

# EESy Solutions

## Engineering Equation Solver Newsletter

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### Welcome

This is the 33<sup>rd</sup> issue of EESy Solutions, a newsletter that provides news, tips, and other updates for users of the Engineering Equation Solver software. This issue discusses the use of Macros in the Professional version to control EES.

EES has been commercially available for more than two decades. If you have missed any of the previous issues of EESy Solutions, they can be downloaded from [www.fchart.com](http://www.fchart.com).

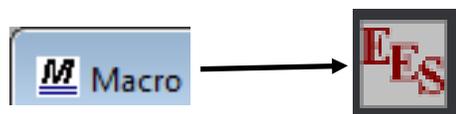
### Advantages of Macros

A *macro* is a set of instructions that can be used to control EES in the same way that you can control EES manually from the graphical user interface. Macro commands can instruct EES to solve, create a plot, save data, etc. Almost anything that you can do with the menu commands or with a directive can be done using a macro command.

Macros allow you to automate a series of commands that you otherwise would have to manually execute. For example, maybe you have found a method for reliably obtaining a solution that requires you to set guess values, solve, update guesses, etc. all in some prescribed order. These commands can be programmed in a macro and executed with the click of a single button.

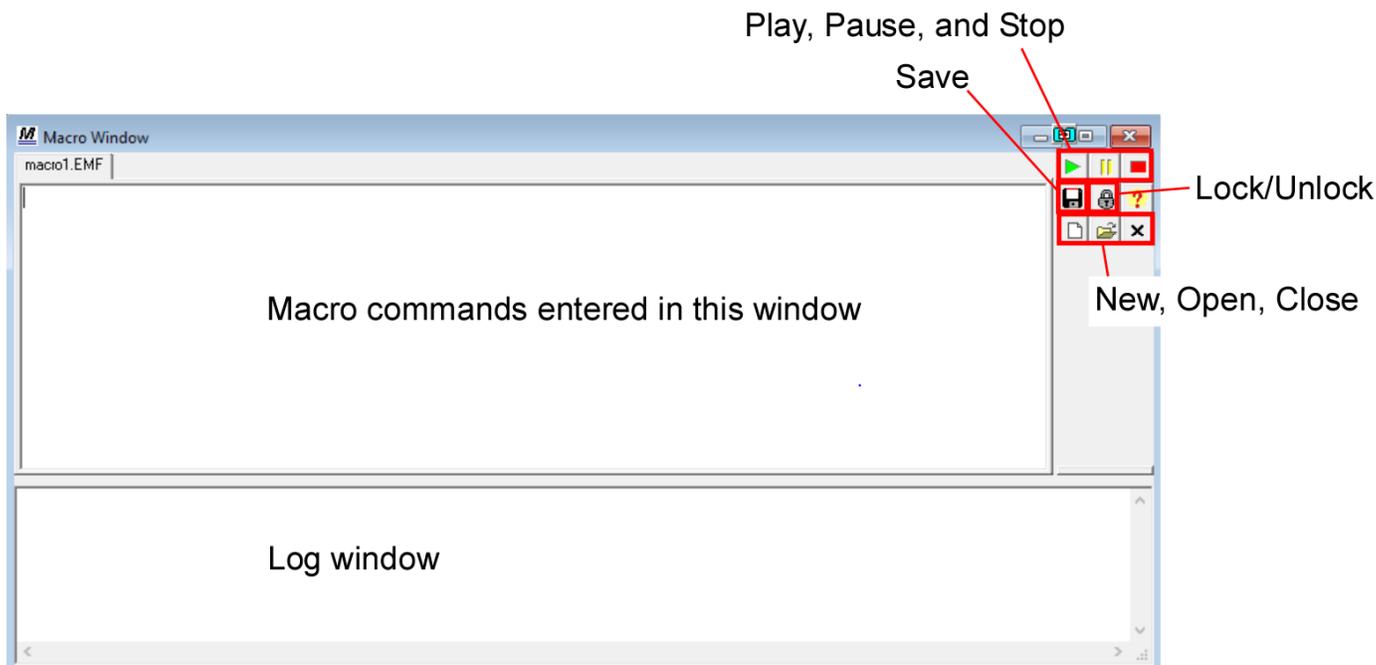
Macros allow you to interface multiple EES programs that must run in series. For example, a macro can execute a string of commands that open one EES file and run it and then use the outputs of the calculation as the inputs to a second EES file that is opened and run.

