Third press of ÷ : (<i>Length Units</i>)	FEET 1.
+	MET 1.
+ (<i>repeats options</i>)	FEET 1.

BASIC MATH OPERATIONS

This calculator uses standard chaining logic, which simply means that the entered mathematical string is evaluated from left to right without any priority given to different operators.

KEYSTROKE	DISPLAY
3 + 2 =	5.
3 - 2 =	1.
3 x 2 =	6.
3 ÷ 2 =	1.5

PERCENT CALCULATIONS

The **%** key can be used for finding a given percentage of a number or for working add-on, discount or division percentage calculations.

KEYSTROKE	DISPLAY
3 5 5 x 1 5 %	53.25
2 5 0 + 6 • 5 %	266.25
2 5 - 5 %	23.75
1 0 0 ÷ 5 0 %	200.

The **%** key also allows you to change percentages to decimals (e.g., **2** **5** **%** displays 0.25).

MEMORY OPERATIONS

Whenever the **Stor** **0** keys are pressed, the displayed value will be added to the Cumulative Memory. Other Memory functions:

FUNCTION	KEYSTROKE
Add to Memory	Stor 0
Subtract from Memory	Set - Stor 0
Recall total in Memory	Rcl 0
Display/Clear Memory	Rcl Rcl
Clear Memory	Set Rcl

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Memory is semi-permanent, clearing only when you do one of the following:

- turn off the calculator
- press **Rcl** **Rcl**
- press **Set** **Rcl**
- press **Set** **X** (Clear All).

When memory is recalled (**Rcl** **0**), consecutive presses of **Rcl** **0** will display the calculated Average and total Count of the accumulated values.

Using M+

KEYSTROKE	DISPLAY
3 5 5 Stor 0 (M+)	M+ 355. M
2 5 5 Stor 0 (M+)	M+ 255. M
7 4 5 Set – Stor 0 (M+)	M+ –745. M
Rcl 0	TTL – 135. M
Rcl 0	AVG – 45. M
Rcl 0	CNT 3. M
Rcl Rcl	– 135.

Using Memory Storage Keys (M1- M9)

In addition to the standard cumulative Memory (as previously described), your calculator has nine independent Storage Registers – M1 through M9 – that can be used to permanently store single, non-cumulative values. The following example shows the use of M1 (**Stor** **1**). To use M2 through M9, replace the presses of the **1** key with presses of the corresponding number key (**2** through **9**).

You can replace a value in one of these Memory registers by storing a new value in place of the stored value.

FUNCTION	KEYSTROKE
Store single value in M1	Stor 1
Clear M1	0 Stor 1
Recall M1	Rcl 1
Store 175 into M1, recall the value, and then clear the value.	
KEYSTROKE	DISPLAY
1 7 5 Stor 1	M-1 175.
Off On/C	0.
Rcl 1	M-1 175.
0 Stor 1	M-1 0.

USING THE *ELECTRIC CALC PRO*

KIRCHHOFF'S LAW

The *ElectriCalc Pro* utilizes Kirchhoff's Law in finding Volts, Amps, Volt-Amps, Watts, Horsepower (theoretical), Efficiency and Power Factor.

Finding Voltage

Find the Voltage supply to a Single-Phase load drawing 14,605 Volt-amps and 115 Amps.

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 1-Phase:	
Set 1 (1Ø)	1 Ø 1 PH
2. Enter VA:	
1 4 6 0 5 VA	VA 14,605.
3. Enter Amps:	
1 1 5 Amps	AMPS 115.
4. Solve for Volts:	
Volts	VOLT 127.

Finding Amps

What is the current (Amps) for a load drawing 8,250 Volt-Amps on a 240 Volt, Three-Phase circuit?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-Phase: Set 3 (3Ø)	3Ø 3 PH
2. Enter VA: 8 2 5 0 VA	VA 8,250.
3. Enter Volts: 2 4 0 Volts	VOLT 240.
4. Solve for Amps: Amps	AMPS 19.846416

Finding Current Load

A building with 120/240 Volt 1Ø service has the following loads:

Range = 7,800 VA

Heating = 15,100 VA

Dryer = 5,100 VA

Appliances = 8,900 VA

Lighting = 6,470 VA

What is the service load (Amps) of the circuit supplying this building?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 1-Phase: Set 1 (1Ø)	1Ø 1 PH
2. Add VA loads: 7 8 0 0 +	7,800.
1 5 1 0 0 +	22,900.
5 1 0 0 +	28,000.
8 9 0 0 +	36,900.
6 4 7 0 =	43,370.

KEYSTROKE	DISPLAY
3. Enter as VA: VA	VA 43,370.
4. Enter Volts: 2 4 0 Volts	VOLT 240.
5. Solve for Amps: Amps	AMPS 180.70833

Finding Amps From Kilowatts

What is the Amperage for a 75 kW load connected in a 120/208 Volt, 3Ø circuit?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-Phase: Set 3 (3Ø)	3Ø PH
2. Enter kilowatts: 7 5 kilo- Watts	KW 75.
3. Enter Volts: 2 0 8 Volts	VOLT 208.
4. Solve for Amps: Amps	AMPS 208.17918

Finding Volt-Amps

What is the VA rating for a 120 Volt, 22 Amp, 1Ø circuit? What is the kVA rating?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 1-Phase: Set 1 (1Ø)	1 Ø 1 PH

(cont'd)

(cont'd)

KEYSTROKE	DISPLAY
2. Enter Volts:	
1 2 0 Volts	VOLT 120.
3. Enter Amps:	
2 2 Amps	AMPS 22.
4. Solve for Volt-Amps:	
VA	VA 2,640.
5. Solve for kVA:	
kilo- VA	KVA 2.64

Finding kVA Rating

What is the kVA rating for a 120/208 Volt, Three-Phase, 65 Amp transformer?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-Phase:	
Set 3 (3Ø)	3Ø 3 PH
2. Enter Volts:	
2 0 8 Volts	VOLT 208.
3. Enter Amps:	
6 5 Amps	AMPS 65.
4. Solve for kVA:	
kilo- VA	KVA 23.417327

Finding Wattage

A 120 Volt, Single-Phase, 45 Amp electrical motor has an 87% Power Factor. What is its Wattage?

