

# EESy Solutions

Engineering Equation Solver Newsletter

No. 19, Spring 2009

## Welcome

This is the 19<sup>th</sup> issue of **EESy Solutions**, a newsletter developed to provide news, tips, and tricks relating to Engineering Equation Solver. Did you miss any of the previous issues? The previous 18 issues are available from our web site: [www.fchart.com](http://www.fchart.com).

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## Instant Update Service

Each time 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 is placed on our website. Although the program has become very robust and stable, there have been over 250 new versions released since the last EESy Solutions was composed in Spring 2008. Any user who has 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 current cost of the program per year. Contact F-Chart Software if you wish to re-subscribe to Instant Update Service.

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## What's New?

New features are added to EES very carefully. A concern is that the program will become so feature-loaded, it will be difficult to use, which is a complaint that sometimes is directed to Microsoft products. Another concern is stability. Any change in the program introduces the possibility of errors and unwanted interactions. Over the years, EES has become very stable, and we wish to keep it that way. On the other hand, there are many ways that the program can be improved. We have been particularly responsive to users who have provided suggestions for improvements. If you have a suggestion for an enhancement, send it to [info@fchart.com](mailto:info@fchart.com). Listed below are some of the new features that have been added in the last year.

## Phase\$ Function

Using property tables, you always know the phase (compressed liquid, saturated, superheated) of the state, since you need to determine the phase to determine which table to use. The new thermodynamic function Phase\$ returns the phase as a string that can be assigned to a string variable, e.g.

```
P$[1]=Phase$(Steam, h=h[1], P=P[1])
```

## Additional Property Data

High accuracy property data have been added for R142b, n-nonane, n-decane, R41, R218, and R 245fa.

## No More BEEPs

Tired of the "beep"? Well now, 5 separate sounds can be selected for different conditions from the Sound tab of the Preferences dialog. The different sound choices provide some diagnostic information as different sounds can be chosen for errors, warnings, information, completed and unexpected situations.

## New Directives

The \$StopCriteria directive allows the stopping criteria that control the results of iterative calculations to be specified in the Equations window.

The \$IntegralAutoStep allows parameters for automatic step size integration to be specified without accessing the Preferences dialog.

The \$EXPORT directive can be used to export numerical or string constants in addition to variables.

The \$HideWindow directive will hide the Equations, Formatted, Solution, Residuals, Arrays, Parametric, Lookup, Integral, Plot, or Diagram windows

The \$ShowWindow Solution 'Key Variables' directive will bring the Key Variables Solution window to the front of all other windows after the equations are solved.

Macro Enhancements

Macro commands allow a series of tasks to be automated and greatly expand the capabilities of the graphic user interface provided with the Diagram window. The following improvements have been made to the Macro capabilities. See the online help for implementation details.

The MessageDialog command provides a means for a macro command to display a message in a dialog with 1, 2, or 3 buttons. The message may include a hot link to a URL. The format of the command is:

```
R=MessageDialog([Yes, No, Maybe],
  'Visit http://fchart.com. Do you agree that this
  is a useful website?')
```

F\$=GetDirectory will get the current Windows directory and assign it to a string variable. SetDirectory(F\$) will set the current Windows directory to the string constant or string variable provided in the parentheses.

Beep n, where n is an integer between 1 and 5 will play on of the five sounds defined on the sounds tab of the Preferences dialog

The OpenLookup macro command can request that an open file dialog be displayed to select the lookup file by providing a ? as the file name.

The macro commands InsertLookupRows and InsertParametricRows allow rows to be added at a specified location in the specified Lookup and Parametric tables, respectively.

The InsertLookupColumn macro command allows new columns to be inserted into an existing Lookup table.

The Macro window will save its position and size and it will return to this condition when it is next opened.

The NewContourPlot allows contour plots to be prepared with a macro command.

Miscellaneous Improvements

A tilde can be placed above a character by following the name with \_tilde, e.g., V\_tilde.

Access the EES Calculator window can be attained by clicking on the calculator button at the right of the button bar below the main EES menu. The Calculator window will accept % as shorthand for the last calculated result. For example:

```
?2*pi
6.283185
?%/4
1.570796
```

A message with up to 1000 characters can be displayed in a distributable program if it is executed beyond its specified expiration date.