Macros allow EES to interact automatically with other programs. For example, EES can be controlled automatically by a second program such as MATLAB or LabView by running a macro file.



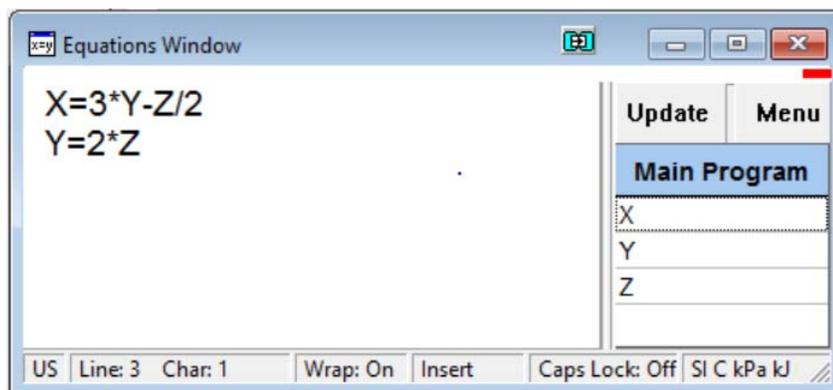
## The Macro Window

A macro file is a set of instructions that can be read from any ASCII file. The file name extension for a macro file is .emf (for EES Macro File). The easiest way to create a macro file is to use the Macro Window within EES. The Macro Window is a text editor, but it includes controls that allow you to play, pause, stop, close, open, and save a macro.



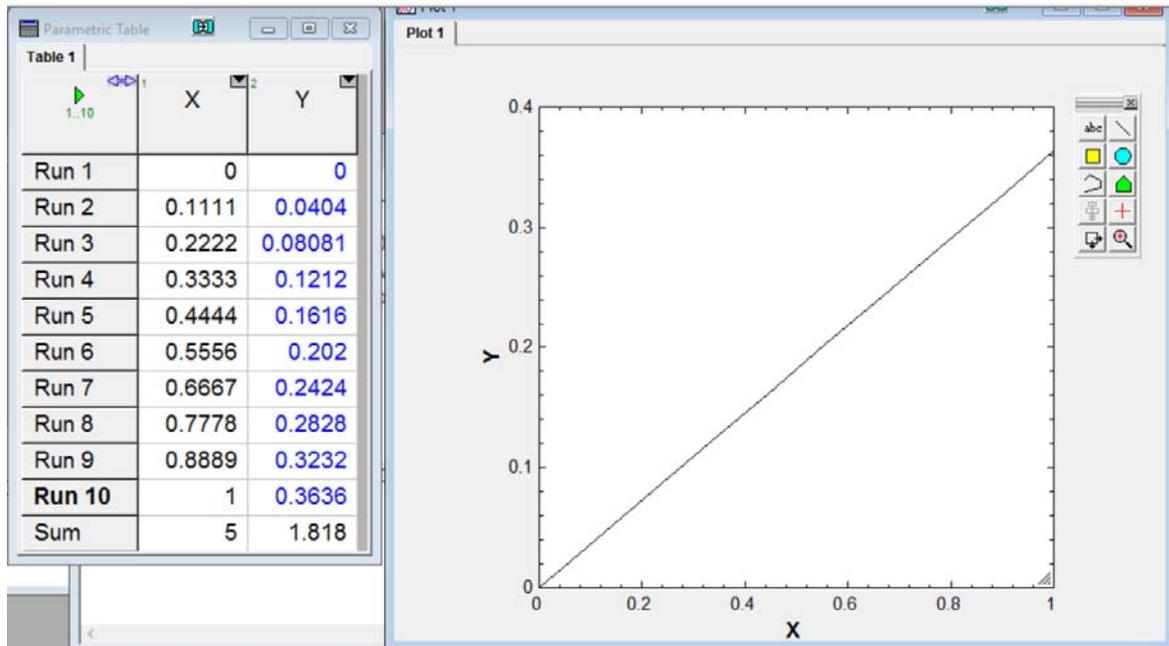
The macro window includes a Log window that shows you the outcome of executing the macro. The splitter bar above the Log window can be used to change the size of the Log window or hide it. When the Macro command window is unlocked, the Macro window will echo commands that are entered in manually in EES. Playing the macro repeats the commands automatically.

For example, open EES and open a Macro window (select Macro Window from the Windows menu). Then enter a simple set of equations, for example those shown below.

