Electrical Calc Elite™

For iOS

The most up-to-date NEC compliant electrical calculator in the world.

CyberProdigy LLC

The Electrical Calc Elite™ is designed with electricians in mind to solve the most common and tedious electrical calculations based on required National Electrical Codes. The Electrical Calc Elite™ conforms to NEC 2011, 2008, 2005, 2002 and 1999 as well as future releases of the NEC.

The key advantages of a smartphone electrical calculator are:

- Instant updates for future code editions
- No need to carry around code books or other calculators
- Time and cost savings

To purchase a copy of Electrical Calc Elite™ for your smartphone please visit us at www.ElectricalCalcElite.com or search for Electrical Calc Elite on Apple iTunes.

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Definitions of Basic Keys

[Clear] - Clear

Press once – clears display

Press twice – clears stored values (does not clear user preferences)

[Shift] [+] - Clear All

Use to clear all register values and restore default settings. Preferences (i.e. NEC version) are not affected.

[Shift] - Secondary Function

Use to access secondary functions of other

[Store] - Memory Store

Use to store a value from display into memory

[Recall] - Memory Recall

Use to list values stored in memory and to select/recall them from memory to the display.

[Shift][Recall] - Memory Recall

Use to clear entries from memory.

[kilo-] - kilo

Use this key in combination with inputs for Watts, Amps, Volts, or VA to designate KW, KA, KV, or KVA.

[Shift][kilo-] - milli

Use this key in combination with inputs for Watts, Amps, Volts, or VA to designate mW, mA, mV, or mVA.

[Shift][VD%] - % operator

Use this key to calculate a give percentage of a number or for working add-on, discount, or division percentage calculations. For example:

255 x 15% = 38.25

150 + 6% = 159

240 – 3% = 232.8

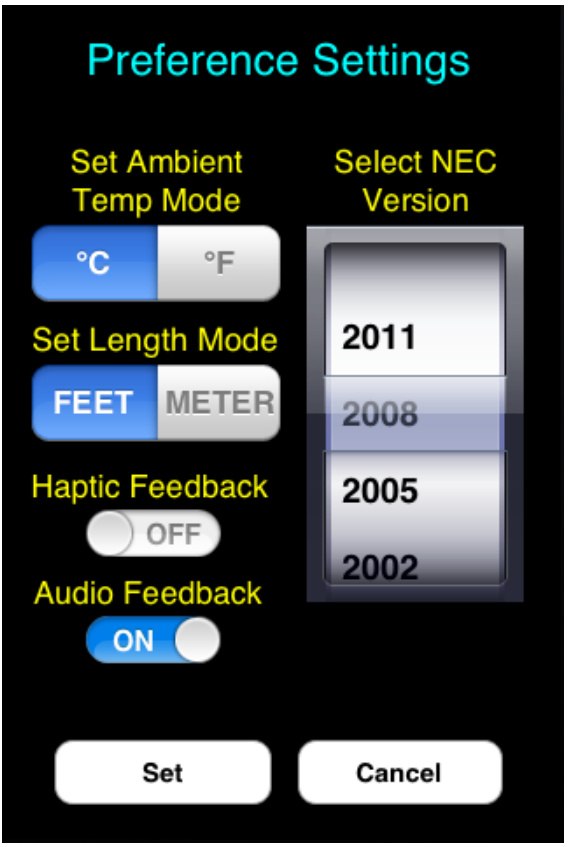
150 ÷ 50% = 300

This key can also be used to change percentages to decimals (for example, 25%=0.35)

Setting Preferences

[Shift][Store] - (Preferences) Set Preferences

Use to set calculator preferences including NEC version, °F/°C, Feet/Meters, and Haptic Feedback. When accessing preferences you will see this pop-up window:



Use the pickerview to select the NEC version (default is NEC 2008). Selectable options include 2011, 2008, 2005, 2002, and 1999.

Temperature mode can be set to Fahrenheit (°F) or Celsius (°C) by clicking the respective button. Length mode can be set to feet or meters in a similar fashion.

'Haptic Feedback' is an option that causes your iOS device to vibrate slightly when pressing keys within the application. Haptic feedback is not supported on the iPod touch. 'Audio Feedback' provides a keyboard click sound each time a button is pushed.

Click the 'Set' button at the bottom to save and close the preferences window.

Setting Modes

[Shift][4]- (1Ø/3Ø) Single-Phase and Three-Phase Toggle

Use to toggle between single-phase and three-phase power modes.

[Shift][6]- (Ambient°) Ambient Temperature

Use to set ambient temperature surrounding wires. When calculating wire sized based on ampacity, the ambient temperature is used. The

ambient temperature is displayed on the screen (default is 30°C).

[Cu/Al]- (Copper/Aluminum)

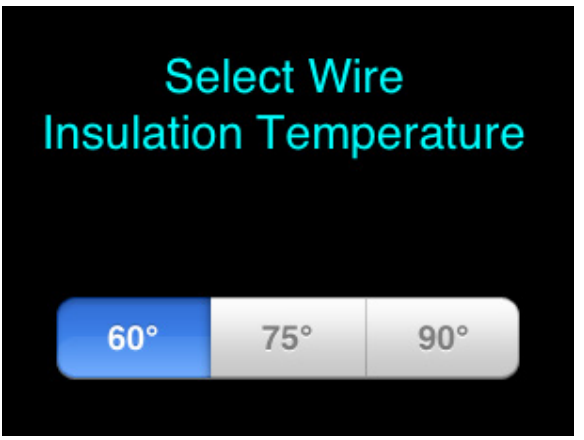
Use to set wire type to Copper or Aluminum. Button toggles between the two wire types.

[Shift][Cu/Al]- (FreeAir) Free Air Mode

Use to set wire environment to Free Air Mode. Pushing button again will toggle back to raceway mode which is the default mode. When calculating wire size, calculator references NEC 310-17 for Free Air mode and NEC 310-16 for raceways.

[Shift][5] – (Wire Temp) Wire Insulation Temp

Use to set wire insulation rating to 60°C, 75°C, or 90°C. Wire insulation rating is a variable used in the wire size functions. When this button is pushed you'll see a popup window (shown below) to select 60, 75, or 90C.