KEYSTROKE	DISPLAY
On/C On/C	0.

KEYSTROKE	DISPLAY
1. Set to 1-Phase: Set 1 (1Ø)	1 Ø 1 PH
2. Enter Volts: 1 2 0 Volts	VOLT 120.
3. Set Power Factor: 8 7 Set Watts (PF%)	PF% 87.
4. Enter Amps: 4 5 Amps	AMPS 45.
5. Solve for Watts: Watts	WATT 4,698.

Finding kW Rating

What's the kW rating for a 90 Amp, 208 Volt, Three-Phase boiler with 100% Power Factor?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-Phase: Set 3 (3Ø)	3Ø 3 PH
2. Set Power Factor: 1 0 0 Set Watts (PF%)	PF% 100.
3. Enter Amps: 9 0 Amps	AMPS 90.
4. Enter Volts: 2 0 8 Volts	VOLT 208.
5. Solve for kW: kilo- Watts	KW 32.423991

OHM'S LAW

The *ElectriCalc Pro*'s built-in Ohm's Law functions allow you to easily solve for Voltage (Volts), Current (Amps), or Resistance (Ohms) by entering in any two variables (e.g, Volts and Amps) and solving for the third (e.g., Ohms).

$$\text{Ohm's Law: } V = I \times R$$

The Ohm's Law functions on the *ElectriCalc Pro* are identified as follows:

- Vdc = Voltage, in Volts
- Idc = Current, in Amps
- R = Resistance, in Ohms

Finding Volts

The Current in a circuit is 0.0125 Amps, and the total Resistance is 480 Ohms. Find the Voltage.

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter Current:	
0 0 1 2 5 Set Amps (Idc)	Idc 0.0125 A
2. Enter Resistance:	
4 8 0 Set VA (R)	OHMS 480.
3. Find Voltage:	
Set Volts (Vdc)	Vdc 6. v

Finding Amps

A 120k electrical resistor is plugged into a 12 volt circuit. Find the Current (in Amps).

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter Resistance:	
1 2 0 kilo- Set VA (R)	KOHM 120.

KEYSTROKE**DISPLAY**

2. Enter Voltage:

1 2 Set Volts (Vdc)**Vdc 12. v**

3. Find Current:

Set Amps (Idc)**Idc 0.0001 A****Finding Resistance (Ohms)**

An electrical circuit operating at 240 Volts has a Current of 14.6 Amperes. Find the total Resistance (in Ohms) of the circuit.

KEYSTROKE**DISPLAY****On/C On/C****0.**

1. Enter Voltage:

2 4 0 Set Volts (Vdc)**Vdc 240. v**

2. Enter Current:

1 4 . 6 Set Amps (Idc)**Idc 14.6 A**

3. Find Resistance:

Set VA (R)**OHMS 16.438356****MOTOR FUNCTIONS**

The *ElectriCalc Pro* can calculate the Full-Load Current (Amps) of a motor, based on Phase, Voltage and Motor (Synchronous, Induction, or DC) Horsepower. It uses NEC Tables 430.247, 430.248 and 430.250 to determine the motor Full-Load current. (If you enter a value for HP or Voltage that does not correspond to these tables, the unit will display **nonE**).

The *ElectriCalc Pro* can also calculate an equivalent Horsepower for an Induction, Synchronous or Direct Current motor based on a Voltage, Phase and Full-Load Current. When calculating Motor HP from an entered Amperage, a result not directly matching a value in NEC Table 430.247, 430.248 or 430.250 will cause the calculator to choose the next higher table value for Motor Horsepower.

Finding Single-Phase Full-Load Current

A 2 HP Induction motor operates on 230 Volt, Single-Phase power.
What is the Full-Load Current for this motor?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 1-Phase: Set 1 (1Ø)	1 Ø 1 PH
2. Enter Volts: 2 3 0 Volts	VOLT 230.
3. Enter HP: 2 HPmotor	IND* 2. HP
<i>* If IND is not shown, press Set 8 until IND is displayed in the upper left area of the display.</i>	
4. Find Full-Load Current: Amps	FLC 12. A

Finding Motor Wire Size and Ampacity

Find the Wire Size required to connect a continuous run, 3Ø, 10 HP Induction motor into a 230V circuit.

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-Phase: Set 3 (3Ø)	3Ø 3 PH
2. Set to 60° C: Set 6 (60°)	3Ø 60 3 PH
3. Set to Copper (if necessary): Set 4 (Cu/Al)	3Ø 60 Cu 3 PH
4. Enter Volts: 2 3 0 Volts	VOLT 230.

KEYSTROKE

DISPLAY

5. Enter HP:

1 0 HPmotor

IND* 10. HP

* If **IND** is not shown, press **Set 8** until **IND** is displayed in the upper left area of the display.

6. Find Full-Load Current:

Amps

FLC 28. A

7. Find 125% Ampacity Wire Size:

Set WireSz (125%)

AWG 8 CU WIRE SIZE 125%

8. Find max Ampacity:

WireSz

8* 40.0 WIRE A125%

* The Wire Size will be shown in the upper left area of the display when displaying the Wire Ampacity rating.

Finding Synchronous Motor Horsepower

A Synchronous motor is defined as having a 27 Amp load on a 240 Volt, 3Ø circuit. What is its Horsepower?

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to 3-Phase:

Set 3 (3Ø)

3Ø 3 PH

2. Set to Synchronous motor:

Set 8 *(Ind/Sync/DC)

SYNC 0.

* If necessary, continue pressing **Set 8** until the desired Motor Type is displayed.

3. Enter Volts:

2 4 0 Volts

VOLT 240.

4. Enter Amps:

2 7 Amps

AMPS 27.

(cont'd)

(cont'd)

KEYSTROKE

DISPLAY

5. Solve for HP:

HPmotor

SYNC 25. HP

6. Set to Induction motor:

Set 8 Set 8 (Ind/Sync/DC)

IND 0.

