FC F-Chart Software

EESy Solutions

Engineering Equation Solver Newsletter

Inside this issue:

Welcome

This is the 32nd issue of EESy Solutions, a newsletter that provides news, tips, and other updates for users of the Engineering Equation Solver software. This issue provides an overview of several interesting, new features of EES as well as a discussion of changes to the Academic License of EES.

EES has been commercially available for more than 25 years. If you have missed any of the previous issues of EESy Solutions, they can be downloaded from www.fchart.com.

The Variable Info Palette

The Equations Window now provides a Variable Information Palette in a pane to the right of the Equations Window. The palette provides a list of the variables that are in use in the EES program in alphabetical order as well as their units. The width of the palette can be adjusted by dragging the splitter control between the editor window and palette to the desired position; the palette can be hidden by dragging the splitter completely to the right.
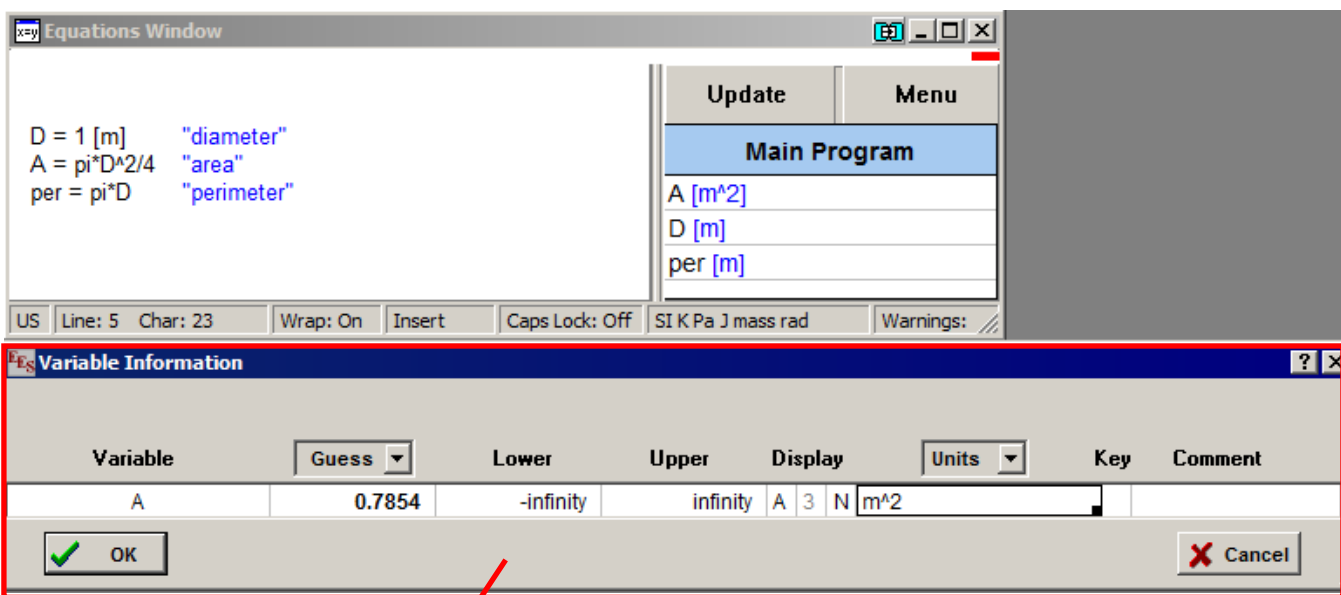
Variable Information Palette
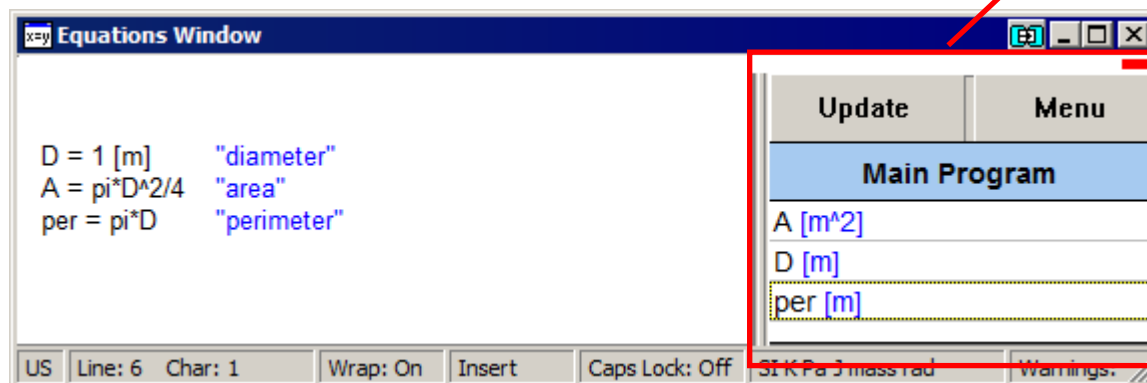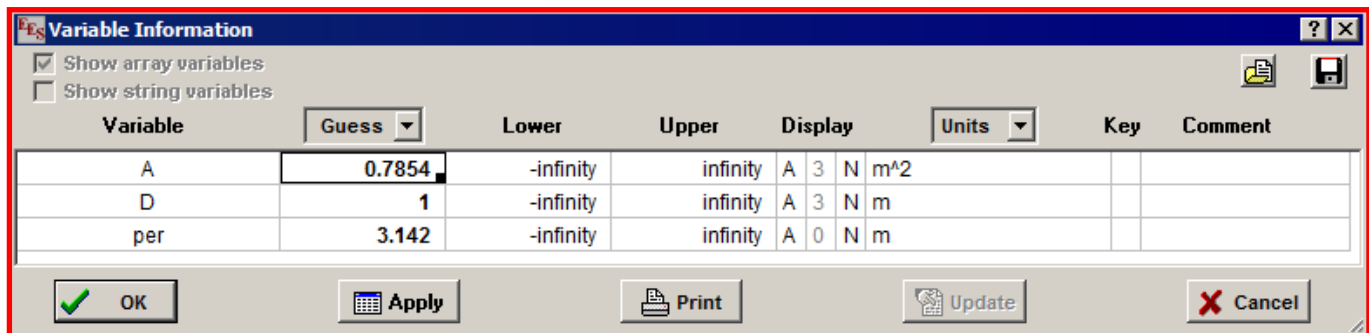
The Variable Information Palette