Default Mode Settings

When the calculator is first loaded onto your iOS device, or when you hit ‘Clear All’ [Shift][+], the following are default settings:

Wire Type	Copper (Cu)
Ambient Temperature	30°C
Wire Insulation Rating	60°C
Volts	240V
Phase	3
Efficiency	100%
Power Factor	100%
Voltage Drop %	3%
Wire Environment (Free Air or Raceway)	Raceway

Ohm's Law Functions

The Electrical Calc Elite™ allows the user to solve for Amps, Volts, or Ohms using Ohm's Law based on this equation:

$$V = I * R$$

These calculations are for DC circuits. By entering two of the three variables the calculator can solve for the third.

Key Definitions:

[Shift][Amps] - (Idc) DC Amps

Use to enter or calculate DC Amps. DC Amps calculation uses DC volts and Resistance. Default value is 0 Amps.

[Shift][Volts] - (Vdc) DC Volts

Use to enter or calculate DC Volts. DC Volts calculation uses DC Amps and Resistance. Default value is 0 Vdc.

[Shift][VA] - (R) DC Resistance

Use to enter or calculate DC Resistance in Ohms. DC Resistance calculation uses DC Amps and DC Volts. Default value is 0 Ohms.

Sample Calculations:

Solving for Volts

The current in a circuit is 1.5 Amps, and the total resistance is 290 Ohms. Solve for the voltage.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input Current	[1][•][5][Shift][Amps]	IDC 1.5A
Input Resistance	[2][9][0][Shift][VA]	OHMS 290
Solve for Voltage	[Shift][Volts]	VDC 435.0V

Solving for Amps

A 10k resistor is inserted into a 12VDC circuit. Solve for the current through the resistor.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input Resistance	[1][0][kilo][Shift][VA]	kOHM 10
Input Voltage	[12][Shift][Volts]	VDC 12V
Solve for Amps	[Shift][Amps]	IDC 0.0012A

Solving for Ohms

A circuit with 120V across it has a current of 15.6 Amps. Solve for the total resistance of the circuit in ohms.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input voltage	[1][2][0][Shift][Volts]	VDC 120V
Input current	[1][5][•][6][Shift][Amps]	IDC 15.6A
Solve for resistance	[Shift][VA]	OHMS 7.69231

Kirchhoff's Law Functions

The Electrical Calc Elite™ allows users to solve for Amps, Volts, Volt-Amps, Watts, Horsepower, power factory and efficiency using Kirchhoff's Law based and these equations:

$$VA = V * A\ (*\sqrt{3}\ for\ 3\emptyset)$$

$$W = VA * PF\%$$

$$HPth = \frac{W * Eff\%}{746}$$

Key Definitions:

[Amps] - Amps

Use to enter or calculate Amps. Amps calculation uses Volts and Watts, VA, HPth, or MotorHP. Default value is 0 Amps.

[Volts] - Volts

Use to enter or calculate Volts. Volts calculation uses watts, VA, or HPth and Amps. Default value is 240V.

[VA] - Volt-Amps

Use to enter or calculate Volt-Amps. VA calculation uses Volts, Amps, Watts, HPth, or MotorHP. Default value is 0 VA.

[Watts] - Watts

Use to enter or calculate Watts. Watts calculation uses Volts, Amps, VA, HPth, or MotorHP. Default value is 0 W.

[Shift][Watts] - Power Factor%

Use to enter or calculate Power Factor. PF calculation uses Watts and VA. Default value is 100%.

[HPth] - Theoretical Horsepower

Use to enter or calculate Theoretical Horsepower. Calculation uses Volts, Amps, Watts, VA, or MotorHP. It also factors in Efficiency and PF%. Default value is 0 HP.

[Shift][HPth]- Efficiency%

Use to calculate efficiency using Watts and Theoretical Horsepower. Default value is 100%.

Sample Calculations:

Solving for Voltage

A 3 phase load is drawing 16,540 Volt-amps and 80 amps. Solve for the supply voltage.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Input VA	[1][6][5][4][0][VA]	VA 16540
Input Amps	[8][0][Amps]	AMPS 80
Solve for Voltage	[Volts]	VOLTS 119.367

Solving for Load Current/Amps

There is a load drawing 8,469 VA on a 240V single phase circuit. Solve for current (amps).

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 1-phase	[Shift][4]	1 PHASE
Input VA	[8][4][6][9][VA]	VA 8469
Input Volts	[2][4][0][Volts]	VOLTS 240
Solve for Amps	[Amps]	AMPS 35.2875

Solving for Volt-Amps (VA)

There is a 115V single phase circuit pulling 18 amps. Solve for Volt-Amps(VA).

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 1-phase	[Shift][4]	1 PHASE
Input Volts	[1][1][5][Volts]	VOLTS 115
Input Amps	[1][8][Amps]	AMPS 18
Solve for VA	[VA]	VA 2070.0

Solving for Amps using Kilowatts

There is a load drawing 98kW on a 277/480 Volt 3 phase circuit. Solve for current (amps).

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Input KW	[9][8][Kilo][Watts]	kW 98
Input Volts	[4][8][0][Volts]	VOLTS 480
Solve for Amps	[Amps]	AMPS 117.87568

Solving for kVA Rating

There is a 3 phase transformer rated at 50 amps and 120/208 Volts. What is the kVA rating of the transformer?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Input Volts	[2][0][8][Volts]	VOLTS 208
Input Amps	[5][0][Amps]	AMPS 50
Solve for kVA	[Kilo][VA]	kVA 18.01333

Solving for Watts

What's the wattage for a 65 Amp, 208 Volt, 3 phase motor with a 85% power factor? How many KW?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Set power factor	[8][5][Shift][Watts]	85% Power Factor
Input Volts	[2][0][8][Volts]	VOLTS 208
Input Amps	[6][5][Amps]	AMPS 65
Solve for Watts	[Watts]	Watts 19904.73
Solve for KW	[Kilo][Watts]	kW 19.90473

Ampacity Wire Sizing

The Electrical Calc Elite™ allows users to solve for required wire size of a conductor based on specific electrical inputs including: wire insulation temperature rating (60°C, 75°C, or 90°C), wire material type (copper or aluminum), and free air versus raceway. The wire size

function also derates for ambient temperature and parallel conductors as required.

Electrical Calc Elite™ uses standard AWG wire sizes (up to 2000 AWG) as well as Circular Mils. Entries must match the standard wire sizes or else the calculator will produce an error.

1/0, 2/0, 3/0 and 4/0 size wires must be entered with multiple presses of the [0] button (0 =1/0, 00=2/0, 000=3/0, 0000=4/0).