Finding Direct Current Motor Horsepower

A Direct Current motor is defined as having a 10 Amp load on a 180 Volt circuit. What is its Horsepower?

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to DC motor:

Set 8 Set 8 *(Ind/Sync/DC)

DC 0.

* If necessary, continue pressing **Set 8** until the desired Motor Type is displayed.

2. Enter Volts:

1 8 0 Volts

VOLT 180.

3. Enter Amps:

1 0 Amps

AMPS 10.

4. Solve for HP:

HPmotor

DC 2. HP

5. Set to Induction motor:

Set 8 (Ind/Sync/DC)

IND 0.

AMPACITY WIRE SIZING

The required Wire Size of a service conductor can be determined based on the specified electrical requirements and the **WireSz** key. The Wire Size is automatically recalculated whenever the Wire Insulation (temperature) ratings or Wire material (Copper or Aluminum) types are revised. Wire Sizing is based on the requirements defined in NEC Tables 310.15(B)(16) and 310.15(B)(17).

Wire Sizing Based on Insulation Rating

Wiring is being installed in a 240 Volt, Single-Phase system rated at 30 kVA. What is the Wire Size needed if you use 60° C Copper wire?

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to 1-Phase:

Set 1 (1Ø)

1 Ø 1 PH

2. Set to 60° C:

Set 6 (60°)

1 Ø 60 1 PH

3. Set to Copper (if necessary):

Set 4 (Cu/Al)

1 Ø 60 Cu 1 PH

4. Enter kVA:

3 0 kilo- VA

KVA 30.

5. Enter Volts:

2 4 0 Volts

VOLT 240.

6. Find Amps:

Amps

AMPS 125.

7. Find Wire Size:

WireSz

AWG 0 CU WIRE SIZE

8. Display Wire Ampacity:

WireSz

Ø* 125.0 WIRE A

* The Wire Size will be shown in the upper left area of the display when displaying the Wire Ampacity rating.

9. Display CMIL:

WireSz

CMIL 105,600. WIRE

10. Display NEC Table:

WireSz

NEC 310.15.b.16

Re-Sizing Wire Based on Different Insulation Ratings

What Wire Size is required for a 3Ø, 75°C Copper branch circuit carrying a load of 260 Amps? What would the Wire Size be if 90°C Copper is used?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-Phase: Set 3 (3Ø)	3Ø 3 PH
2. Set to 75° C: Set 7 (75°)	3Ø 75 3 PH
3. Set to Copper (if necessary): Set 4 (Cu/Al)	3Ø 75 Cu 3 PH
4. Enter Amps: 2 6 0 Amps	AMPS 260.
5. Find Wire Size: WireSz	AWG 300 CU WIRE SIZE
6. Change to 90° C: Set 9 (90°)	3Ø 90 Cu AWG 0000 CU WIRE SIZE

Wire Sizing Based on Ambient Temperature

Find the 90°C Copper Wire Size needed to connect a 47,700 Volt-Amp load to a 240 Volt, Single-Phase source. What is the adjusted Wire Size, if the Ambient temperature rating is changed from the default 30°C to 20°C?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 1-Phase: Set 1 (1Ø)	1Ø 1 PH

KEYSTROKE

DISPLAY

2. Set to 90° C:

Set **9** (90°)

1 Ø 90 1 PH

3. Set to Copper (if necessary):

Set **4** (Cu/Al)

1 Ø 90 Cu 1 PH

4. Enter VA:

4 **7** **7** **0** **0** **VA**

VA 47,700.

5. Enter Volts:

2 **4** **0** **Volts**

VOLT 240.

6. Find Amps:

Amps

AMPS 198.75

7. Find Wire Size:

WireSz

AWG 000 CU WIRE SIZE

8. Change Ambient temperature:

2 **0** **Set** **2** (Amb°)

1Ø 90 Cu Amb AMB° 20. °C

9. Find adjusted Wire Size:

WireSz

AWG 00 CU WIRE SIZE

10. Display Wire Ampacity:

WireSz

ØØ* 210.6 WIRE A

* The Wire Size will be shown in the upper left area of the display when displaying the Wire Ampacity rating.

11. Display CMIL:

WireSz

CMIL 133,100. WIRE

12. Display NEC table:

WireSz

NEC 310.15.b.16

13. Reset Ambient Temperature and Clear:

3 **0** **Set** **2** **On/C**

1Ø 90 Cu 0.

Wire Sizing Based on Material Type

Find the Wire Size for a 75°C Copper Wire carrying a 3Ø load of 265 Amps. What is the equivalent Aluminum Wire Size?

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to 3-Phase:

Set 3 (3Ø)

3Ø 3 PH

2. Set to 75° C:

Set 7 (75°)

3Ø 75 3 PH

3. Set to Copper (if necessary):

Set 4 (Cu/Al)

3Ø 75 Cu 3 PH

4. Enter Amps:

2 6 5 Amps

AMPS 265.

5. Find Wire Size:

WireSz

AWG 300 CU WIRE SIZE

6. Change to Aluminum:

Set 4 (Cu/Al)

3Ø 75 Al AWG 400 AL WIRE SIZE

7. Display Wire Ampacity:

WireSz

4ØØ* 270.0 WIRE A

* The Wire Size will be shown in the upper left area of the display when displaying the Wire Ampacity rating.

8. Display CMIL:

WireSz

CMIL 400,000. WIRE

9. Display NEC Table:

WireSz

NEC 310.15.b.16

Sizing Parallel Conductors

What size 60°C insulated Copper Wire is required for a single conductor carrying a 500 Amp load in a Free Air environment (30°C Ambient Temperature.)? What size for two Parallel conductors? For three conductors?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 60° C: Set 6 (60°)	60 0.
2. Set to Copper (if necessary): Set 4 (Cu/Al)	60 Cu 0.
3. Set to Free Air mode: Set 5 (FrAir)	60 Cu FrAir 0.
4. Enter Amps: 5 0 0 Amps	AMPS 500.
5. Find Wire Size for one conductor: WireSz	AWG 500 CU WIRE SIZE
6. Find Wire Size for two conductors: 2 ParSz	PAR 000 CU WIRE SIZE
7. Find Wire Size for three conductors: 3 ParSz	PAR 0 CU WIRE SIZE
8. Exit Free Air Mode and Clear: Set 5 On/C	60 Cu 0.