The list of variables in the palette is automatically updated whenever the equations are processed, e.g., when the Check/Format or Solve command is issued, Clicking on the Update button also causes the palette to update so that it reflects the most recent changes made to the Equations Window.

One purpose of the Variable Information Palette is to make it easier to change variable information. Clicking on a variable brings up a reduced version of the Variable Information Window containing only the selected variable.   The guess value, limits, units, format, and other information can be set in this window. Array variables, e.g., x[2], will be displayed in the palette as the parent array, e.g., x[ ]. Changes made to the parent array will affect all of the variables in the array.

Variable Information Window including only the variable A

Right-clicking on the Update button causes the entire Variable Information menu to be displayed, allowing the user to quickly set the units of all of the variables.

Variable Information Window with all of the variables

The Variable Information Palette

In EES programs that have Functions, Procedures, Subprograms, or Modules in the Equations window selecting the Menu button will bring up a popup menu that allows a choice of the program unit.
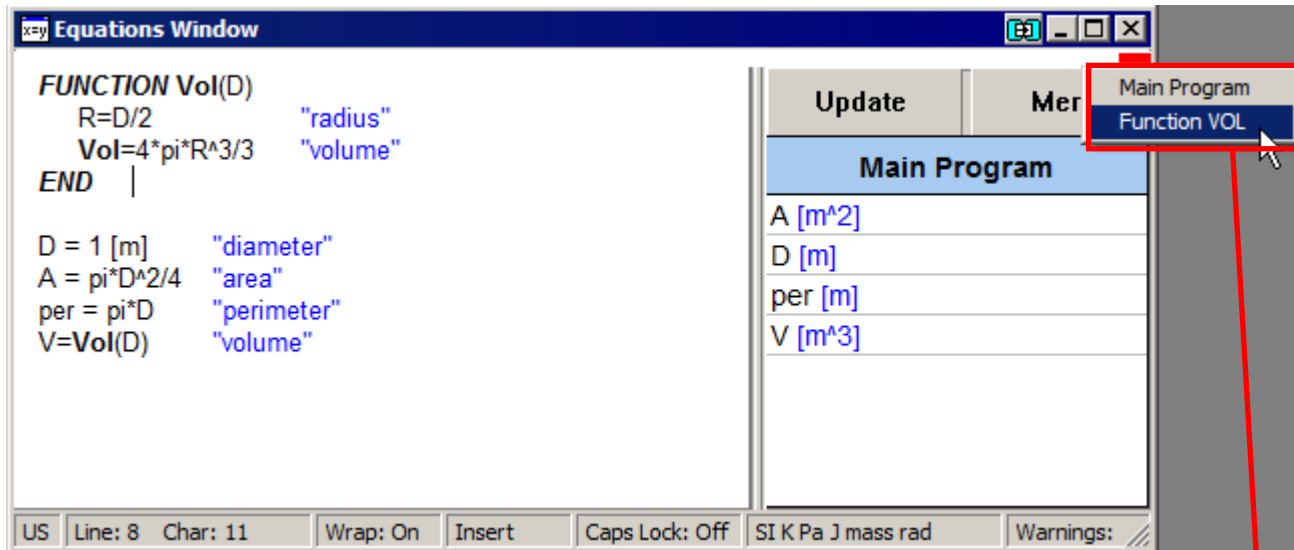
Popup menu allowing choice of program unit