Wire size and ampacity calculations are based strictly on requirements from NEC tables 310-16 (310-17 for Free Air).

Key Definitions:

[WireSize] - Wire Size or Ampacity

Use to enter or calculate wire size or ampacity. Wire size is calculated based on amps and voltage drop (if length of wire has been entered).

The first press of the wiresz button will calculate the wire size required based on amps entered (using NEC 310-16 or 310-17). If a length of wire has been entered, “VD wire size” will be calculated as well to keep you within the voltage

drop settings (default 3%). The first press of the wire size button will produce the larger of the two wire sizes (VD wire size or wire size based on 310-17). The second press will produce the smaller of the two. The next press displays the maximum ampacity for the calculated wire size. Continuing to press the wiresize button will display the wire size in circular Mils and the NEC table used for the calculation.

[Shift][WireSize] - 125% Ampacity

Use to calculate wire size based on 125% of the entered amps. This function is commonly used to size motor wiring where wires cannot exceed 80% of its rated ampacity.

[ParSize] - Parallel Conductors

Use to calculate the size of parallel conductors using amps and entered number of conductors. Parallel conductors smaller than 1/0 will display an error as this is not allowed by NEC. Enter a number before hitting the ParSize button and the calculator will determine the required wire size for that quantity of conductors run in parallel. Hitting ParSize button a second time will produce the max ampacity (not derated) of the wire.

[Shift][ParSize] - (D/R Size) Derated Wire Size

Use to calculate derated wire sizes based on number an entered number of conductors. Calculation uses NEC Table 310-16 and 310-15.B.2.a. Derating is not performed for three or less conductors in a raceway or when conductor are run in Free Air.

The first press of the D/R button should be preceded by a number for the number of wires. The calculator will produced the derated wire size. Pressing the D/R button again will generate the ampacity of the derated wire size. Subsequent presses of the D/R button will display the derating adjustment factor used (from NEC Table 310-15.b.2.a) and the NEC reference.

Sample Calculations:

Solving for Wire Size Based on Insulation Rating

Using 75°C copper wire, what wire size is required for a 3 phase, 240V, 25kVA system?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Set 75C	[Shift][5]	75°
Input kVA	[2][5][kilo-][VA]	kVA 25.0
Input Volts	[2][4][0][Volts]	VOLTS 240
Solve for Amps	[Amps]	AMPS 60.14
Solve wire size	[WireSize]	AWG 6 Cu WIRE SIZE
Wire Ampacity	[WireSize]	AWG 6 Cu WIRE AMPACITY: 65.0A
Show CMIL	[WireSize]	CMIL 26240 WIRE
Show NEC Table	[WireSize]	NEC 310.16

Solving for Wire Size Based on Ambient Temp

If ambient temperature is changed from default 30C to 40C, what wire size is required for a 260Amp load, 240V, single-phase, using 90C insulated copper wire?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 1-phase	[Shift][4]	1 PHASE
Set 90C	[Shift][5]	90°
Input Amps	[2][6][0][Amps]	AMPS 260
Solve wire size	[WireSize]	AWG 0000 Cu WIRE SIZE
Input Amb Temp	[4][0][Shift][6]	Amb° 40.0°C
Adjusted wire size	[WireSize]	AWG 250 Cu WIRE SIZE
Wire Ampacity	[WireSize]	AWG 250 Cu WIRE AMPACITY: 263.9A
Show CMIL	[WireSize]	CMIL 250000 WIRE
Show NEC Table	[WireSize]	NEC 310.16

Solving for Wire Size Based on Material Type

What wire size is needed for a 60C copper wire carrying three-phase 350 amps. What would the equivalent aluminum wire size be?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Set 60C	[Shift][5]	60°
Input Amps	[3][5][0][Amps]	AMPS 350
Solve wire size	[WireSize]	AWG 600 Cu WIRE SIZE
Change to Alum.	[Cu/Al]	AWG 900 Al WIRE SIZE
Wire Ampacity	[WireSize]	AWG 900 Al WIRE AMPACITY: 355.0A
Show CMIL	[WireSize]	CMIL 900000 WIRE
Show NEC Table	[WireSize]	NEC 310.16

Solving for Parallel Conductor Wire Size

In a free air environment, what size of 75C insulated copper wire is required for a single conductor carrying 600 amps? If you run 2 conductors in parallel, what size wire is required? What about 3 parallel wires?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set 75C	[Shift][5]	75°
Set FreeAir Mode	[Shift][Cu/Al]	FreeAir
Input Amps	[6][0][0][Amps]	AMPS 600
Solve wire size for 1 conductor	[WireSize]	AWG 500Cu WIRE SIZE
Solve wire size for 2 conductors	[2][ParSize]	2 PAR 000 Cu WIRE SIZE
Solve wire size for 3 conductors	[3][ParSize]	3 PAR 0 Cu WIRE SIZE
Clear All	[Shift][+]	

Note: NEC does not allow, and calculator will produce an error, if parallel wire conductors are smaller than 1/0.

Solving for Derated Wire Size

In a raceway carrying more than 3 conductors, ampacity of conductors is derated per NEC 310-15.B.2.a.

Solve for the derated wire size for seven 60C copper wires, each carrying a load of 70 amps.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set 60C	[Shift][5]	60°
Input Amps	[7][0][Amps]	AMPS 70
Solve Wire Size	[WireSize]	AWG 4 Cu WIRE SIZE
Solve for derated wire size	[7][Shift][ParSize]	AWG 1 Cu Derated Wire Size
Derated wire ampacity	[ParSize]	AWG 1 Cu DERATED AMPACITY: 77.0A
Adjustment Factor	[ParSize]	70% Derating Adjustment Factor
NEC Reference	[ParSize]	NEC 310.15(B)(2)(a)
Clear All	[Shift][+]	

Solving for Derated Wire Size

(Multiple conductors and ambient temp adjustments)

A 40kVA load is connected to a 240V, three-phase transformer with 75C rated copper wire. The ambient temperature is 55C. Solve for the derated wire size required if running 10 current-carrying conductors in the raceway.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set 75C	[Shift][5]	75°
Input kVA	[4][0][kilo-][VA]	kVA 40.0
Input Volts	[2][4][0][Volts]	VOLTS 240
Input 55C Ambient	[5][5][Shift][6]	Amb° 55.0°C
Solve adj wire size	[WireSize]	AWG 0 Cu WIRE SIZE
Solve derated wire size	[1][0][Shift][ParSize]	AWG 350 Cu DERATED WIRE SIZE
Solve Derated Wire Ampacity	[ParSize]	AWG 350 Cu DERATED AMPACITY: 103.9A
Adjustment Factor	[ParSize]	33.5% Derating Adjustment Factor
NEC Reference	[ParSize]	NEC 310.15(B)(2)(a)
Clear All	[Shift][+]	

