HP Prime Electric & Electronic Circuit Solver (EEC_Solver)

Copyright (C) 2017-2018 Jesus Calvino-Fraga
EECSolver@gmail.com

Introduction

The Electric & Electronic Circuit Solver is an HP Prime application that allows for the creation, solution, and display of results for basic electric and electronic circuits. The solver can handle a variety of circuit elements, both linear and non-linear. It is also capable of solving both DC and AC circuits. At the moment of the writing of this documentation the following components are supported:

- Linear elements: resistors, inductors, capacitors, ideal transformers, complex impedances, active mode BJTs, and ideal OP Amps,.
- Sources: DC voltage sources, DC current sources, VCCSs, VCVSs, CCCSs, CCVSs, AC voltage sources, and AC current sources.
- Non-Linear elements: diodes, LEDs, zener diodes, BJTs (using Ebers-Moll model), and MOSFETs.

Disclaimer

Requirements

In order to run the application the following items are required:

- An HP Prime calculator. The application was tested and found to work properly with an older version of the calculator (Hardware version: A), a newer version of the calculator (Hardware version: C), the virtual HP Prime program running under Window 10 and 8, and the HP Prime Pro App running on an Android phone.

EEC_Solver is a memory demanding application. Your HP Prime calculator must have around 10 Mega bytes of memory available in order to be capable of running the EEC_Solver application.

- The HP Connectivity Kit. This is only needed to install the EEC_Solver application. The HP Connectivity Kit can be also used to manage (load and delete) circuits into the HP Prime calculator.

- The EEC_Solver application itself.

Installing the EEC_Solver Application

To install the EEC_Solver application follow the steps you'll normally follow to install any application into the HP Prime calculator: with the calculator connected to the HP Connectivity Kit, drag the EEC_Solver installation zip file from the hard drive of your computer into the "Application Library" folder of the HP Prime.

Quick Start Guide

Start by pressing the "Apps" key in the HP Prime calculator. The available applications are displayed.

Use the arrow keys to highlight "EEC_Solver" and then tap the "Start" soft button. A brief copyright message is displayed followed by a list of saved circuits; for this guide we should start with a new circuit. Therefore select the "New" option is selected as shown in the picture below.
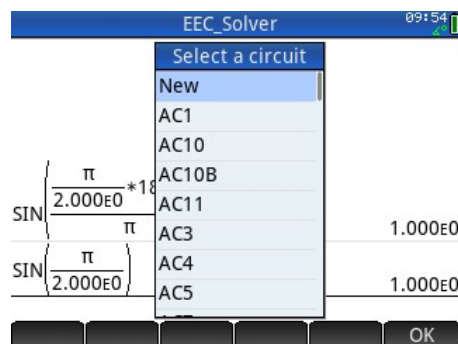
Tap the "Ok" soft button. A blank circuit schematic is created with a soft menu of commands at the bottom of the screen.
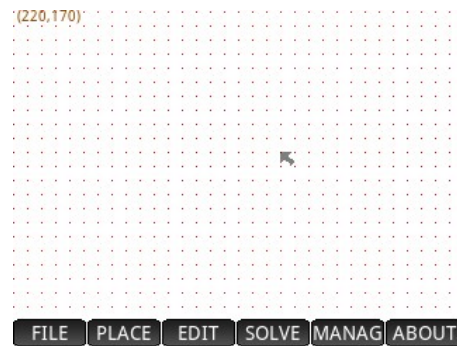