Selecting a different program unit will update the variable list so that it only display the variables in the selected program unit..
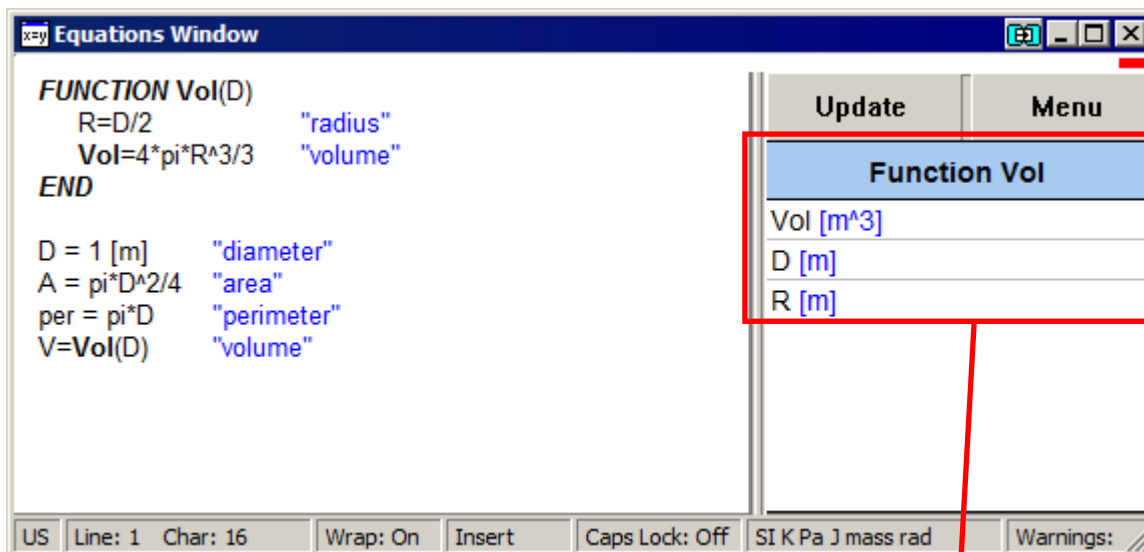
Variable list for the function Vol

Date and Time Format

EES has previously had a time format available for variables. Recently, a date format has been added. Dates and times are stored internally as numbers and therefore they can be plotted intelligently, just like other numbers.   EES stores dates as the number of days that have passed since December 30 of 1899 which is consistent with how other programs, such as Excel, store dates. Therefore, dates can be copied from other programs and pasted into an EES Lookup Table (assuming that the column has been previously configured as having a date format).

Date	High Temp. (F)
1/1/17	36
1/2/17	38
1/3/17	34
1/4/17	11
1/5/17	7
1/6/17	4
1/7/17	13
1/8/17	17
1/9/17	29
1/10/17	43
1/11/17	32
1/12/17	21
1/13/17	13
1/14/17	27

Data in Excel

Table in EES with Date column formatted

	Date	High Temp [F]
Row 1	01/01/2017	36
Row 2	01/02/2017	38
Row 3	01/03/2017	34
Row 4	01/04/2017	11
Row 5	01/05/2017	7
Row 6	01/06/2017	4
Row 7	01/07/2017	13
Row 8	01/08/2017	17
Row 9	01/09/2017	29
Row 10	01/10/2017	43
Row 11	01/11/2017	32
Row 12	01/12/2017	21
Row 13	01/13/2017	13
Row 14	01/14/2017	27