Voltage Drop Functions

The Electrical Calc Elite™ allows users to solve for voltage drop on a wire based on phase, voltage, amps, length (one way), and wire material. The calculator determines the DC resistance of a wire according to NEC 2008 Chap 9, Table 8 using wire type (Cu/AL and 60/75/90 insulation rating) and wire size. Users must input the one-way length of the wire and Amps. With these inputs voltage drop can be calculated. Voltage input is required only to determine percent voltage drop. The following equations are used for this function:

$$VD_{1\emptyset} = I * R * L * 2$$

$$VD_{3\emptyset} = I * R * L * \sqrt{3}$$

$$VD\% = \frac{VD}{Volts}$$

The default allowable voltage drop on a wire is 3%. This can be manually adjusted to something different. The Electrical Calc Elite™ can determine voltage drop wire size when wire length is entered. The calculator will look up the required wire size in the NEC ampacity tables however if that wire size exceeds the set VD%

(for instance you have an extra-long run giving you 8% voltage drop) the calculator will recommend a larger wire size that keeps you with the 3% VD limit for safety. When it makes this recommendation the calculator will display "VD WIRE SIZE" rather than "WIRE SIZE".

Along those same lines, if you perform a standard wire size calculation using the ampacity tables, you can press the [Length] button and the calculator will display the maximum length (one-way) that you can run that wire and still be within the set voltage drop limits (default 3%).

NOTE: Calculator automatically makes adjustments to resistance values in NEC Chap 9, Table 8 if wire rating is other than 75C. The following formula is used for the adjustment:

$$R_2 = R_1[1 + \alpha(T_2 - 75)]$$

$$where\ \alpha_{CU} = 0.00323, \alpha_{AL} = 0.00330$$

Key Definitions:

[VD%]- Voltage Drop Percent

Use button to calculate voltage drop or to enter max allowed voltage drop %. Default value is 3%. Solving for voltage drop requires a valid entry for wire length, amps, and wire size.

[Length] - Wire Length

Use button to calculate max wire length for a given VD% or enter one-way wire length. See "setting preferences" section to change between feet and meters.

[Shift][Length] - (Wire Resist) Wire Resistance

Use to calculate resistance per 1000ft of wire. Calculation utilizes wire size and wire type (AL/CU and 60/75/90) and references NEC Chapter 9, Table 8.

Sample Calculations:

Solving for Single Phase Voltage Drop

A 240V, single phase source is feeding an appliance drawing 25 amps. Copper 10AWG (75C) Romex is run 100ft between the panel and the appliance. What is the voltage drop and % voltage drop at the load?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 1-phase	[Shift][4]	1 PHASE
Set 75C	[Shift][5]	75°
Input Volts	[2][4][0][Volts]	VOLTS 240
Input Amps	[2][5][Amps]	AMPS 25
Input Length	[1][0][0][Length]	FEET 100.0
Input wire size	[1][0][WireSize]	AWG 10 Cu WIRE SIZE
Find voltage drop	[VD%]	DROP 6.2V
Find % volt drop	[VD%]	DROP 2.58 % V

Solving for Voltage Drop Wire Size

A three-phase motor drawing 65A is fed by 208V and is located 200 feet from the panel. For efficiency, you want to limit voltage drop to 2.5%. What size 90C copper conductor should you use? How much voltage drop and % voltage drop will this circuit have?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Set 90C	[Shift][5]	90°
Input Volts	[2][0][8][Volts]	VOLTS 208
Input Amps	[6][5][Amps]	AMPS 65
Input Length	[2][0][0][Length]	FEET 200.0
Set VD% limit	[2][•][5][VD%]	DROP 2.5% V
Solve VD wire size	[WireSize]	AWG 2 Cu VD WIRE SIZE
Find voltage drop	[VD%]	DROP 4.58 V
Find % volt drop	[VD%]	DROP 2.2 % V

Solving for Voltage Drop Distance

How far from a breaker panel can you place a single-phase 240V range drawing 60 amps using 60C copper #6 conductors? You are targeting less than 3% voltage drop.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 1-phase	[Shift][4]	1 PHASE
Set 60C	[Shift][5]	60°
Input Volts	[2][4][0][Volts]	VOLTS 240
Input Amps	[6][0][Amps]	AMPS 60
Input wire size	[6][WireSize]	AWG 6 WIRE SIZE
Set VD% limit	[3][VD%]	DROP 3 % V
Solve max distance	[Length]	FEET 128.42
Find volt drop	[VD%]	DROP 7.2V
Find % volt drop	[VD%]	DROP 3.0 % V

Solving for Wire Resistance

What is the resistance of 50ft of copper #12 wire rated for 75C?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set 75C	[Shift][5]	75°
Input wire size	[1][2][WireSize]	AWG 12 WIRE SIZE
Solve resistance	[Shift][Length]	OHMS 1.98
Solve 50ft (divide by 1000 and multiply by 50)		0.099

Note: Resistance function calculates resistance per 1000 feet of wire so you must divide by 1000 to get resistance per foot.

Motor Horsepower

The Electrical Calc Elite™ allows users to solve for full load current of a motor using voltage, phase, motor type, and motor horsepower (MotorHP). Supported motor types include synchronous, induction, and DC. Full load current is determined using NEC Tables 430-247, 430-248, and 430-250. If user inputs motor HP or voltage not contained in these tables the calculator will display an error.

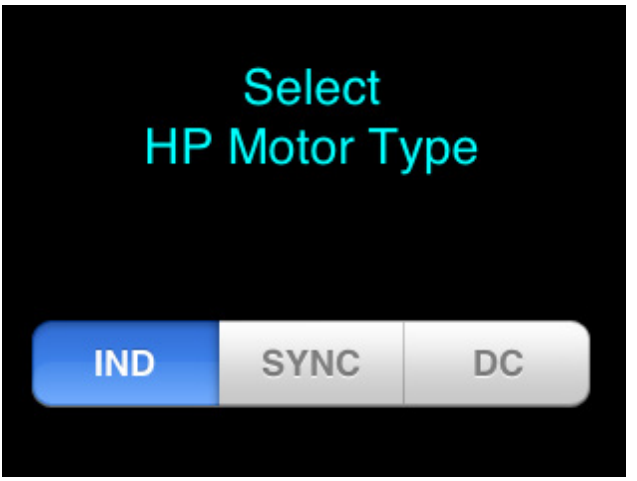
Electrical Calc Elite™ also solves for Motor HP based on user inputs for voltage, phase, and full load current. These calculations are based on the same Motor Horsepower tables listed above. If full load current doesn't directly match the table it will select the next higher Motor HP value.