At this point we can start adding parts and other elements to the circuit. Move the cursor to the position of the screen where you want to add the part by either using the arrow keys or the touch screen. Continue by tapping the "PLACE" soft button followed by the "PART" soft button. Alternatively, you can use the "EEX" key (or "P" if you wish). The screen shown below is displayed. We will start by adding a resistor. There are different versions of the resistor component available. Select the small one as shown in the picture and press the soft button "Ok".
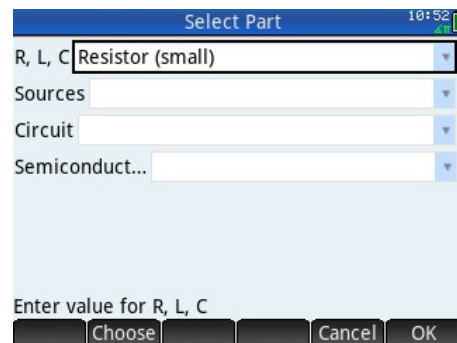

The part, in this case the small resistor, is added to the circuit diagram. If the part is selected (its color is red) it can be moved around the circuit diagram by entering Shift Mode. To select the part, place the cursor over it and press the Enter key. To un-select the part, press the Esc key. To enter Shift Mode press the "Shift" key. You can tell when the circuit editor is in Shift Mode by looking at the message at the top left corner of the screen. Use the arrow keys or the touch screen to move the selected component on the screen while in Shift Mode. To exit Shift Mode, press the Shift key again.
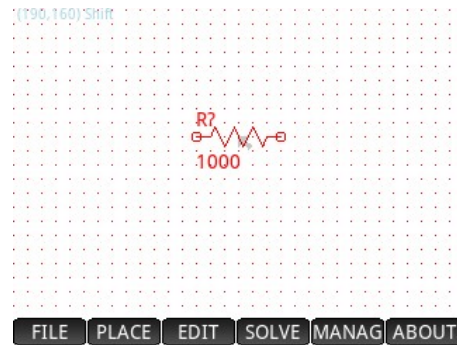
Parts can also be rotated in 90˚ increments. Use either the soft menu buttons "EDIT" followed by "ROTATE" or press key "8" (or "R" if you wish). You can move the part reference designator (in this case "R?") or the part value (in this case "1000") independently by selecting them in a similar manner as described above and using the arrow keys or the touch screen while in Shift Mode.
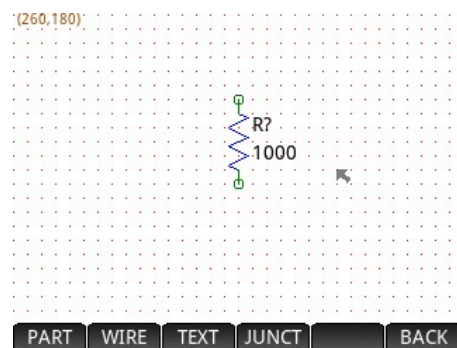

The part properties, in this case the reference designator and value, can be modified. While the cursor is over the part, tap the soft buttons "EDIT" and "PROPER" or alternatively press the key "Vars" located just under the home key in the HP Prime calculator. Let us modify the reference designator from "R?" so it says "R1":
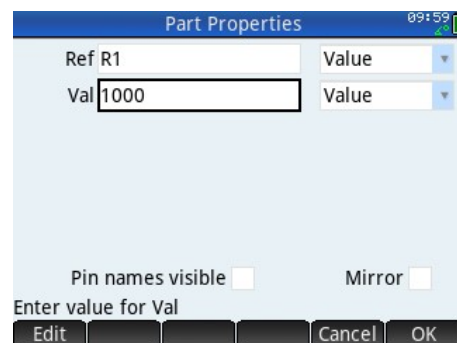

The circuit editor allows us to copy and paste parts. To copy a part, first select the part by placing the cursor on top and pressing "Enter"; then press the "Shift" key followed by the key "Copy".