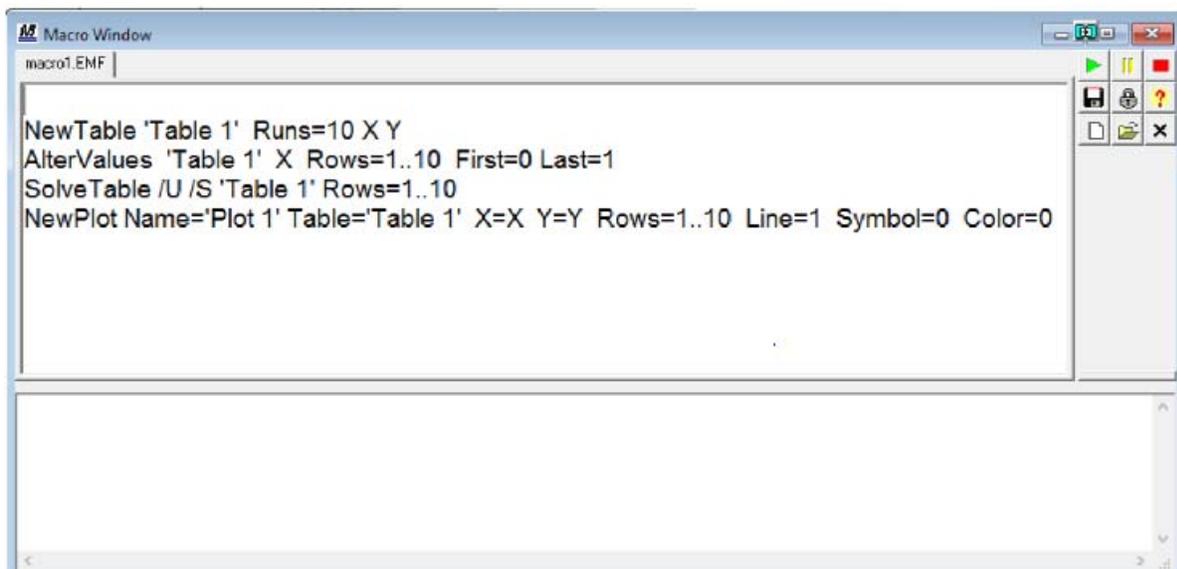


## The Macro Window

Now go through the manual actions associated with making a new Parametric Table that includes the variables X and Y, and using the Alter Values command to set the values in the X column in the table from 0 to 1. Finally, solve the table and create a plot of Y vs X.