Full voltage NEMA starter size can also be solved for using phase, voltage, and motor HP. NEMA ICS specifications are used for these calculations.

Key Definitions:

[Shift][0]- (Ind/Sync/DC) Motor Type

Use to switch between induction, synchronous, and DC motor types. When [Shift][0] is pressed you will see a popup, shown below, which is used to select the motor type.



[HPmotor] - Motor Horsepower

Use to enter or calculate Motor Horsepower.

[Shift][HPmotor]- (Starter) Starter Size

Use to calculate NEMA starter size using phase, voltage, and motor HP. If motor HP does not match a value in the NEMA ICS tables, the next larger starter size will be selected.

Sample Calculations:

Solving for Induction Motor Horsepower

An induction motor creates a 30 amp load on a 208V, 3 phase circuit. Solve for motor Horsepower.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Set to Induction	[Shift][0]	INDUCTION MOTOR
Input Volts	[2][0][8][Volts]	VOLTS 208
Input Amps	[3][0][Amps]	AMPS 30
Solve for HP	[HPmotor]	IND 10.0 HP

Solving for Motor Full Load Current

A 50HP synchronous 3 phase motor is operating on 575V. What is the full load current for this motor?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Set to SYNC	[Shift][0]	SYNCHRONOUS MOTOR
Input Volts	[5][7][5][Volts]	VOLTS 575
Input Motor HP	[5][0][HPmotor]	SYNC 50.0 HP
Solve for FLC	[Amps]	FLC 42.0 A

Solving for Motor Wire Size

What wire size is required to feed a single phase 1.5 HP induction motor on a 230V circuit?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 1-phase	[Shift][4]	1 PHASE
Set 60C	[Shift][5]	60°
Set to IND	[Shift][0]	INDUCTION MOTOR
Input Volts	[2][3][0][Volts]	VOLTS 230
Input Motor HP	[1][•][5][HPmotor]	IND 1.5 HP
Solve for FLC	[Amps]	FLC 10.0 A
Solve for 125% wire size	[Shift][WireSize]	AWG 14 Cu WIRE SIZE 125%
Solve for 125% wire ampacity	[WireSize]	AWG 14 Cu WIRE AMPACITY 125%: 20.0A

Solving for Motor Starter Size

What NEMA size starter is required for a 1.5 HP, 230V, 3 phase induction motor?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Input Volts	[2][3][0][Volts]	VOLTS 230
Input Motor HP	[1][•][5][HPmotor]	IND 1.5 HP
Solve starter size	[Shift][HPmotor]	SIZE 00 NEMA STARTER

Grounding and Fuses

The Electrical Calc Elite™ allows users to solve for ground conductor size, equipment grounding size, and fuse/circuit breaker size.

Ground electrode conductor wire size is determined using NEC Table 250-66. The largest service entrance conductor size (or equivalent area conductor size if multiple service entrance conductors are used) is used for the calculation.

Equipment grounding conductor wire size can be calculated using current rating or setting of "automatic overcurrent device in circuit ahead of equipment". This calculation is based on NEC 250.122 and assumes conductors are run in a raceway.

The Electrical Calc Elite™ allows users to solve for amperage ratings of over-current protection devices including 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.

Fuse and circuit breaker sizes are based on NEC Table 430-52.

Key Definitions:

[Ground] – Ground Electrode Conductor

Use to calculate grounding electrode conductor size using entered or calculated service entrance conductor size. The first press of this button will calculate the copper ground conductor size. The second press will calculate the aluminum ground conductor size. Subsequent presses of the [Ground] button will display the circular MIL area

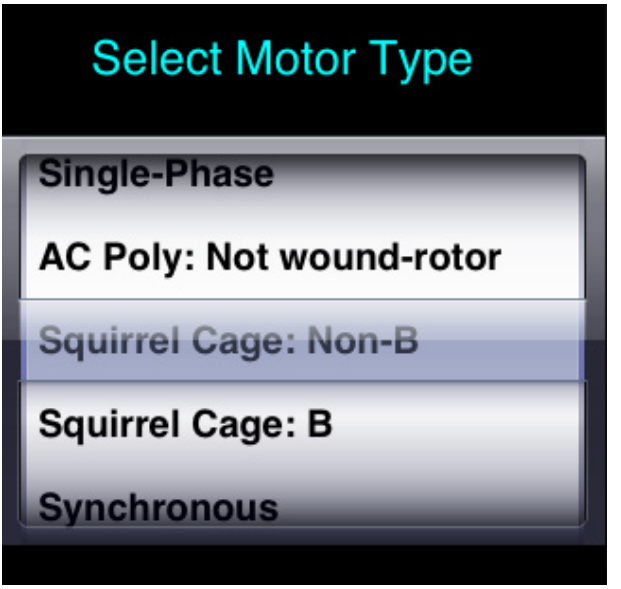
used to calculate the ground size and NEC reference 250-66.

[Shift][Ground] - (EquipGnd) Equipment Ground

Use to calculate equipment ground conductor overcurrent device up stream protecting the equipment. Calculation uses NEC Table 250-122. The first press of EqGrnd displays the copper ground conductor size. The second press displays the aluminum ground conductor size. The third press displays the NEC reference.

[Shift][•] – (Motor Type) Motor type for Fuses and Breakers

Use to select motor type required for breaker and fuse calculations. The first press of the button will produce a popup (shown below) allowing you to select the motor type.