The computational speed of the psychrometrics routines has been significantly increased.

If there are more than one solution windows (for example, for Key variables and/or functions, procedures and subprograms) the Solution window menu item will display a flyout menu that provides access to any of the solution windows.

Objects on the plot and diagram windows can be resized while keeping their aspect ratio fixed.

A RETURN statement may be used within Functions and Procedures. When a RETURN is encountered, the Function or Procedure is closed and control transfers to the statement directly that follows the call to the Function or Procedure.

The Unit Conversion Info dialog will show the conversion factor and inverse conversion factor for any two items selected from the list on the right.

Buttons, text and graphic items that appear in the Diagram window can be hidden or shown by entering Name.hide or Name.show in the Equations window or in any Diagram window.

***Tips and Tricks***Calculator Window

Surprisingly (to us), many users are unaware of the Calculator feature in EES. We find this feature so useful, we no longer use our hand-held calculators. We added a button on the tool bar to make the calculator more accessible. The Calculator operates very much like the Apple II computers, for those of you old enough to remember them. You enter a query by preceding it with a ?. For example,

?3+4

The Calculator window will immediately return

**7.000000**

Any of the property functions in EES can be used in the Calculator, e.g.,

?Temperature(Water,P=101.3 [kPa],x=0)

**99.967662**

Unit conversions are accessible in the Calculator window. For example, to convert 72°F into its equivalent in the Kelvin scale, you can enter

?convertTemp(F,K,72 [F])

**295.372222**

Any variable that has been defined in Equations window can be used in the Calculator after the equations have been solved. For example, if the Equations window sets X=5, then

?X^2

will return

**25.000000**

You can also define new variables in the Calculator window, e.g.,

A=5

B=6

?A^2+B^3

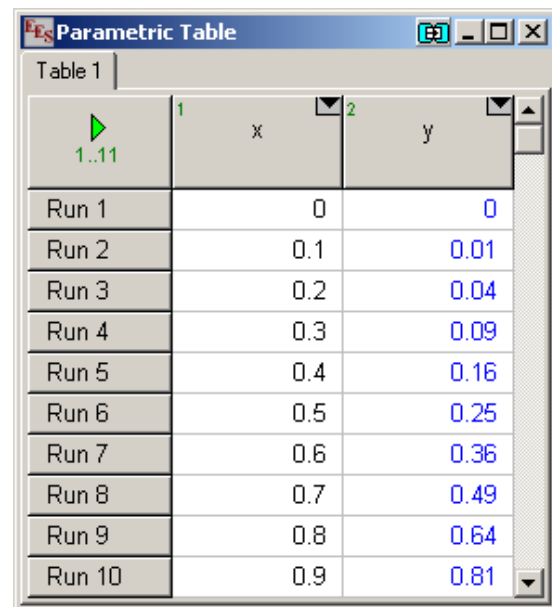
**241.000000**

Integration in Plots

EES can automatically determine the integral of any plotted quantity, although this capability is well hidden. To demonstrate this capability enter the following equation into an empty Equations window.

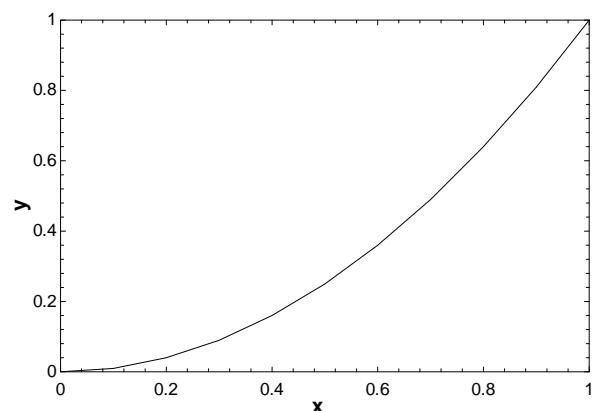
$$y=x^2$$

Create a Parametric table with columns for x and y with 11 rows. Enter values for x between 0 and 1. Solve the table and the Parametric table should now appear as shown.