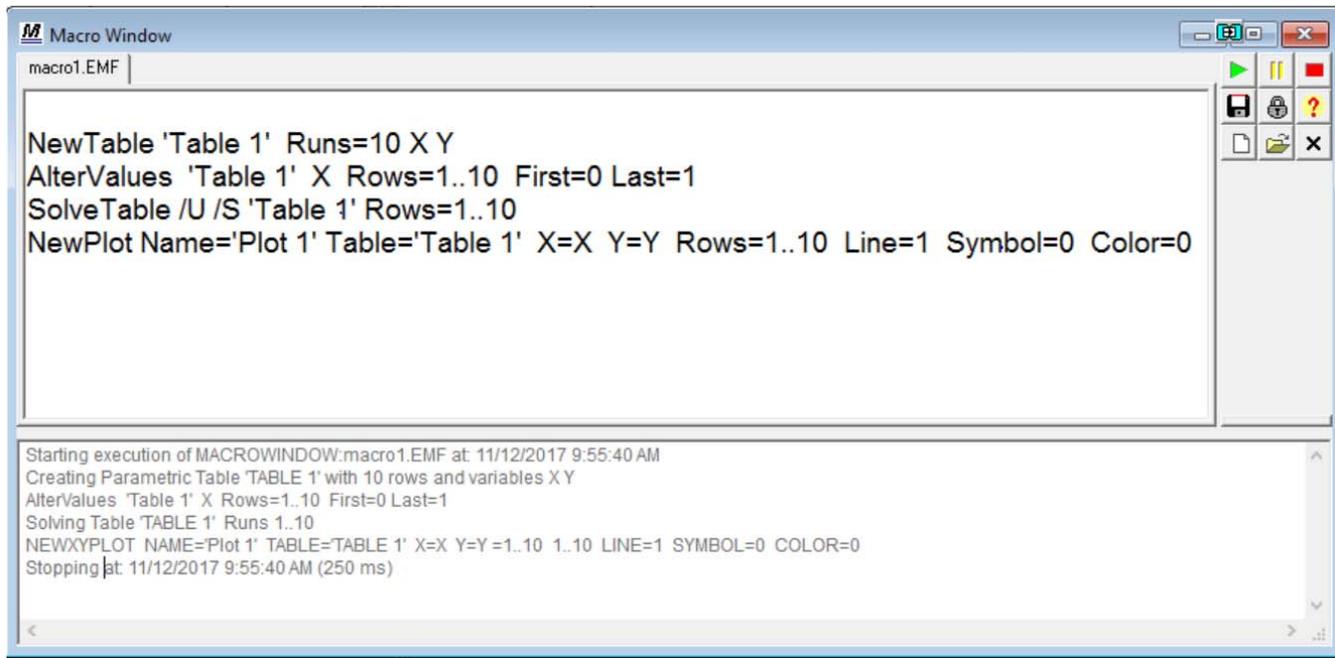


Now select the Macro Window from the Windows menu and you should see a macro command that corresponds to each of the actions that you just manually executed. (If you don't want the macro version of your commands echoed in the Macro Window, then click the Lock/Unlock in the macro toolbar.) You also can enter the commands directly into the Macro Window. Click the Help button  to show a list and explanation of all macro commands.



## The Macro Window

If you click the Play button in the macro toolbar, then the commands will be repeated, causing another Parametric Table and Plot to be generated. Also, the result of running each command in the macro will be logged in the Log window. A Play button is also provided in the button strip below the main menu.

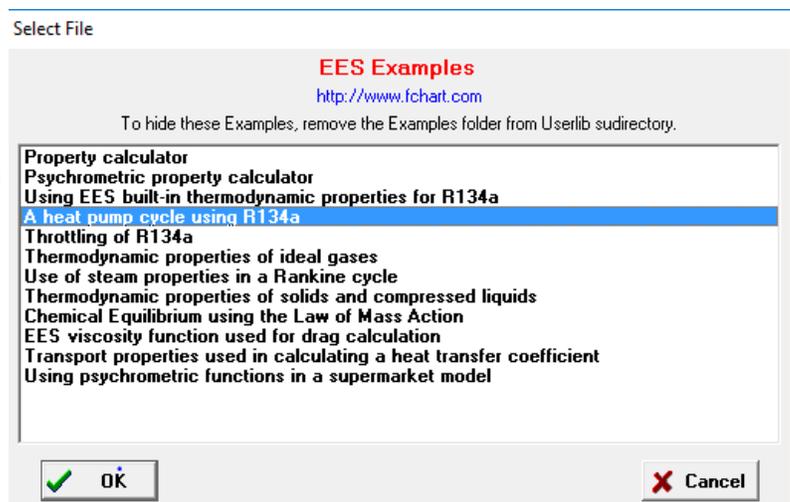


## Variables in Macros

Variables can be used within macros to control the flow of information. For example, you might want to run an EES model at some nominal conditions in order to establish a baseline performance and then modify the conditions and determine the change in performance.

Open the example EES file CapvsT.ees. This example can be accessed from the Examples menu under the “Properties, thermodynamic” heading with the item titled “A heat pump cycle using R134a”.

Let’s run the model once with an ambient temperature of 0°C ( $T_{amb} = 0$  [C]) and determine the COP. Then we’ll reduce the ambient temperature to -10°C ( $T_{amb} = -10$  [C]) and calculate the percent reduction in the COP in the Macro window. To do this calculation, we set the value of  $T_{amb}$  in a macro file and also store the value of COP in a variable.