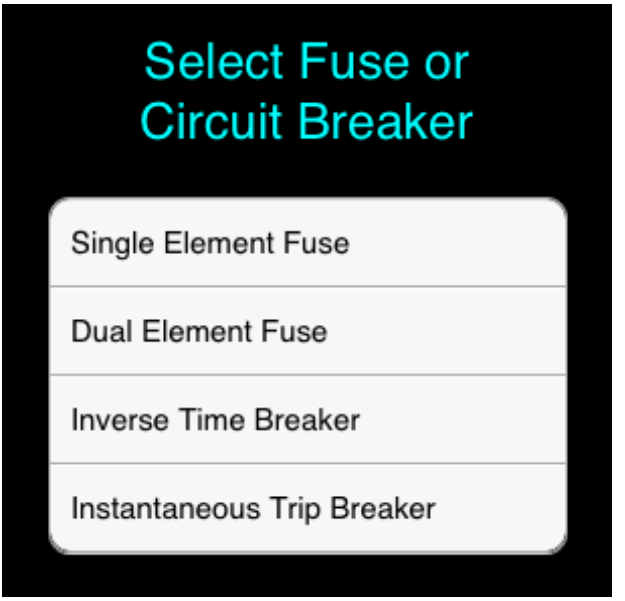


Motor types include:

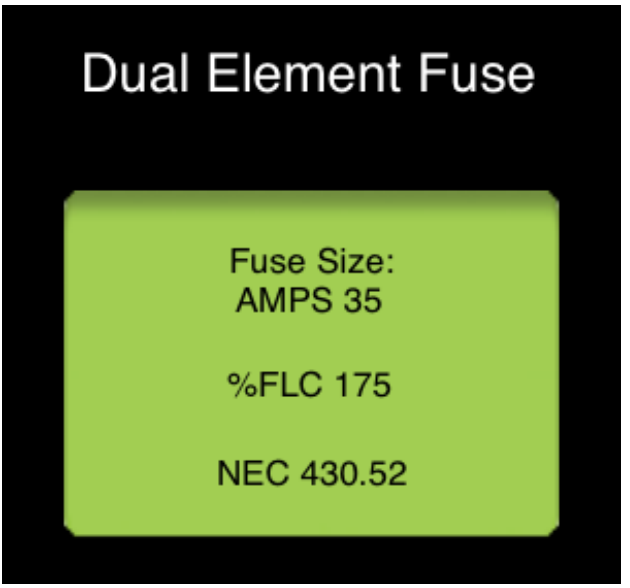
-Single Phase AC
-AC Polyphase: Not wound-rotor
-Squirrel Cage: Non B
-Squirrel Cage: B
-Synchronous
-Would rotor
-Direct Current (DC)

[Shift][8] – (Fuses) – Fuse or Circuit Breaker Calculations

Use to calculate the minimum amp rating for a fuse or circuit breaker protecting a motor with selected motor type. Pressing the button will produce the popup window shown below:



Assuming you have already entered a value for ‘amps’ in the calculator, selecting one of the four fuses or circuit break types will then perform calculations to determine required fuse size, % multiplier used to determine fuse size (based on NEC 430-52), and also provides the NEC reference. An example output window is shown below:



[Shift][9] – (Overload) – Overload Protection

Use to calculate required motor overload protection based on NEC 430.32 (A)(1). Calculation uses motor nameplate full load current input by the user and multiplies by 115% (default). User can also change this multiplier by entering a value before pressing the [Overload] button (e.g. 125 [Overload]). When 'Overload' is pressed in this case, it calculates the overload protection based on the new % multiplier. Pressing the [Overload] button a second time displays the % multiplier used to calculate the overload protection size.

Sample Calculations:

Solving for Ground Conductor Wire Size

Solve for the ground electrode conductor wire size required if the largest service-entrance conductor is aluminum and 350KCMILs. What size is required for an aluminum ground conductor wire? What is the equivalent CMIL area used for the service-entrance conductor?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input wire size	[3][5][0][WireSize]	AWG 350 Cu WIRE SIZE
Solve gnd wire size	[Ground]	2 Cu GROUND WIRE SIZE
Solve AL gnd size	[Ground]	0 AL GROUND WIRE SIZE
Find circular mils	[Ground]	CMIL 350000
NEC reference	[Ground]	NEC 250.66

Solving for Equipment Ground Conductor Wire Size

Solve for the equipment grounding conductor size required if the equipment is protected by a 60 amp circuit-breaker. What is the equivalent size aluminum ground conductor required?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input CB rating	[6][0][Amps]	AMPS 60.0
Solve equipment ground wire size	[Shift][Ground]	10 Cu EQUIPMENT GROUND SIZE
Solve AL gnd size	[Ground]	8 AL EQUIPMENT GROUND SIZE
Find circular mils	[Ground]	NEC 250.122

Solving for Motor Fuse and Breaker Size

What size single element fuse is required for a 3 phase , squirrel cage(non-b) motor with a FLC of 95 Amps? What size instantaneous Trip Breaker circuit breaker is required?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Set Motor Type	[Shift][•]	Sqrl Cage: Non-B Motor Type
Set Motor FLC	[9][5][Amps]	AMPS 95.0
Find SE fuse size	[Shift][8]	*'Select SE fuse'*
Display fuse characteristics		Fuse Size: AMPS 285.0 %FLC 300 NEC 430.52
Find instant trip breaker size	[Shift][8]	*'Select Inst. Trip Breaker'*
Display CB characteristics		Breaker Size: AMPS 760.0 %FLC 800 NEC 430.52

Solving for Overload Protection Size

Solve for the overload protection device size required for a 230V, 3 phase motor with a nameplate FLC of 45.2 amps? What is the required overload protection rating at 125%?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Input Volts	[2][3][0][Volts]	VOLTS 230.0
Input motor FLC amps	[4][5][•][2][Amps]	AMPS 45.2
Solve overload size	[Shift][9]	AMPS 51.98 Motor Overload Current
Show % used	[Shift][9]	115.0% of motor nameplate FLC
Solve 125% overload size	[1][2][5][Shift][9]	AMPS 56.5 Motor Overload Current
Show % used	[Shift][9]	125.0% of motor nameplate FLC
NEC reference	[Shift][9]	NEC 430.32(A)(1)

Conduit Sizing

The Electrical Calc Elite™ allows users to determine what size conduit is required for a given set of wires. Calculations are based on NEC chap. 9 Tables 1, 3, 4, and 5. NEC values are used for the area of each wire type THW, XWH, and THHN/THWN. Conduit size function can utilize the same or multiple wires types and sizes for its calculation.