(190,160)

R1
1000

PROPER MIRROR DEL ROTATE SELECT BACK
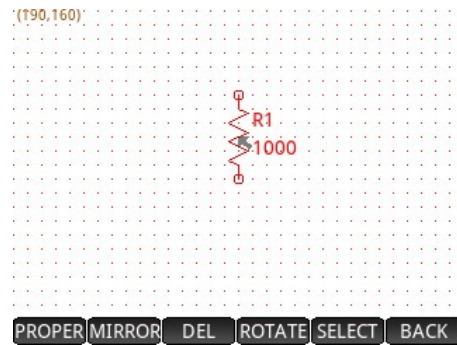
To paste the part, move the cursor to the location on the screen where you want the part pasted and press the "Shift" key followed by the key "Paste". Additionally, undo and redo operations are supported. To undo an action press the "Shift" key followed by the key "2"/"Z". To redo an action press the "Shift" key followed by the key "1"/"Y".

(300,220)

R1
1000

R1
1000

PROPER MIRROR DEL ROTATE SELECT BACK
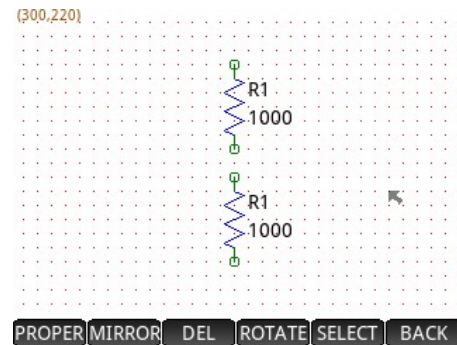
As we did before, the properties of the newly pasted part can be changed by placing the cursor over it and pressing the soft button "PROPER" or the key "Vars". The figure below shows the pasted part with an edited reference designator "R2".

(190,240)

R1
1000

R2
1000

PROPER MIRROR DEL ROTATE SELECT BACK
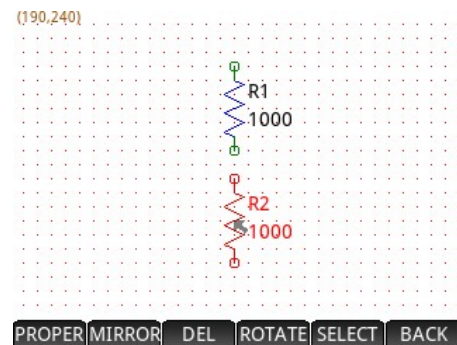
To connect parts we use Wires and Junctions. To place a Wire use the soft menu buttons "PLACE" and "WIRE" or press key "6" (or "W" if you wish). That will set the start point of the wire. To finalize the wire, move the cursor to the destination point using the arrow keys or the touch screen and press key "6"/"W" again.
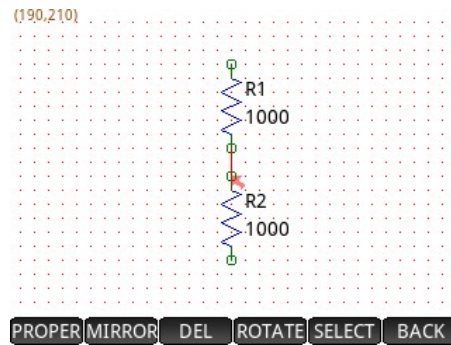
When a part's pin is connected, the little circles or "bubbles" at the end of part's pin and wires disappear. A complete circuit should not have any pins unconnected; that means that empty bubbles are not allowed before solving the circuit.
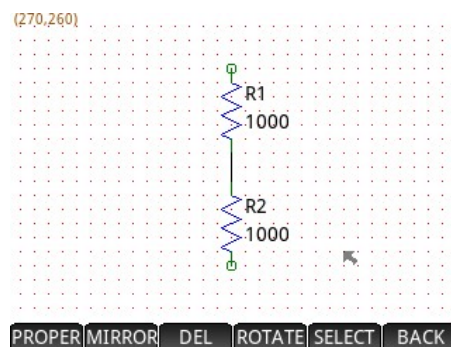
When some progress has been made editing the circuit, is often convenient to save it. To save the circuit press the "Shift" key followed by the "9' key (or "S" if you wish) or use the soft buttons "FILE" and "SAVE".
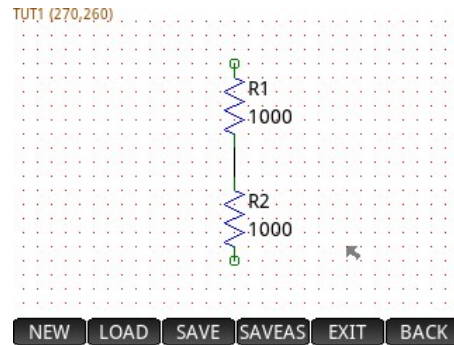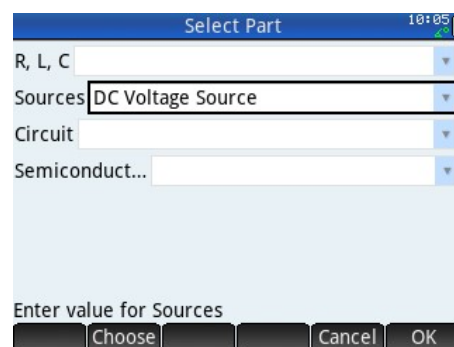