Note: Parallel Wire Sizes smaller than 1/0 will be displayed as **nonE**.

Finding Derated Wire Size

What is the Derated Wire Size required for nine 75°C Copper wires, each carrying a maximum load of 65 Amps?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 75° C: Set 7 (75°)	75 0.
2. Set to Copper (if necessary): Set 4 (Cu/Al)	75 Cu 0.
3. Enter Amps: 6 5 Amps	AMPS 65.
4. Find normal Wire Size: WireSz	AWG 6 CU WIRE SIZE
5. Find Derated Wire Size: 9 Set ParSz (D/R Size)	D/R 3 CU WIRE SIZE
6. Display Wire Ampacity: ParSz	D/R 45.5 WIRE A
7. Display Adjustment Factor: ParSz	ADJ 70. %
8. Display NEC Table: ParSz	NEC 310.15.b.3

Sizing Temperature-Adjusted Derated Wires

A circuit was built with 60°C Copper wire connecting a 47,650 Volt-Amp load to a 240 Volt, Three-Phase source. Ambient Temperature is 50°C. What is the Derated Wire Size required if eight current-carrying THHN wires are installed in the raceway?

KEYSTROKE	DISPLAY
On/C On/C	0.

KEYSTROKE

DISPLAY

1. Set to 3-Phase:

Set **3** (3Ø)

3Ø 3 PH

2. Set to 60° C:

Set **6** (60°)

3Ø 60 3 PH

3. Set to Copper (if necessary):

Set **4** (Cu/Al)

3Ø 60 Cu 3 PH

4. Enter Volt-Amps:

4 **7** **6** **5** **0** **VA**

VA 47,650.

5. Enter Volts:

2 **4** **0** **Volts**

VOLT 240.

6. Set to 50° C Ambient Temperature:

5 **0** **Set** **2** (Amb°)

3Ø 60 Cu Amb AMB° 50. °C

7. Find Adjusted Wire Size:

WireSz

AWG 250 CU WIRE SIZE

8. Find Derated Wire Size:

8 **Set** **ParSz** (D/R Size)

D/R 500 CU WIRE SIZE

9. Display Wire Ampacity:

ParSz

D/R 46.5 WIRE A

10. Display Adjustment Factor:

ParSz

ADJ 41. %

11. Display NEC Table:

ParSz

NEC 310.15.b.3

12. Reset Ambient Temperature and Clear:

3 **0** **Set** **2** **On/C**

3Ø 60 Cu 0.

VOLTAGE DROP

The reduction in Voltage between the power source and the load can be determined by entering the Phase, Volts, Amps, Wire material, Voltage Drop Wire Size and Length of run. The calculator determines Resistance and then the Voltage reduction. Voltage Drop can be displayed as Volts dropped, or as a percent reduction of potential load.

This calculator also finds Voltage Drop Wire Size once you have entered or calculated the Phase, Volts, Amps, Length, Wire Type, and allowable VD percentage. It will solve for the distance (**Length**) once you have entered or calculated the Phase, Volts, Amps, Wire Type, Voltage Drop Wire Size, and allowable VD percentage. The *ElectriCalc Pro* uses Resistance values found in NEC Table 8 Chapter 9 to determine Voltage Drop.

Note: *Voltage Drop solutions may vary slightly from actual AC circuit measurements, as the calculator does not incorporate factors such as inductive reactance, skin effect, raceway material, etc. In most situations, the DC Voltage Drop calculation method is sufficient to meet safety standards for AC systems.*

IMPORTANT NOTE ON VOLTAGE DROP CALCULATIONS

The *ElectriCalc Pro* calculates Voltage Drop and Wire Size using DC Resistance as defined by the 2014 NEC. To find the Voltage Drop for a specific Wire Size, you must first enter Amps and the one-way wire Length (and other required variables), entering the specific Wire Size last. Otherwise, for your safety, the calculator will recalculate the Wire Sizes based on the NEC Ampacity Tables and maximum allowable Voltage Drop.

Finding Single-Phase Voltage Drop

You are installing 175 Feet of 75°C, #8 THW branch circuit Copper conductors to supply an 11A load on a 208V 1Ø system. What is the source Voltage Drop at the load?

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to 1-Phase:

Set 1 (1Ø)

1 Ø 1 PH

2. Set to 75 ° C:

Set 7 (75°)

1 Ø 75 1 PH

3. Set to Copper (if necessary):

Set 4 (Cu/Al)

1 Ø 75 Cu 1 PH

4. Enter Amps:

1 1 Amps

AMPS 11.

5. Enter Volts:

2 0 8 Volts

VOLT 208.

6. Enter Length:

1 7 5 Length

FEET 175.

7. Enter Wire Size:

8 WireSz*

AWG 8 CU WIRE SIZE

8. Solve Voltage Drop:

VD%

DROP 3.0 v

9. Solve percent Voltage Drop:

VD%

DROP 1.4 % v

* Wire size can also be entered in Circular Mils (e.g.,

1 6 5 1 0 WireSz enters 16,510 CMILs and displays 8 AWG Wire Size).**Finding Three-Phase Voltage Drop**

A 20 Amp, Three-Phase load is being fed by a 230 Volt source located 150 Feet away. The installation specifications require 75°C #10 THW stranded Copper conductor. What is the Voltage Drop on this branch circuit?