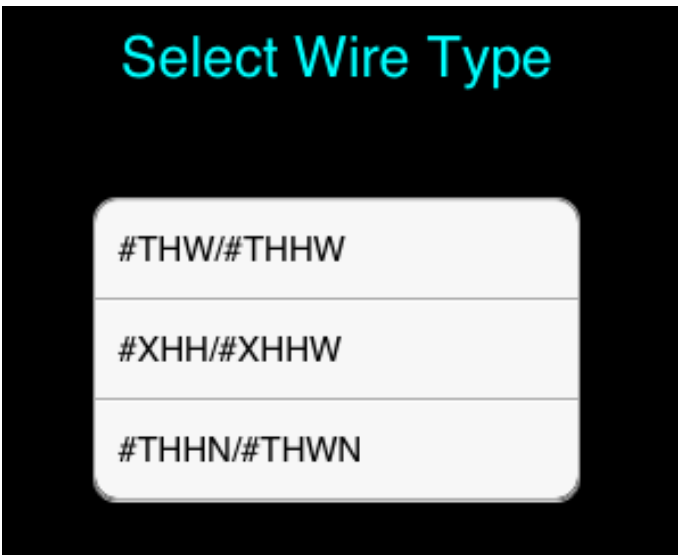
Conduit type is selected by pressing [Shift][CondSz] (Cond Type) and then selecting a conduit type from the popup window.

In addition to calculating required conduit size for a given set of wires, the Electrical Calc Elite™ can calculate the number of wires of a particular wire size that will fit in a specified conduit size. Available conduit sizes for this calculation include 1/2” through 6”.

Key Definitions:

[Wire Type] – Wire Type/ Quantity

Use to calculate or enter the number of wires in a raceway. When you press the wire type button you'll see a popup window allowing you to select between THW, XHH, and THHN wire types and shown below.



The first press of one of these buttons enters the number of wires or calculates the maximum number of wires of that type that can fit in the defined conduit. Subsequent presses of the button displays the cross section area of all wires entered and the total wire area within the conduit.

[CondSize] – Conduit Size

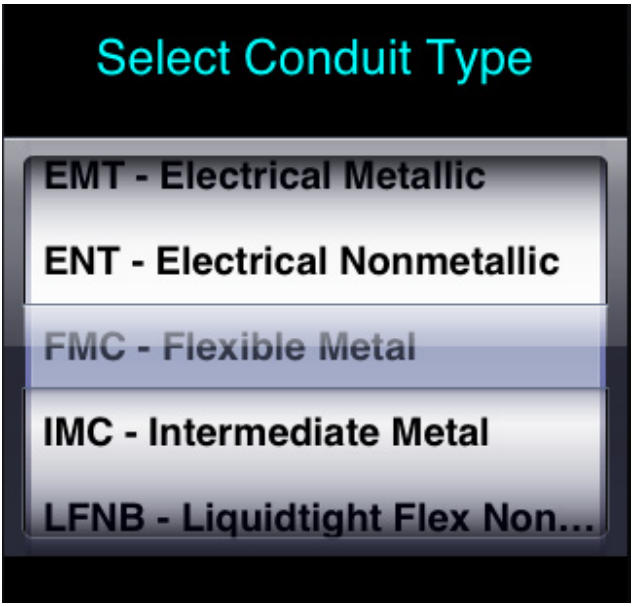
Use to calculate or enter conduit size. When solving for conduit size, calculator uses the total area of the entered wires and the allowed conduit fill percentage (defined in NEC Chapter 9). The first press of this button will enter or calculate the conduit size. The second press displays the total number of wires in the conduit if user is solving for conduit size. If conduit size was entered, the second press displays the conduit internal area for the defined conduit. The third button press displays the conduit fill percentage when calculating conduit size. Note, NEC chap9, table 1 defines the max allowable conduit fill percentage for calculating conduit size. The forth press displays the total area of all wires entered for the calculation. The fifth press displays the remaining area in the conduit for wires.

Note: If wire type and quantity are not defined and user attempts to solve for conduit size, calculator will assume 2 THHN wires (single phase) or 3 THHN wires (three phase).

[Shift][CondSize]– Conduit Type

Use to select conduit type. Button produces a popup window as shown below. Select the

desired conduit type and press the ‘Shift’ button in the window.



Conduit types include:

EMT – Electrical Metallic
ENT – Electrical Nonmetallic
FMC – Flexible Metal Conduit
IMC – Intermediate Metal Conduit
LFNB – Liquidtight Flex Nonmetal B
LFNA – Liquidtight Flex Nonmetal A
LFMC – Liquidtight Flex Metal
RMC – Rigid Metal Conduit
Rigid PVC, sched-80
Rigid PVC, sched-40 and HDPE
Type A, Rigid PVC
Type EB, Rigid PVC

Sample Calculations:

Solving for Conduit Size

What wire size (THHN copper) and FMC conduit size are required to connect a 40 HP, 3 phase induction motor to a 208V panel?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Set to 3-phase	[Shift][4]	3 PHASE
Set to Induction	[Shift][0]	INDUCTION MOTOR
Input Volts	[2][0][8][Volts]	VOLTS 208
Input Motor HP	[4][0][HPmotor]	IND 40.0 HP
Input conduit type	[Shift][CondSize]	FMC Conduit
Solve for FLC	[Amps]	FLC 114.0 A
Solve 125% wire size	[Shift][WireSize]	AWG 00 Cu WIRE SIZE 125%
Solve ampacity	[WireSize]	AWG 00 Cu WIRE AMPACITY 125%: 145.0 A
Solve conduit size	[CondSize]	FMC 1.5 in CONDUIT SIZE
Solve total wires	[CondSize]	TOTAL WIRES: 3
Solve conduit fill %	[CondSize]	FILL 35.89 CONDUIT %
Solve fill area	[CondSize]	FILL 0.6669 TOTAL WIRE AREA
Solve remaining fill area	[CondSize]	RMNG 0.0763 WIRE AREA

Solving for Conduit Size (multiple conductors)

Solve for the smallest size EMT conduit required to run sixteen #10 copper THW conductors?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input conduit type	[Shift][CondSize]	EMT Conduit
Input wire gauge	[1][0][WireSize]	AWG 10 Cu WIRE SIZE
Input qty wires	[1][6][WireType] [#THW]	THW 16 WIRES
Solve conduit size	[CondSize]	EMT 1.25 in CONDUIT SIZE