The name of the just saved circuit it then displayed on the top left corner of the screen as shown in the figure below.

With the circuit saved, we can now proceed to add more components and other circuit elements. In the figure below a DC voltage source is selected:


The newly added part can be moved, rotated, and its properties adjusted as outlined above so it follows the desired circuit configuration:
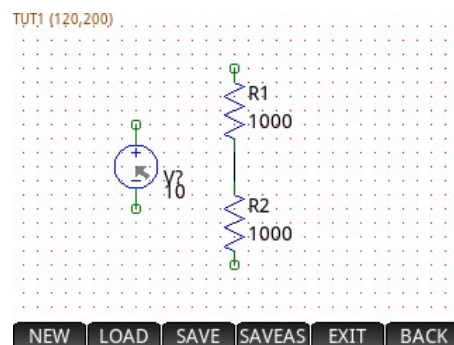

The voltage source is then wired to the rest of the circuit. In this case we are going to solve a voltage divider which consists of a voltage source and two resistors in series.
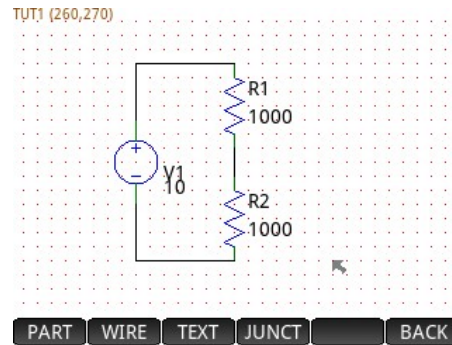
Every circuit must have a "zero" voltage reference before a solution is attempted. This reference is often called "ground" or GND. To add a ground reference look under the "Sources" part list for the "Reference/GND" part.
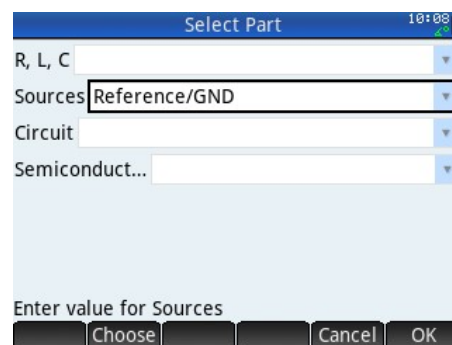

In Shift Mode, with the Reference/GND part selected, we can move it to the desired position as shown in the figure below.
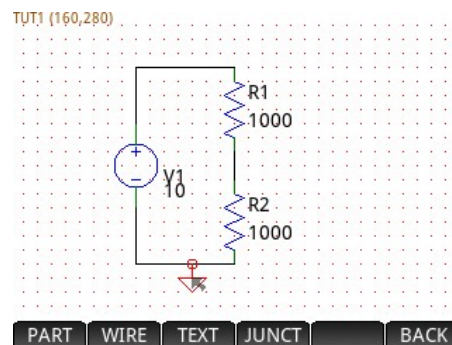