(cont'd)

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(cont'd)

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-Phase: Set 3 (3Ø)	3Ø 3 PH
2. Set to 75 ° C: Set 7 (75°)	3Ø 75 3 PH
3. Set to Copper (if necessary): Set 4 (Cu/Al)	3Ø 75 Cu 3 PH
4. Enter Amps: 2 0 Amps	AMPS 20.
5. Enter Volts: 2 3 0 Volts	VOLT 230.
6. Enter Length (Feet): 1 5 0 Length	FEET 150.
7. Enter Wire Size: 1 0 WireSz	AWG 10 CU WIRE SIZE
8. Solve Voltage Drop: VD%	DROP 6.4 v
9. Solve percent Voltage Drop: VD%	DROP 2.8 % v

Finding Voltage Drop Wire Size

A 20 Amp, Three-Phase 208 Volt load will be located 175 Feet away from the source. Assuming a 3% allowable Voltage Drop, what is the size of 75°C conductor required for this branch circuit? What is the resulting voltage drop?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-Phase: Set 3 (3Ø)	3Ø PH

KEYSTROKE

DISPLAY

2. Set to 75° C:

Set **7** (75° C)

3Ø 75 3 PH

3. Set to Copper (if necessary):

Set **4** (Cu/Al)

3Ø 75 Cu 3 PH

4. Enter Amps:

2 **0** **Amps**

AMPS 20.

5. Enter Volts:

2 **0** **8** **Volts**

VOLT 208.

6. Enter Length:

1 **7** **5** **Length**

FEET 175.

7. Enter allowable VD%:

3 **VD%**

DROP 3.0 % V

8. Find Wire Size:

WireSz

AWG 8 CU VD WIRE SIZE

9. Find actual Voltage Drop:

VD%

DROP 4.7 V

10. Find percent Voltage Drop:

VD%

DROP 2.3 % V

Finding Voltage Drop Distance

How far from a Three-Phase 240 Volt source can you install a 15 Amp load using 60°C #10 Copper branch circuit conductors? Assume a 3% allowable Voltage Drop.

KEYSTROKE

DISPLAY

On/C **On/C**

0.

1. Set to 3-Phase:

Set **3** (3Ø)

3Ø 3 PH

(cont'd)

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(cont'd)

KEYSTROKE

DISPLAY

2 Set to 60° C:

Set **6** (60°)

3Ø 60 3 PH

3. Set to Copper (if necessary):

Set **4** (Cu/Al)

3Ø 60 Cu 3 PH

4. Enter Amps:

1 **5** **Amps**

AMPS 15.

5. Enter Volts:

2 **4** **0** **Volts**

VOLT 240.

6. Enter Wire Size:

1 **0** **WireSz** *

AWG 10 CU WIRE SIZE

7. Enter 3% allowable Voltage Drop:

3 **VD%**

DROP 3.0 % V

8. Find distance:

Length

FEET 234.86987

9. Find actual Voltage Drop:

VD%

DROP 7.2 v

10. Find percent Voltage Drop:

VD%

DROP 3.0 % V

* Wire size can also be entered in Circular Mils (e.g.,

1 **0** **3** **8** **0** **WireSz** enters 10,380 CMILs and displays 10 AWG Wire Size).

Note: The calculator automatically makes adjustments for Resistance using NEC Chapter 9, Table 8, if the Insulation Type is other than 75°C.

Finding Voltage Drop Resistance

What is the Resistance of 85 Feet of #2 90° C Copper conductor?

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to 90° C:

Set 9 (90°)

90 0.

2. Set to Copper (if necessary):

Set 4 (Cu/Al)

90 Cu 0.

3. Enter Wire Size:

2 WireSz *

AWG 2 CU WIRE SIZE

4. Find Resistance:

Set Length (Wire Res)

OHMS 0.2033993 WIRE

5. Find 85-foot Resistance**:

÷ 1000 X 85 =

0.0172889

* Wire size can also be entered in Circular Mils (e.g.,

10380 WireSz enters 10,380 CMILs and displays 10 AWG Wire Size).

** Given Resistance per 1,000 Feet, divide by 1,000 to get a per Foot Resistance, then multiply by 85.

GROUND CONDUCTOR WIRE SIZE

You can use single or multiple service entrance conductor(s) to find the grounding electrode conductor for AC systems. When using multiple conductors, the *ElectriCalc Pro* uses the equivalent Circular Mils to find the Grounding electrode conductor (based on NEC Table 250.66).

Find the Grounding electrode conductor Wire Size required when 2/0 is the largest 3-Phase 75°C Copper service-entrance conductor being used. What is the equivalent Aluminum size? What is the equivalent Circular Mils?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter Wire Size and find Ground Wire Size: 0 0 Grnd	GRND 4 CU WIRE SIZE
2. Find Aluminum size: Grnd	GRND 2 AL WIRE SIZE
3. Find Circular Mils: Grnd	CMIL 133,100. WIRE
4. Display NEC Table: Grnd	NEC 250.66

* Wire size can also be entered in Circular Mils (e.g.,

1 3 3 1 0 0 Grnd enters 133,100 CMILs and displays 4 GRND Wire Size). If Wire Size is not entered using the **Grnd** key, the calculation will be based on the Wire Size stored in the **WireSz** key.

EQUIPMENT GROUNDING CONDUCTOR WIRE SIZE

The **Set Grnd** keystroke can be used to find the Grounding conductor size for raceways and “over-current devices in circuit ahead” equipment. The calculator assumes the displayed value as Amperage to solve for the Equipment Grounding conductor based on NEC Table 250.122.

Find the Equipment Grounding conductor size required when the circuit breaker is rated at 45 Amps. What is the equivalent Aluminum size?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Find Equipment Ground Wire Size: 4 5 Set Grnd (EqGrnd)	EQPG 10 CU WIRE SIZE
2. Find Aluminum size: Grnd	EQPG 8 AL WIRE SIZE
3. Display NEC Table: Grnd	NEC 250.122

FUSE AND CIRCUIT BREAKER SIZE

Fuse and Breaker sizing is determined by NEC Table 430.52. Once the Motor Type is defined via **Set O-Load**, a Full-Load Current amperage value can be used to find the Fuse Breaker Sizes.

What is the calculated Dual Element and Single Element Fuse size for a 230 Volt, 3-Phase, 50 HP Induction motor? What are the Instantaneous Trip and Inverse Time Circuit Breaker requirements?

KEYSTROKE	DISPLAY
On/C On/C	0.

(cont'd)

(cont'd)

KEYSTROKE

DISPLAY

1. Set to 3-Phase:

Set **3** (3Ø)

3Ø 3 PH

2. Enter Volts:

2 **3** **0** **Volts**

VOLT 230.