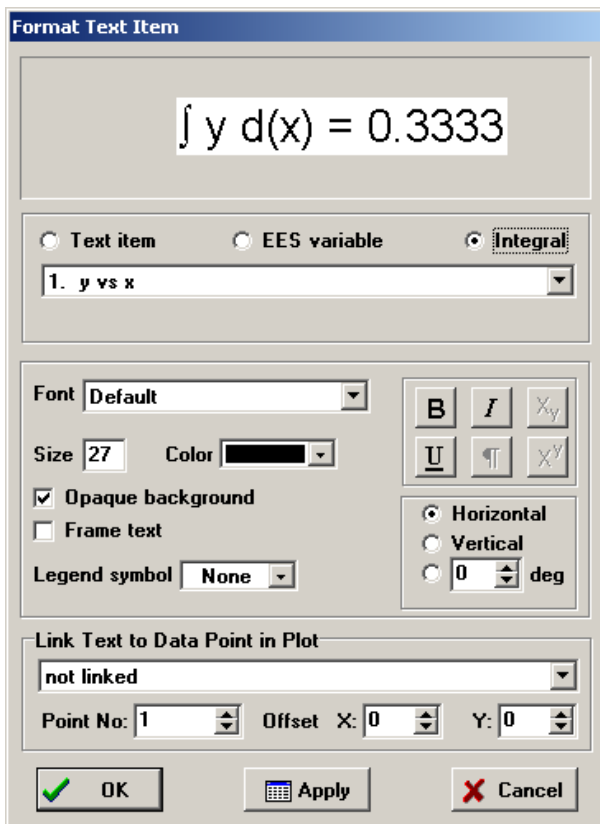


	1	2
	x	y
Run 1	0	0
Run 2	0.1	0.01
Run 3	0.2	0.04
Run 4	0.3	0.09
Run 5	0.4	0.16
Run 6	0.5	0.25
Run 7	0.6	0.36
Run 8	0.7	0.49
Run 9	0.8	0.64
Run 10	0.9	0.81

Use the New Plot Window (X-Y Plot) command in the Plots menu to plot y vs x.



Now suppose you want to know the value of  $\int y dx$ , which is the area under the line that has just been plotted. Click the Add text button (showing abc) on the plot toolbar and then click the Integral button in the dialog window, as shown. The value of the integral will appear in the dialog window. Click the OK button to place this integral on the plot window.



The integral will automatically update if the plot is changed. The plot will automatically change if the automatic update option is selected in the Modify Plot dialog window. Right-click on the plot and check this option. Now you can return to the Equations window and change the equation to be  $y=x^3$ . Solve the Parametric table. When you view the plot window, both the plot line and the integral will be updated.

### The \$Constant Directive and Array Notation

Take a look at this short example program that uses a function called SumSquares.

```
$Constant N#=5
function SumSquares(A[1..N#])
  SumSquares=0
  i=0
  repeat
    i=i+1
    SumSquares=SumSquares+A[i]^2
  until (i>=N#)
end
```

```
A[1..N#]=[1,2,3,4,5]
S=SumSquares(A[1..N#])
```

We wish to pass an array A to the function with a variable number of elements. Normally, EES would not like this since it compiles the equations ahead of time. However, we can specify the maximum number of elements with a \$Constant directive, which then causes N# to be known in the function and the main program. It is, in effect, a global variable and it can be used with the array notation to pass information to functions. Note also that values can be loaded into an array with the shorthand notation of  $A[1..N#]=[1,2,3,4,5]$

### ***HEAT TRANSFER Textbook***

The Heat Transfer textbook by G.F. Nellis and S.A. Klein was published in December, 2008 by Cambridge University Press. See <http://www.cambridge.org/nellisandklein> for information. This is the first textbook that directly integrates EES and other programs such as MATLAB and Maple with the engineering content. The thrust of the book is to show how real-world heat transfer problems can be solved. Many detailed EES example problems are provided that solve a variety of heat transfer problems from state to finish. In addition to demonstrating heat transfer principles, the examples illustrate many capabilities and best practices for using EES. The heat transfer libraries that are now provided with EES were developed in conjunction with this textbook.