Data in EES
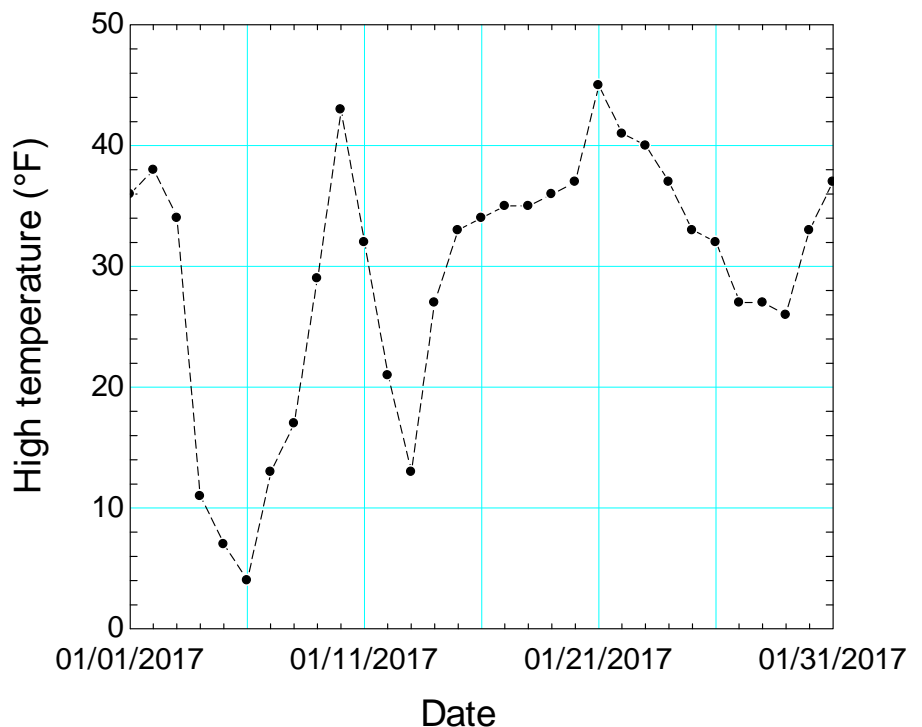
EES_REFPROP Interface

EES provides a large and growing library of high-accuracy property data. Fluids that have been added recently include R1216, RE245cb2, and RE245fa2. However, EES provides little property data for fluid mixtures. The REFPROP program the (also known as NIST Standard Reference Database 23) developed by the National Institute of Standards and Technology (NIST) provides property data for both pure fluids and mixtures. REFPROP is the most respected source of fluid property data. Version 9.1 provides property data for 121 pure fluids and mixtures of up to 20 components. It is possible to access the REFPROP's property data in EES using the EES_REFPROP interface. The interface is available at extra cost as listed in the webstore.

A new directive has been added to EES to make it easier to work with the EES_REFPROP interface. The EES_REFPROP interface internally requires inputs and outputs to use the SI unit system (with temperature in K and pressure in kPa) and it expresses all specific properties on a molar basis. Also, viscosity and conductivity are returned in μPa and W/m-K. The $ConvertEESREFPROPUnits directive in EES provides automatic unit conversion of the inputs provided to and the outputs from the EES_REFPROP interface. If a $ConvertEESREFPROPUnits On directive is placed in the Equations Window, EES will automatically convert all inputs to and outputs from the EES_REFPROP interface so that they are consistent with the unit system set in EES (either with the $UnitSystem directive or by selecting Unit System from the Options menu). In this way, the EES_REFPROP interface can work directly with English units. Specific properties, e.g., enthalpy, will be converted from a molar to a mass basis if EES is configured to display properties on a mass basis. The composition for mixtures can be provided as mole fractions or with mass fractions if a /mass flag is provided.

The following example illustrates the use of the $ConvertEESREFROP directive with English units.

```
$UnitSystem Eng F psia mass deg
$ConvertEESREFPROPUnits On /mass
$TabStops 3.5 in

Mixture$='R32+R134a'
mf=0.3                              "mass fraction of R32"
TF=80 [F]                          "temperature"
rho_m=80[lbm/ft^3]                 "density"


TD=13                              "mode for flash calculation, given temperature and density"
Call EES_REFPROP(Mixture$, TD,  TF, rho_m, mf :T,
P,rho,v,h,s,Q,Cv,Cp,w,Qm,x_R32,x_R134a,y_R32,y_R134a)
CRIT=100                           "mode for calculation of critical properties"
Call EES_REFPROP(Mixture$, CRIT, mf : Tc, Pc, rhoc)
ST=70                              "mode for calculation of surface tension"
Call EES_REFPROP(Mixture$, ST, TF, mf : sigma)
TRN=90                             "mode for calculation of transport properties"
Call EES_REFPROP(Mixture$, TRN, TF, rho, mf : Visc, Cond)
```

Note that the EES_REFPROP interface is needed only when property data for the fluid or mixture are not provided in the EES property library.

