GUI GUIDE – VERSION 34.3 ADDENDUMS

This document contains addendums to the 34.2 documentation. It is not intended to replace the supplied 34.2 documentation but to enhance it. It documents functionality that was added in 34.3.

Chapter 11 – Power Flow Solutions - Robust Solution

Introduction

There are several strategies employed by power systems engineers to achieve a successful solution. The Robust Solution applies these strategies programmatically, attempting to find a set of solution options and a sequence of actions that result in a successful solution. Various permutations of the following strategies are used in the Robust Solution:

Attempting Various Solution Methods

Various Newton and Gauss solution methods are attempted in combination with the other strategies. This includes an attempt to solve with a Modified Gauss-Seidel for a certain number of iterations, followed by a Newton solution.

Smart Flat Starting

Two initial voltage vector conditions are attempted in combination with the other options: The result stored in the current case, and a flat start initialization that sets the bus voltage magnitudes and voltage angles based on a pseudo-dc solution.

Bus Voltage and Angle Smoothing

Bus voltage magnitude and angle smoothing is applied at high-mismatch buses. The threshold MVA mismatch to apply this smoothing is adjustable.

Slowing the Solution Acceleration and Increasing Iterations

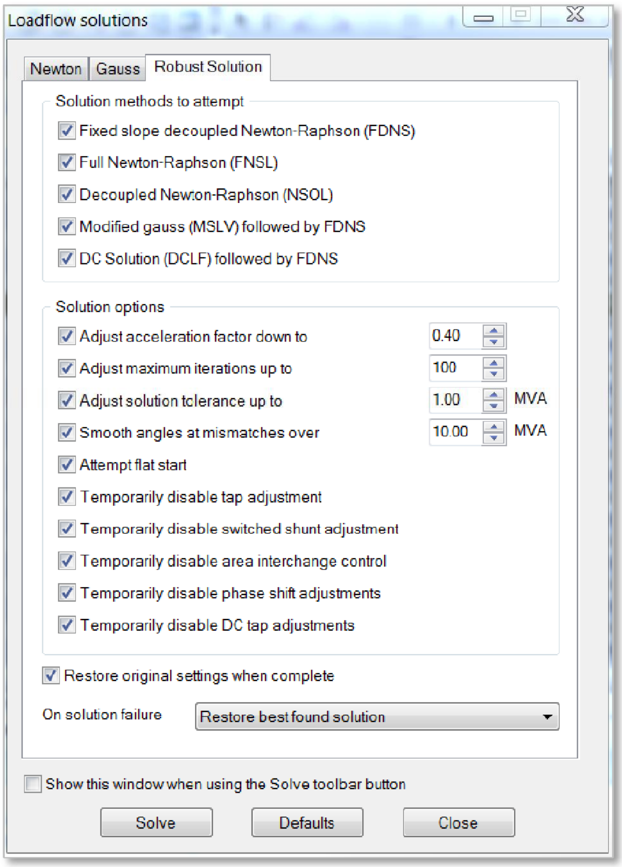
The acceleration factors for the Newton solutions are relaxed down to a settable minimum value, and the maximum number of iterations is increased up to a settable maximum value. This can significantly increase the time required to achieve a solution, but it can allow an ill-conditioned case to solve that would not with typical settings.

Phasing in Controls

All controls (Machine MVAR, Switch Shunts, Tap Settings, etc.) can be relaxed and phased in one at a time in a strategic order.

Robust Solution Dialog

The Robust Solution is available in the GUI via **Power Flow > Solution**, and selecting the **Robust Solution** Tab. The below table describes the Robust Solution options.



Robust Solution Option	Description
Solution Methods to Attempt	
Fixed-slope decoupled Newton-Raphson (FDNS)	Attempt solution using the Fixed-Slope Decoupled Newton-Raphson method
Full Newton-Raphson (FNSL)	Attempt solution using the Full Newton-Raphson solution method
Decoupled Newton-Rapshon (NSOL)	Attempt solution using the Fast Decoupled Newton-Raphson method
Modified Gauss (MSLV) followed by FDNS	Attempt solution using the Modified Gauss-Seidel method followed by the Fixed-Slope decoupled Newton-Raphson method
DC Solution (DCLF) followed by FDNS	Attempt solution using the DC load flow method followed by the Fixed-Slope decoupled Newton-Raphson method
Solution Options	
Adjust acceleration factor down to	Adjust Newton solution acceleration factors down to the minimum specified value
Adjust maximum iterations up to	Adjust the iteration limit of the solution up to the maximum specified value
Adjust solution tolerance up to	Adjust the system MVA mismatch tolerance up to the specified maximum value
Smooth angles at mismatches over	Use angle/voltage magnitude smoothing for high buses with MVA mismatches greater than the specified value
Attempt flat start	Try flat start initialization in addition to trying

	original initial condition
Temporarily disable tap adjustment	Turn off and phase back in transformer taps adjustment controls
Temporarily disable switched shunt adjustment	Turn off and phase back in switch shunt adjustment controls
Temporarily disable area interchange control	Turn off and phase back in area interchange adjustment controls
Temporarily disable phase shift adjustments	Turn off and phase back in phase shifter adjustment controls
Temporarily disable DC tap adjustments	Turn off and phase back in DC taps adjustment controls
Other Settings	
Restore original settings when complete	Reset the solution settings back to the pre-solution settings
On solution failure	Options for what to do following a failure to meet convergence tolerance: 1. Restore best found solution 2. Restore original solution 3. Keep final failed solution