Solving Number of Wires that will Fit in Conduit

Assuming you have a 2” ENT conduit in place, how many #12 THHN conductors can fit in the conduit? What about XHH and THHW?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input conduit type	[Shift][CondSize]	ENT Conduit
Input conduit size	[2][CondSize]	ENT 2 in CONDUIT SIZE
Input wire gauge	[1][2][WireSz]	AWG 12 Cu WIRE SIZE
Solve max THHN	[WireType][#THHN]	THHN 96 TOTAL WIRES
Solve max XHH	[WireType][#XHH]	XHHW 70 TOTAL WIRES
Solve max THW	[WireType][#THW]	THW 70 TOTAL WIRES

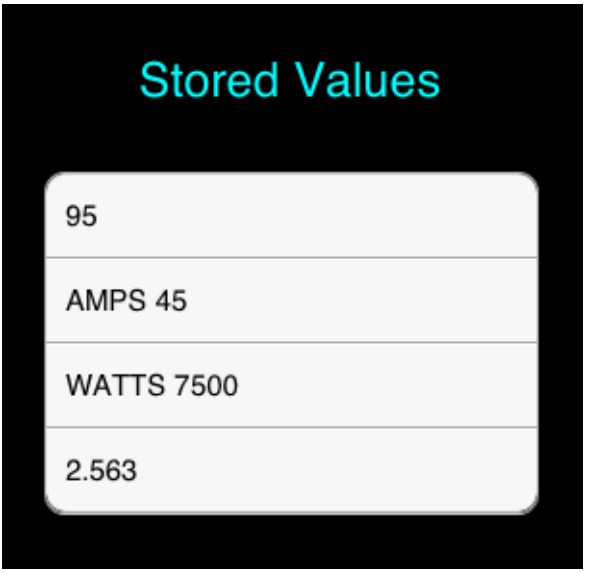
Solving Conduit Size (Different wires types)

You need to run a RMC conduit with four #1 THHN conductors and two #4 THHW conductors? What conduit size is required, area of the wires, conduit fill area and fill % and how much area remains for running future wires?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input conduit type	[Shift][CondSize]	RMC Conduit
Input 1st wire size	[1][WireSize]	AWG 1 Cu WIRE SIZE
Input # wires	[4][WireType][#THHN]	THHN 4 WIRES
Solve wire area	[WireType][#THHN]	THHN 0.6248 WIRE AREA
Input 2nd wire size	[4][WireSize]	AWG 4 Cu WIRE SIZE
Input # wires	[2][WireType][#THW]	THW 2 WIRES
Solve wire area	[WireType][#THW]	THW 0.1946 WIRE AREA
Solve conduit size	[CondSize]	RMC 1.5 in CONDUIT SIZE
Solve total wires	[CondSize]	TOTAL WIRES: 6
Solve conduit fill %	[CondSize]	FILL 39.57 CONDUIT %
Solve fill area	[CondSize]	FILL 0.8194 TOTAL WIRE AREA
Solve remaining fill area	[CondSize]	RMNG 0.009 WIRE AREA

Memory Storage

The Electrical Calc Elite™ allows users to store numbers or calculated results by pressing the [Store] button. You can store as many values/results as you like and the calculator will put them in a list. Values can be viewed and recalled from a popup window by pressing the [Recall] button as shown below:



Values can be cleared from memory by pressing [Shift][Recall] (Rcl-Clear) and selecting the entry to be cleared.
Values stored in memory are persistent and stay saved when the program is closed and reopened. The entire memory storage can be cleared with the clear all command, [Shift][+].

Miscellaneous Functions

The Electrical Calc Elite™ has built in functions to solve for parallel resistance and to convert between KW-HR and BTU.

Key Definitions:

[Shift][7] - (Parallel Res) Parallel Resistance

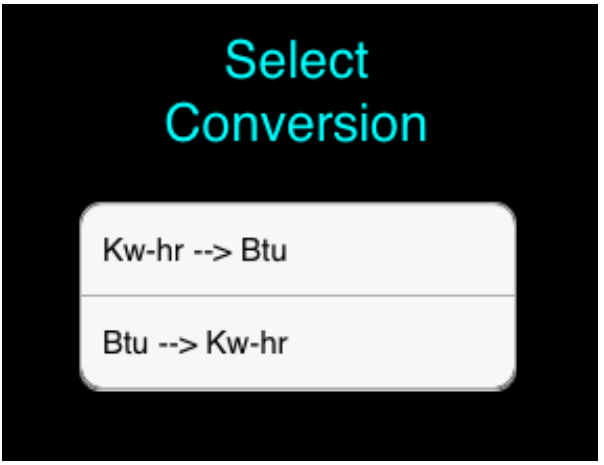
Use to calculate Parallel resistance. Calculation uses multiple resistance inputs and determines equivalent resistance of all resistors connected in parallel. Equation:

$$\frac{1}{R_{Parallel}} = \frac{1}{R_1} + \frac{1}{R_2} \cdots \frac{1}{R_n}$$

[Shift][X] – Convert BTU to kWh or kWh to BTU

Use to convert British Thermal Units (BTU) to Kilowatt Hours (kWh) or vice versa. A popup window, shown below, will allow you to select which conversion to calculate. Equations:

$$kWh = \frac{BTU}{3412.3}, BTU = kWh * 3412.3$$



Sample Calculations:

Solving for Parallel

Solve for the equivalent resistance if you place a 100-ohm resistance, 200-ohm resistor, and 120-ohm resistor in parallel.

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input first resistor	[1][0][0][Shift][7]	OHMS 100.0 PARALLEL RESISTANCE
Input 2nd resistor	[2][0][0][Shift][7]	OHMS 66.67 PARALLEL RESISTANCE
Input 3rd resistor	[1][2][0][Shift][7]	OHMS 42.86 PARALLEL RESISTANCE

*Notice the parallel resistance is updated after each resistor entry.

Converting BTU to KW-HR

A 12,000 BTU furnace is equivalent to what KW-HR rating?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input BTU	[1][2][0][0][0]	12000
Convert BTU to KW-HR	[Shift][X]	KWH 3.516

Converting KW-HR to BTU

A 20 kw-hr furnace is equivalent to what BTU rating?

STEPS	KEYSTROKES	DISPLAY
Clear calculator	[Clear][Clear]	
Input KWh	[2][0]	20
Convert KW-HR to BTU	[Shift][X]	BTU 68246.0

Future NEC Code Revisions:

The Electrical Calc Elite™ will support future code revisions as they become available. Updates will be made available via the Android Market place. More information can be found on our website at www.ElectricalCalcElite.com

Legal:

Technical Support:

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