At this point if you un-select the Reference/GND part you'll notice that the "bubble" at the end of its pin is still visible. That means that the pin is not connected to anything! To connect the pin to the wire we add a "Junction" by either using the soft menu button "PLACE" followed by the soft menu button "JUNCT" or by pressing the "LN" key (or "J" if you wish). Junctions are also used to connect wires that cross each other.
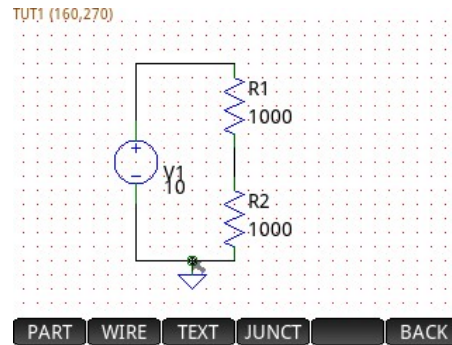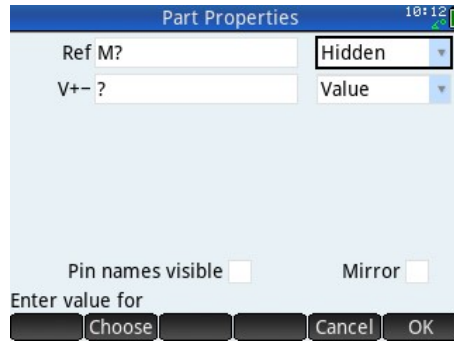
The circuit is now complete and can be solved, but we need to add a couple of extra circuit elements to see the results of the solution. Let us start with a "Voltage Indicator" to display the resulting voltage across resistor R2. The "Voltage Indicator" is available in the "Circuit" submenu of the "Select Part" screen. Press the key "EEX" (or "P" if you wish) to quickly display the "Select Part" Screen.
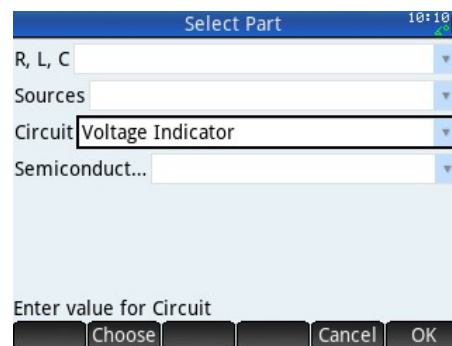

As described before for other circuit elements, you can move and rotate the "Voltage Indicator" until you are satisfied with its position and orientation.
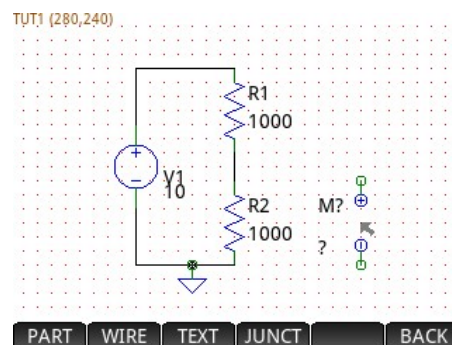

When you edit the part properties you can select what information to display in the schematic diagram. For example, let us hide the reference designator of the "Voltage Indicator" we just added.

Part Properties	10:12

Ref M?   Hidden

V+- ?   Value

Pin names visible ☐   Mirror ☐

Enter value for

| Choose | | | Cancel | OK |

After the circuit is solved, the "Voltage Indicator" displays the voltage between the '+'
and '-' pins where the '?' is located in the screen.