Python API

The Robust Solution is available programmatically via the robosolve module. The rsol function

Example Script

```
import psse34
import robosolve
result, steps, settings = robosolve.rsol(case="mydir/mycase.raw")
```

Keyword Arguments Recognized by rsol Function

Argument Keyword	Description
case	Powerflow case path (sav or raw) (default None)
try_fdns	Try fixed-slope decoupled method (default True)
try_fnsl	Try full Newton solution method (default True)
try_nsol	Try fast-decoupled method (default True)
try_mslv	Try Guass-Seidel method (default True)
try_dclf	Try DC load flow method (default True)
try_flat	Try flat start solution (default True)
smoothing	Use angle/voltage magnitude smoothing
smoothing_msm	MVA Mismatch for angle/voltage smoothing (default 10.0)
adj_accel	Adjust acceleration factor (default True)
min_accel	Minmum acceleration factor (default 0.4)
adj_tol	Adjust solution tolerance (default True)
max_tol	Maximum iteration limit (default 2.0 MVA)
adj_iter	Adjust solution iteration limit (default True)
max_iter	Maximum iteration limit (default 200)
adj_actap	Adjust transformer taps (default True)

adj_dctap	Adjust DC taps (default True)
adj_swshnt	Adjust switch shunt control (default True)
adj_phshft	Adjust phase shifter control (default True)
adj_areain	Adjust area interchange control (default True)
restore_params	Resore original parameters (default True)
restore_case	Restore original case on failure (default False)
use_best	Revert to best known settings on failure (default True)

Returned Values from rsol Function

Argument Keyword	Description
result	The PSS®E solution result code (matches return value of psspy.solved())
steps	A list of strings describing each step the solver uses in the solution attempt (useful for spitting out into progress or log)
settings	A dictionary of the settings that obtained the best found solution (keys correspond to the keys used for getting and setting params via psspy.prmint(key) and psspy.solution_parameters_4()). Keys for this dictionary are listed in the table Fields in settings Dictionary.

Fields in settings Dictionary returns by rsol function

Keyword	Description
method	Solution method (fnsl, fdns, solv, mslv, or dclf)
actaps	Transformer taps
areain	Area interchange
phshft	Adjust phase shift
dctaps	Adjust DC taps
swshnt	Adjust switched shunts
flatst	flat start
varlim	Var limit
nondiv	Non-divergent solution
itmx	Gauss-Seidel maximum number of iterations.
itmxn	Newton-Raphson maximum number of iterations.
itmxty	TYSL maximum number of iterations.
mxtpss	maximum number of tap and/or switched shunt adjustment cycles that change
mxswim	maximum number of induction machine state switching during a power flow
accp	Gauss-Seidel real component acceleration factor.
accq	Gauss-Seidel imaginary component acceleration factor.
accm	special MSLV acceleration factor.
tol	Gauss-Seidel convergence tolerance.
accn	Newton-Raphson acceleration factor.
toln	Newton-Raphson mismatch convergence tolerance.
accty	TYSL acceleration factor.
tolty	TYSL convergence tolerance.
blowup	blown-up voltage change threshold.
pqbrak	constant power load characteristic breakpoint.
thrshz	zero impedance line threshold.
adjthr	automatic adjustment threshold tolerance.
acctap	tap movement deceleration factor.

taplim	maximum tap change per adjustment cycle.
dvlim	largest | (delta V) / |V| | for Newton-Raphson solutions.
ndvfct	non-divergent required improvement factor.
vctolq	Newton-Raphson controlled bus reactive power mismatch convergence tolera
vctolv	Newton-Raphson controlled bus voltage error convergence tolerance.
swvbnd	percent of voltage controlling band mode switched shunts to be adjusted.

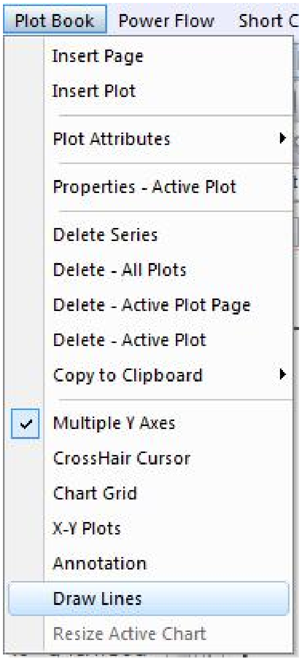
Chapter 22 – Dynamic Simulation PlotPackage

Annotation and Lines

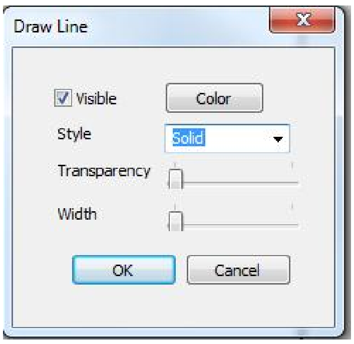
Annotations and Lines can be added interactively to charts and are useful when printing reports. Display attributes of both annotation text and lines can be customized using the following steps:

Lines

1. To display lines that connect pieces of annotation text with points on a chart, select “Draw Line” from the PlotBook menu to customize line drawing attributes.