3. Enter HP:

5 **0** **HPmotor**

IND* 50. HP

* If **IND** is not shown, press **Set** **8** until **IND** is displayed in the upper left area of the display.

4. Find Full-Load Current:

Amps

FLC 130. A

5. Find Dual Element Fuse size:

DEFuse

AMPS 227.5 dE

6. Display percent used:

DEFuse

%FLC 175. %

7. Find Single Element Fuse size:

Set **DEFuse** (SEFuse)

AMPS 390. SE

8. Display percent used:

DEFuse

%FLC 300. %

9. Find Inverse Time Circuit Breaker size:

InvTime

AMPS 325. b2

10. Display percent used:

InvTime

%FLC 250. %

11. Find Instantaneous Trip Circuit Breaker size:

Set **InvTime** (InsTrip)

AMPS 1,040. b1

12. Display percent used:

InvTime

%FLC 800. %

STARTER SIZE

What NEMA size Starter is required for a 575 Volt, 3Ø, 20 HP Induction motor?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 3-phase: Set 3 (3Ø)	3Ø 3 PH
2. Enter Volts: 5 7 5 Volts	VOLT 575.
3. Enter HP: 2 0 HPmotor	IND* 20. HP
* If IND is not shown, press Set 8 until IND is displayed in the upper left area of the display.	
4. Solve for Starter Size: Set HPmotor (Starter)	STAR SIZE 2

OVERLOAD PROTECTION SIZE

What Overload Protection device size is required for an Induction motor with a nameplate Current rating of 19.2 Amps and a 1.0 service factor? What is the required Overload rating at 125% (for a 1.15 service factor)?

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Enter nameplate Current: 1 9 . 2 Amps	AMPS 19.2
2. Find Overload size: 1 1 5 O-Load	AMPS 22.08 o l
3. Display percent used: O-Load	%FLC 115. % (cont'd)

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(cont'd)

KEYSTROKE

DISPLAY

4. Find 125% Load:

1 2 5 O-Load

AMPS 24.0 I

5. Display percent used:

O-Load

%FLC 125. %

6. Reset Overload rating and Clear:

1 1 5 O-Load On/C

0.

CONDUIT SIZE

The *ElectriCalc Pro* can calculate the size of Conduit required when running single or multiple Wires using the **CondSz** key and the calculator's internal tables. The calculator uses NEC values for area of THW/THHW, XHH/XHHW, and THHN/THWN wires. When using the actual Wire areas (and following the guidelines in NEC Chapter 9, Tables 1, 4 and 5), the calculator can calculate a Conduit Size based on the Conduit Type and the same or different Wire Types and Sizes.

To select a specific Conduit Type, enter the corresponding number of the Conduit as shown below and then press **Set CondSz**.

The types and their corresponding numbers are:

- | | | | |
|---------------|-----------------|----------------|-----------------|
| 1) EMT | 4) IMC | 7) LFMC | 10) P-40 |
| 2) ENT | 5) LFNFB | 8) RMC | 11) P-A |
| 3) FMC | 6) LFNA | 9) P-80 | 12) P-EB |

When you enter a new Conduit Type or scroll through the types, you will see the updated Conduit Size (if you have entered the Wire Type and quantity).

Finding Motor Branch-Circuit Wire Size and Conduit Size — Same Wire Type and Size

What size THHN Copper Wire and RMC Conduit are needed to connect a 10 HP 1Ø Induction motor to a 115 Volt source?

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to 1-Phase:

Set 1 (1Ø)

1 Ø 1 PH

2. Set to 60° C:

Set 6 (60°)

1 Ø 60 1 PH

3. Set to Copper (if necessary):

Set 4 (Cu/Al)

1 Ø 60 Cu 1PH

4. Enter Volts:

1 1 5 Volts

VOLT 115.

5. Enter Horsepower:

1 0 HPmotor

IND* 10. HP

* If **IND** is not shown, press **Set 8** until **IND** is displayed in the upper left area of the display.

6. Display Full-Load Amps:

Amps

FLC 100. A

7. Find Wire Size at 125% Ampacity:

Set WireSz (125%)

AWG 0 CU WIRE SIZE 125%

8. Find Wire Ampacity:

WireSz

Ø* 125.0 WIRE A125%

* The Wire Size will be shown in the upper left area of the display when displaying the Wire Ampacity rating.

9. Enter Conduit Type and find Conduit Size:

8 Set CondSz (Cond Type)

RMC 1.25 in COND SIZE

(cont'd)

(cont'd)

KEYSTROKE

DISPLAY

10. Find total number of Wires:

CondSz

2. TTL WIRES

11. Find Conduit Fill Percent:

CondSz

FILL 24.3 % COND

12. Find actual Fill Area:

CondSz

FILL 0.3710 TTL WIRE AREA

13. Find Remaining Area:

CondSz

REM 0.1021 WIRE AREA

Note: If a Wire Size has been calculated or stored, and the Wire Type/quantity is not defined, the calculator will assume 2 THHN wires for 1Ø and 3 THHN wires for 3Ø when calculating Conduit Size.

**Finding Conduit Sizes For Multiple Conductors —
Same Wire Type and Size**

Find the minimum IMC Conduit Size for eleven #6 THHN Copper wires.

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to Copper (if necessary):

Set **4** (Cu/Al)

Cu 0.

2. Enter Conduit Type:

4 **Set** **CondSz** (Cond Type)

IMC nonE COND

3. Enter Wire Size:

6 **WireSz** *

AWG 6 CU WIRE SIZE

4. Enter # THHN:

1 **1** **#THHN**
#THWN

THHN 11. WIRES

KEYSTROKE

DISPLAY

5. Find Conduit Size:

CondSz

IMC 1.25 in COND SIZE

* Wire Size can also be entered in Circular Mils (e.g.,

2 6 2 4 0 WireSz enters 26,420 CMILs and displays 6 AWG Wire Size).