Additions to the Heat Transfer Library

The Heat Transfer Library was developed in order to automate reference material commonly used to solve Heat Transfer problems. These libraries include radiation view factors, convection correlations, conduction shape factors, minor losses and flow measurement, and others. The Heat Transfer Library can be accessed by selecting Function Information from the Options menu and then selecting Heat Transfer & Fluid Flow.

Recently, additional options have been added to the Convection Heat Transfer Library corresponding to impinging jets and longitudinal flow through a tube bundle (i.e., flow parallel to the tube axis). These are accessed within the Convection Library.

The Impinging Jet library is its own subheading in the drop down menu allowing the user to select between correlations for a single jet or various arrays of jets using the scroll bar. These correlations are presented in the Heat Exchanger Design Handbook, G.F. Hewitt, ed. Begell House, New York, (2008) from Section 2.5.6 by H. Martin.
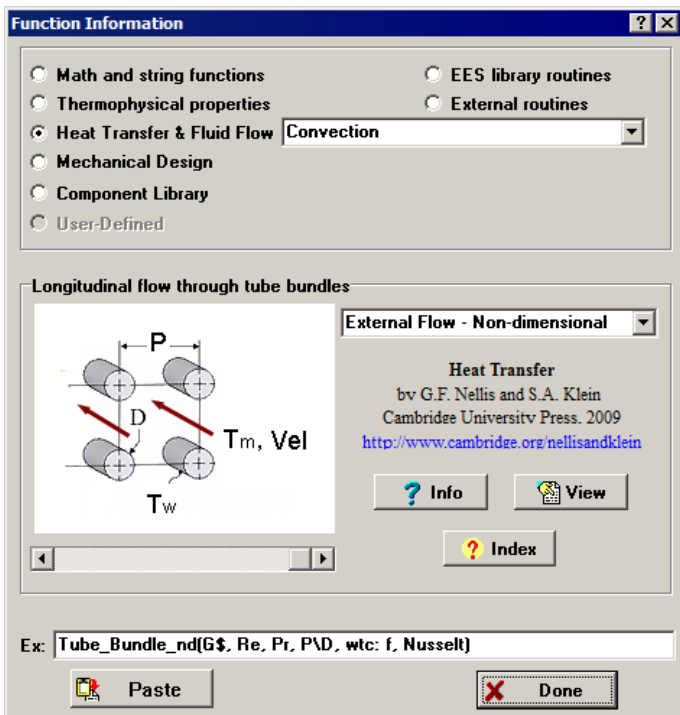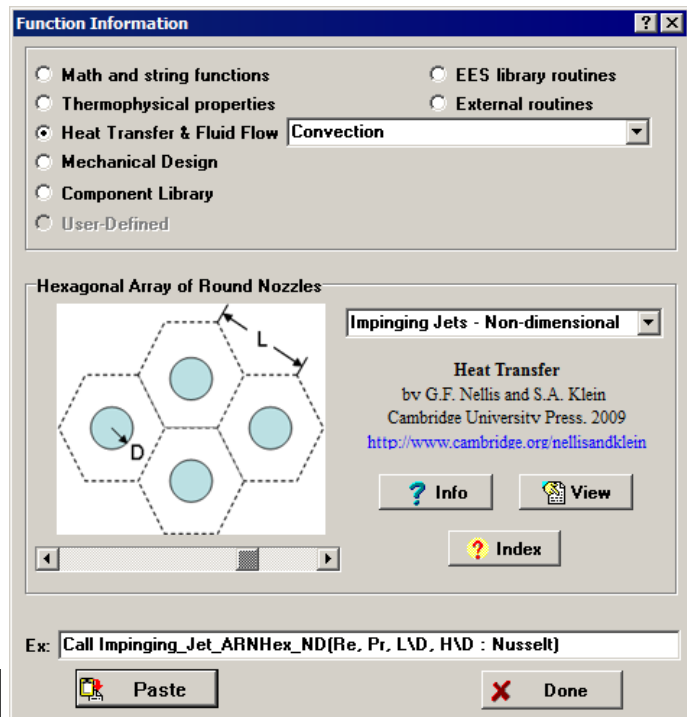
The Tube Bundle correlations are programmed as a procedure located in the External Flow library (either the dimensional or nondimensional version). Tube_Bundle_ND returns the friction factor and Nusselt number associated with flow along a bank of tubes that is either in a triangle or square pattern given the Reynolds number, Prandtl number, and dimensionless pitch. These correlations are presented in the Heat Exchanger Design Handbook Section 3.3.12 by J. Taborek (2008).