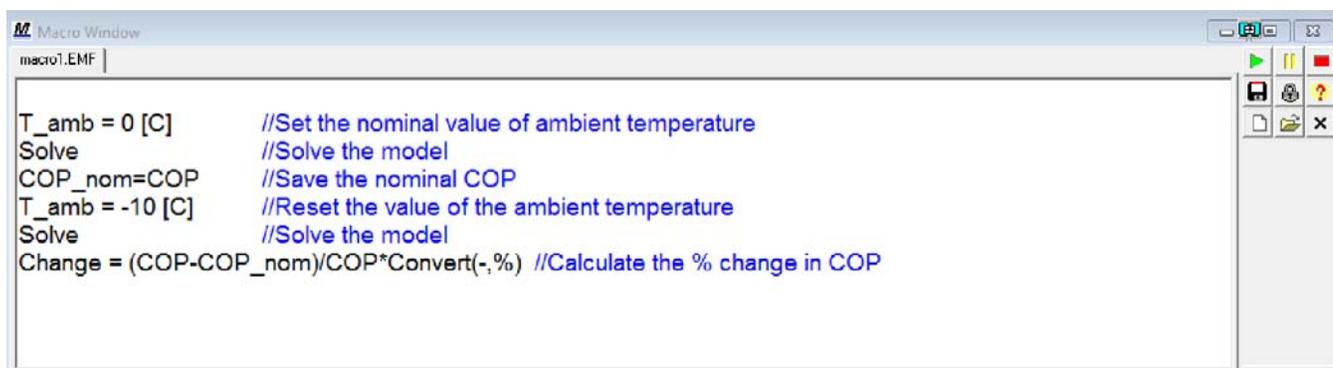


## Variables in Macros

We will first comment out the value of T\_amb that is set in the Equations Window.

```
//T_amb=0 [C]
```

The macro that will accomplish the correct sequence of steps is shown below. Playing the macro will result in a second tab in the Solutions Window, labeled Macro Variables, which includes those variables that are used in the macro file.



```

M Macro Window
macro1.EMF |
T_amb = 0 [C]      //Set the nominal value of ambient temperature
Solve             //Solve the model
COP_nom=COP       //Save the nominal COP
T_amb = -10 [C]   //Reset the value of the ambient temperature
Solve             //Solve the model
Change = (COP-COP_nom)/COP*Convert(-,%) //Calculate the % change in COP

```



```

Solution
Main Macro Variables
T_amb = -10
COP_nom = 3.985
Change = -11.74

```

The result of these calculations suggests that the COP will be reduced by 11.74% if the ambient temperature is reduced from 0°C to -10°C. Note that the variables set in the Macro Window act just as if the variables were set the Equations Window.

You can open multiple macro files in the Macro Window. Each file is identified and accessed with a tab at the top of the Macro Window. Clicking the Play button will play the active macro file, i.e., the one whose tab is selected. This capability provides a simple way to allow different variations or cases of an equation set in the Equation Window. Alternatively, each macro file can open and run a separate EES program.

The \$Include directive accepts an .emf file name. When an EES file has a \$Include directive for a macro file, it will open the macro file and display in the Macro Window, so that it is ready to be played.

EES can be made to run a macro without becoming visible by entering the following command:

```
C:\EES32\EES.exe c:\EES32\myMacro.emf
```

There are many other things that you can do with macros. Chapter 18 of the [Mastering EES book](#) provides a detailed description of the macro capability within EES.

## Additional Changes to EES

- The Equations Window now provides up to 32 Undo/Redo operations.
- The Key Variables Solution window allows text to be displayed within a horizontal separator.
- The number of rows in a Parametric or Lookup table to be increased by changing the value of the Last Row in the Alter Values dialog.
- In the Professional version the crosshairs can be used to identify the location of a plotted point in its table. When you position the crosshairs over a plotted point and press the right mouse button, the status bar will show the coordinates of the point as well as the table and row for these data. In addition, this table will be brought to the front with the appropriate row highlighted.
- The /Skiplines = option in the \$Import directive and Import macro command will accept an integer or an EES variable that has been previously set to an integer
- Multiple \$Include directives can be used to several macro files into the Macro Window (see Macro-Cases.ees for an example). Each macro file is placed in a separate tab within the Macro Window.
- The Round function will accept an optional second argument that specifies the nearest multiple to round to (e.g., Round(11.7, 0.5) will result in 11.5).
- If array variables are among the selected measured variables for an Uncertainty analysis then the Professional version allows the option to set the uncertainties of all array variables at once.
- Uncertainty values can be entered in either the primary or secondary units in the Professional version.
- The Paste Special command allows data to be pasted into a Lookup Table using comma, space, semicolon, or the standard tab delimiter.
- The SquareWave(Time, Period, Value1, Value2) function provides a simple way to implement a square wave.
- Transport properties are provided for R1311, SES36, and R227ea. Transport properties have been improved for Fluorine, R116, and Deuterium.



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### Instant Update Service

EES uses a different model for updating than most other programs. Each time that there is a change in the EES program, either to correct a problem or to add a new feature, the version number is incremented by 0.001 and the latest version of EES is placed on our website. Although the program has become very robust and stable, there have been many new versions of EES released since the last EESy Solutions was distributed.

Any user who has a current subscription to our Instant Update Service can download the latest version. All new licenses of EES are provided with one year of Instant Update Service. The fee to continue Instant Update Service after the first year is 20% of the current cost of the program per year if renewed within 12 months after expiration of the Service. Contact F-Chart Software if you wish to re-subscribe to the Instant Update Service.