Finding Number of Wires in Existing Conduit — Same Size, Various Types

Find the maximum number of #10 THHN Copper wires that can be pulled through an existing 3 inch EMT Conduit. How many XHHW wires? How many THW wires?

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Set to Copper (if necessary):

Set 4 (Cu/Al)

Cu 0.

2. Enter Conduit Type:

1 Set CondSz (Cond Type)

EMT nonE COND

3. Enter Wire Size:

1 0 WireSz *

AWG 10 CU WIRE SIZE

4. Enter Conduit Size:

3 CondSz

EMT 3.00 in COND SIZE

5. Find maximum THHN #:

**#THHN
#THWN**

THHN 167. TTL WIRES

6. Find maximum XHHW #:

**#XHH
#XHHW**

XHHW 145. TTL WIRES

7. Find maximum THW #:

**#THW
#THHW**

THW 145. TTL WIRES

* Wire Size can also be entered in Circular Mils (e.g.,

1 0 3 8 0 WireSz enters 10,380 CMILs and displays 10 AWG Wire Size).

Finding Conduit Size —

Multiple Conductors, Different Wire Sizes and Types

Three 1/0 THWN 75°C conductors and one #2 XHHW 75°C Copper conductor are to connect to a panel board using a single Conduit. What is the cross-sectional area of Wires, Conduit Size and actual fill Area?

Note: The cross-sectional Areas are the same for both THHN and THWN; display will show as THHN.

KEYSTROKE	DISPLAY
On/C On/C	0.
1. Set to 75° C:	
Set 7 (75°)	75 0.
2. Set to Copper (if necessary):	
Set 4 (Cu/Al)	75 Cu 0.
3. Enter Conduit Type:	
3 Set CondSz (Cond Type)	FMC nonE COND
4. Enter first Wire Size:	
0 WireSz *	AWG 0 CU WIRE SIZE
5. Enter number of THWN Wires:	
3 #THHN #THWN	THHN 3. WIRES
6. Find cross-section Wire Area:	
#THHN #THWN	THHN 0.5565 WIRE AREA
7. Enter second Wire Size:	
2 WireSz *	AWG 2 CU WIRE SIZE
8. Enter number of XHHW Wires:	
1 #XHH #XHHW	XHHW 1. WIRE
9. Find cross-sectional Wire Area:	
#XHH #XHHW	XHHW 0.1146 WIRE AREA

KEYSTROKE

DISPLAY

10. Find Conduit Size:

CondSz

FMC 1.50 in COND SIZE

11. Find total number of Wires:

CondSz

4. TTL WIRES

12. Find Conduit Fill Percent:

CondSz

FILL 36.1 % COND

13. Find actual Fill Area:

CondSz

FILL 0.6711 TTL WIRE AREA

14. Find Remaining Area:

CondSz

REM 0.0717 WIRE AREA

* Wire size can also be entered in Circular Mils (e.g.,

1 0 5 6 0 0 WireSz enters 105,600 CMILs and displays 0 AWG Wire Size; **6 6 3 6 0 WireSz** enters 66,360 CMILs and displays 2 AWG Wire Size).

CONVERTING KILOWATT-HOUR AND BTU

Find the equivalent BTU rating of a 3.5 kilowatt-hour rated furnace.

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Enter kilowatt hours:

3 **0** **5**

3.5

2. Find equivalent BTU:

Set **0** (Kw-hr ► Btu)

BTU 11,953.552

What is the kilowatt-hour rating for a 4,500 BTU heater?

KEYSTROKE

DISPLAY

On/C On/C

0.

(cont'd)

(cont'd)

KEYSTROKE

DISPLAY

1. Enter BTU rating:

4 5 0 0

4,500.

2. Find equivalent kilowatt hours:

Set = (Btu ► Kw-hr)

KW-H 1.3176

PARALLEL RESISTANCE

Find the equivalent Resistance for 10 Ohm, 20 Ohm, and 50 Ohm resistors placed in parallel.

KEYSTROKE

DISPLAY

On/C On/C

0.

1. Enter first Resistor:

1 0 Set Stor (Par Res)

P-RS 10.

2. Enter second Resistor:

2 0 Set Stor (Par Res)

P-RS 6.6666667

3. Enter third Resistor:

5 0 Set Stor (Par Res)

P-RS 5.8823529

Note: The total is recalculated with each additional Resistor value entered.

APPENDIX A — DEFAULT SETTINGS

After a Clear All (**Set** **X**), your calculator will return to the following settings:

STORED VALUES	DEFAULT VALUE
Insulation Rating	60° C
Wire Type Rating	Copper
Phase	3Ø
Ambient Temperature	30° C (86° F)
Volts	240V
Voltage Drop %	3%
Power Factor %	100%
Efficiency %	100%
Motor Type	Induction
Conduit Type	EMT
Fuse/Breaker Motor Type	Squirrel Cage non Design E
Overload FLC%	115%
Free Air Mode*	Off

** This setting will also return to its default upon turning the calculator off and back on.*

If you replace your batteries or perform a Full Reset* (Press **Off**, hold down **X** and press **On/C**) your calculator will return to the following settings (in addition to those listed above):

PREFERENCE SETTINGS	DEFAULT VALUE
NEC Code	2014
Ambient Temperature Units	°C
Length Units	FEET

** Depressing the Reset button located above the **CondSz** key will also perform a Full Reset.*

APPENDIX B – PREFERENCE SETTINGS

The *ElectriCalc Pro* has Preference Settings that allow you to set calculator modes. If you replace your batteries or perform a Full Reset* (press **Off**, hold down **X**, and press **On/C**), your calculator will return to the following settings (in addition to those listed on the previous page), with the default setting for each preference listed first:

** Depressing the Reset button located above the **CondSz** key will also perform a Full Reset.*

PREFERENCE	OPTIONS
1) NEC Code	– 2014: Sets the calculator to 2014 NEC Code Year – 2011: Sets the calculator to 2011 NEC Code Year – 2008: Sets the calculator to 2008 NEC Code Year – 2005: Sets the calculator to 2005 NEC Code Year – 2002: Sets the calculator to 2002 NEC Code Year – 1999: Sets the calculator to 1999 NEC Code Year – 1996: Sets the calculator to 1996 NEC Code Year
2) Ambient Temperature Units	– °C: Ambient Temperature is stored and displayed as °C. – °F: Ambient Temperature is stored and displayed as °F.
3) Length Units	– FEET: Length values stored or calculated using the Length key are displayed as Feet. – METERS: Length values stored or calculated using the Length key are displayed as Meters.