Changes to the Academic License

Starting March 27, 2017, the End User License Agreement (EULA) for Administrators of an Academic Site License of EES has changed. Academic versions of EES installed after this date are subject to the new revised agreement. The important change is shown in bold and repeated below:

Installation of the Product on individual's personal computers is not allowed. Furthermore, the setup and installation files must be protected so that they cannot be copied.

FOR ADMINISTRATORS OF AN ACADEMIC LICENSE

The terms in this section are applicable to you if you are the administrator, faculty member or IT support person for this Academic license.   An Academic License is provided directly from F-Chart Software for use iof EES (the "Product") in one academic department in a degree-granting institution. Subject to the terms and conditions of this License, F-Chart Software grants to you a nonexclusive, nontransferable and limited license to install the Product on machines owned by the institution that are accessible to students and faculty in the adopting department.   If two departments within a college or equivalent (for example Mechanical Engineering and Chemical Engineering) both obtain a license, then F-Chart Software will provide a license for the whole College of Engineering or equivalent. An Academic license is for instructional use only. A separate non-academic license is required if the Product is to be used for sponsored research tor other activities that are not part of a student's graduation requirement. The Product expires each September 1. However, in June or July of each year, F-Chart Software will notify the registered contact person by email with information on how to update for the following year (at no cost). The application and license files must be placed on a secure server that provides access to students and faculty in the adopting department(s), but restricts access to others. **Installation of the Product on individual's personal computers is not allowed. Furthermore, the setup and application files must be protected so that they cannot be copied.** One option that allows students to use the Product off campus is the XENAPP application. This application also allows users with Macintosh, Unix, or other non-Windows operating systems to use the Product. F-Chart Software places no restriction on the number of seats or users accessing the Product through your server, provided that these users are affiliated with the adopting department(s). Failure to meet the requirements of this license agreement will result in suspension or cancellation of the license.

Additional Changes to EES

- Thermodynamic and transport property information have been added for RE235fa2, RE245cb2, and R1216.

- Date and Time format for variables based on the first letter of the variable name can be set with the default Information menu in the Options menu

- The fluid Steam_IAPWS uses the "New International Formulation for the Thermal Conductivity of H2O" by Huber, M. et al., J. Phys. Chem. Data, Vol. 41, 033102, (2012).

- The Store Parametric Table and Retrieve Parametric Table commands in the Tables menu can write and read both .txt and .par (binary) files. These commands are useful to transfer a Parametric Table to a different EES file or another program like Excel.

- The equation of state for HFE7100 has been removed because it was found to not provide accurate property information for low temperature liquid. In its place, an incompressible fluid file for liquid HFE7100 has been provided that includes density, viscosity, thermal conductivity, vapor pressure, and specific heat for HFE7100 liquid between –100°C and 100°C

- The $Include directive will accept a previously-defined string variable, e.g., F$, in place of the file name.

- The Find command can be used to locate EES variables in the Diagram Window or the names of Diagram Window items. The Find dialog also provides Find Next and Find Last information.

- The Frame Text option for input variables in the Diagram Window controls the visibility of the rectangle that surrounds the input value.

- Normally error messages are quietly written to the Macro log file rather than shown on the screen. The ShowWindow ErrorMessages command causes these messages to displayed in the normal way.

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Instant Update and Technical 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. Even though the program has become very robust and stable, there have been about 80 versions of EES released since the last EESy Solutions was distributed in October, 2016.

Any user who has a current subscription to our Instant Update and Technical Service (IUTS) can download the latest version. All new licenses of EES are provided with one year of IUTS. The cost to renew IUTS 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. Use the License Information command in the Help menu to see when your IUTS expires. Contact F-Chart Software if you wish to re-subscribe to IUTS.