TUT1 (310,130) Shift

| PART | WIRE | TEXT | JUNCT | | BACK |
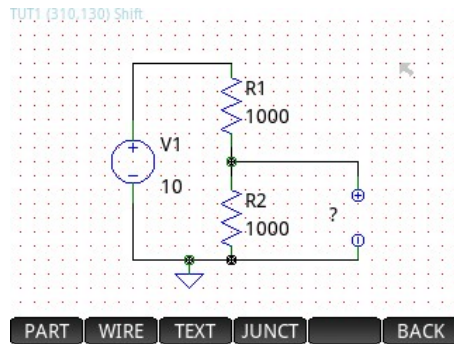
EEC_Solve can also display the current trough some circuit elements. The supported
parts are resistors, diodes, and voltage sources. In this case we want to display the
current flowing through R1. Start by placing the cursor close to the component we are
interested to measure the current through. Three or four grid points are often enough:

TUT1 (230,150) Shift

| PART | WIRE | TEXT | JUNCT | | BACK |
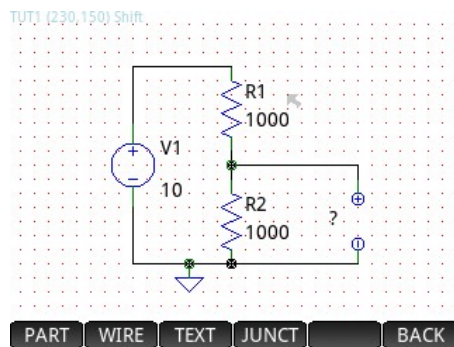
Then use the soft buttons "PLACE" and "PART" (or press key "EEX") and in the
"Circuit" list select "Current Indicator".
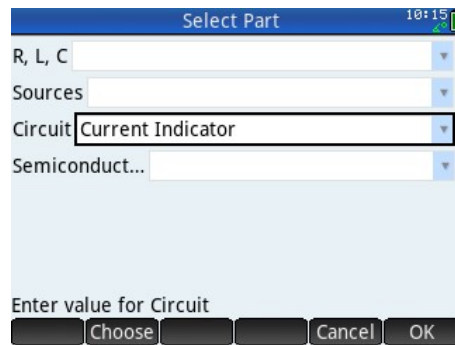
After the circuit is solved the "Current Indicator" part will display the current across the selected component, in this case R1. You can copy and paste the "Current Indicator", but the reference of the component you want the current through has to be edited manually on its "Part Properties" menu.
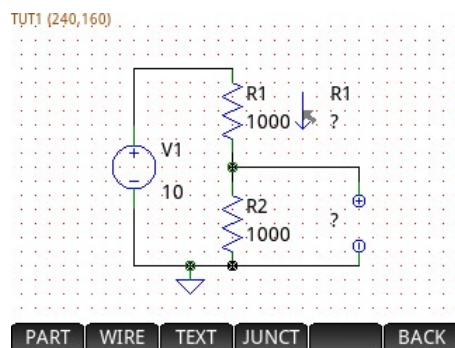
The circuit is now complete. To solve it, use the soft buttons "SOLVE" and "DC". If the circuit has no errors the terminal screen displays the result of the solution as shown in the figure below.
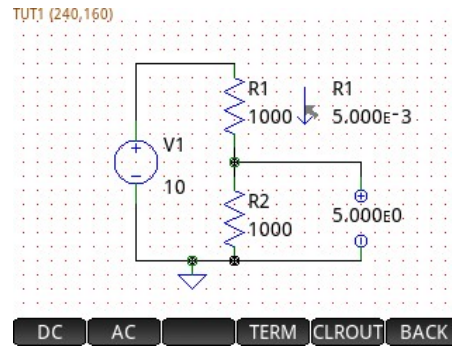

Press the "BACK" soft button or the "Esc" key to go back to the circuit editor, where the solutions are added to the screen as shown below.

R1
1000   R1   5.000ε-3

V1

10   R2
1000   5.000ε0

DC   AC   TERM CLROUT BACK

Finally, to exit the EEC_Solver use the soft menu buttons "CIRCUIT" and EXIT and tap "OK".

R1
1000   R1   5.000ε-3

Do you want to exit the program?

10   R2
1000   5.000ε0

CANCEL   OK