APPENDIX C — 2014 NEC REFERENCES

Table 250.66

Table 250.122

Table 310.15(B)(2)(a)

Table 310.15(B)(3)(a)

Table 310.15(B)(16)

Table 310.15(B)(17)

Chapter 9, Tables 1, 4, 5 and 8

Table 430.247

Table 430.248

Table 430.250

Table 430.52

Appendix C

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All listed table references are based on NEC 2014. Previous code years may have different table references.

APPENDIX D — CARE INSTRUCTIONS

Please follow the guidelines listed in this section for proper care and operation of your calculator. Not following the instructions listed below may result in damage not covered by your warranty. Refer to the **Warranty** section on page 61 for more details.

Do not expose calculator to temperatures outside the operating temperature range of 32°F – 104°F (0°C – 40°C).

Do not expose calculator to high moisture such as submersion in water, heavy rain, etc.

(cont'd)

APPENDIX E — ACCURACY/ERRORS, AUTO SHUT-OFF, BATTERIES, RESET

ACCURACY/ERRORS

Accuracy/Display Capacity — Your calculator has an eight-digit display. You may enter or calculate values up to 99,999,999. Each calculation is carried out internally to 12 digits.

Errors — When an incorrect entry is made, or the answer is beyond the range of the calculator, an error message will display. To clear an error condition, press the **On/C** button once. At this point, you can determine what caused the error and re-key the problem.

Error Codes

DISPLAY	ERROR TYPE
OFLO	Overflow; answer too large to display
ENT Error	Invalid entry
POWR Error	Power Factor (PF) or Efficiency (EFF) calculated above 100%
nonE	Conduit Size beyond limits of table Unable to calculate Voltage Drop Wire Size (Amps/Length too high) Temperature setting out of range for Wire calculation
HP Error	Invalid Horsepower entry per NEC table
FULL Error	Entered or calculated more than 15 different Wires Sizes
EROM Error	Bad EPROM
MATH Error	Math error (i.e., divide by zero)

AUTO SHUT-OFF

Your calculator is designed to shut itself off after about 8-12 minutes of non-use.

BATTERY

The *ElectriCalc Pro* uses one CR2016 battery. Should your calculator display become dim or erratic, replace the battery.

NOTE: Please use caution when disposing of your old battery as it contains hazardous chemicals.

Replacement batteries are available at most discount or electronics stores. You may also call Calculated Industries at 1-775-885-4900 or go to www.calculated.com.

Battery Replacement Instructions

While the calculator is off, turn the calculator over and use a #1 Phillips screwdriver to remove the battery holder screw located near the center at the top. With the screw removed, pull battery holder out, remove old battery, and slide new battery into holder. The negative side of the battery should be facing you as you insert the battery holder into the calculator. Replace screw using a #1 Phillips screwdriver.



RESET

If your calculator should ever “lock up,” press Reset — a small hole located below the **Off** key — to perform a total reset.

REPAIR AND RETURN

RETURN GUIDELINES

1. Please read the **Warranty** in this User's Guide to determine if your Calculated Industries product remains under warranty **before** calling or returning any device for evaluation or repairs.
2. If your product won't turn on, check the battery as outlined in the User's Guide.
3. If you need more assistance, please go to the website listed below.
4. If you believe you need to return your product, please call a Calculated Industries representative between the hours of 7:00am to 4:30pm Pacific Time for additional information and a Return Merchandise Authorization (RMA).

WARRANTY

Warranty Repair Service – U.S.A.

Calculated Industries ("CI") warrants this product against defects in materials and workmanship for a period of one (1) year from the date of original consumer purchase in the U.S. If a defect exists during the warranty period, CI at its option will either repair (using new or remanufactured parts) or replace (with a new or remanufactured calculator) the product at no charge.

THE WARRANTY WILL NOT APPLY TO THE PRODUCT IF IT HAS BEEN DAMAGED BY MISUSE, ALTERATION, ACCIDENT, IMPROPER HANDLING OR OPERATION, OR IF UNAUTHORIZED REPAIRS ARE ATTEMPTED OR MADE. SOME EXAMPLES OF DAMAGES NOT COVERED BY WARRANTY INCLUDE, BUT ARE NOT LIMITED TO, BATTERY LEAKAGE, BENDING, A BLACK "INK SPOT" OR VISIBLE CRACKING OF THE LCD, WHICH ARE PRESUMED TO BE DAMAGES RESULTING FROM MISUSE OR ABUSE.

To obtain warranty service in the U.S., please go to the website. A repaired or replacement product assumes the remaining warranty of the original product or 90 days, whichever is longer.

Non-Warranty Repair Service – U.S.A.

Non-warranty repair covers service beyond the warranty period, or service requested due to damage resulting from misuse or abuse. Contact Calculated Industries at the number listed above to obtain current product repair information and charges. Repairs are guaranteed for 90 days.

Repair Service – Outside the U.S.A.

To obtain warranty or non-warranty repair service for goods purchased outside the U.S., contact the dealer through which you initially purchased the product. If you cannot reasonably have the product repaired in your area, you may contact CI to obtain current product repair information and charges, including freight and duties.

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Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific rights, and you may also have other rights, which vary from state to state.

FCC Class B

This equipment has been certified to comply with the limits for a Class B calculating device, pursuant to Subpart J of Part 15 of FCC rules.

Legal Notes

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Looking for New Ideas

Calculated Industries, a leading manufacturer of special-function calculators and digital measuring instruments, is always looking for new product ideas in these areas.

If you have a new product idea, please visit our "Bright Idea" page at www.calculated.com/brightidea.asp. For suggestions about improving this product or other products, please visit us at www.calculated.com under "Contact Us". Thank You.





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