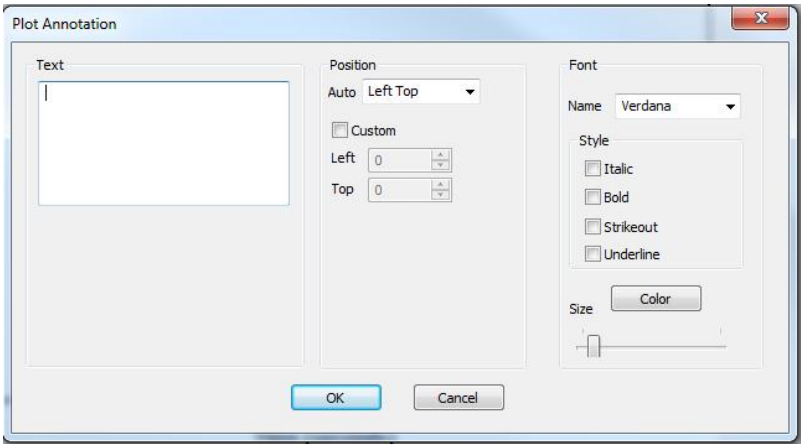
2. On the Draw Line dialog, the user can customize the color, transparency and width of the lines displayed.



3. Once the lines have been set to visible, the user can add them to the chart interactively by using the left mouse button. The lines can only be added after at least one annotation has been placed on the chart.

Annotation

1. To add annotation to a chart, select it from the PlotBook menu shown above. The Plot Annotation dialog below is displayed.



2. Add the required notes in the Text box.

3. The text can be placed on the chart in one of the four corners of the display area by selecting the required corner from the Automatic drop down list. If the user wishes to customize the position, check the Custom box and enter the Left and Top positions.

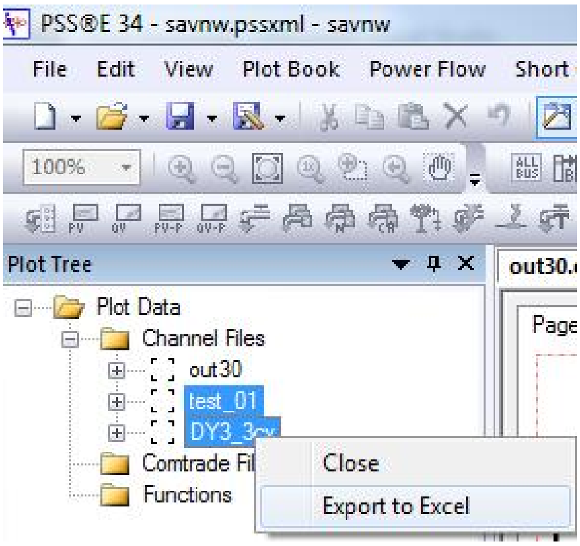
4. Font and style as well as color and size are also customized from this dialog. Once these attributes are set, they will apply to all annotations placed anywhere in the PlotBook.

Export to Excel

The user can now select any combination of files and channels to export to excel. Open the required channels in the Plot Tree and expand the channel nodes so the filenames and or necessary channel names are visible. There are 3 possible options.

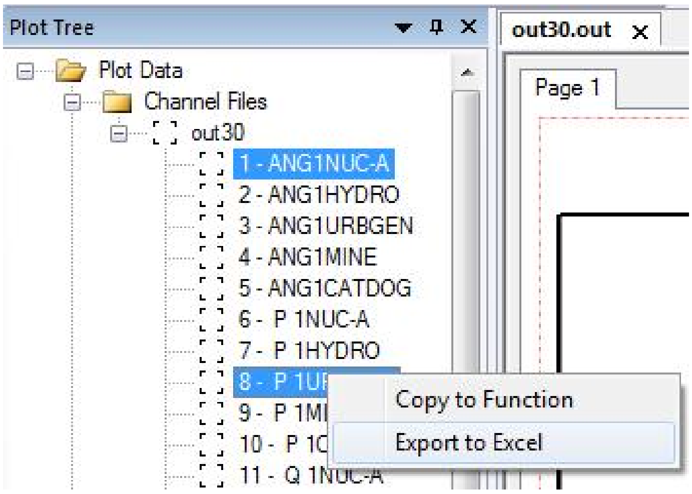
Export entire contents of 1 or more channel files

Select only the required filenames in the Plot Tree using Ctrl-Select. Then right click and choose Export to Excel from the popup menu. All the channels from each file selected will be exported. All data from a single channel file will be placed on a separate tab within the excel file.



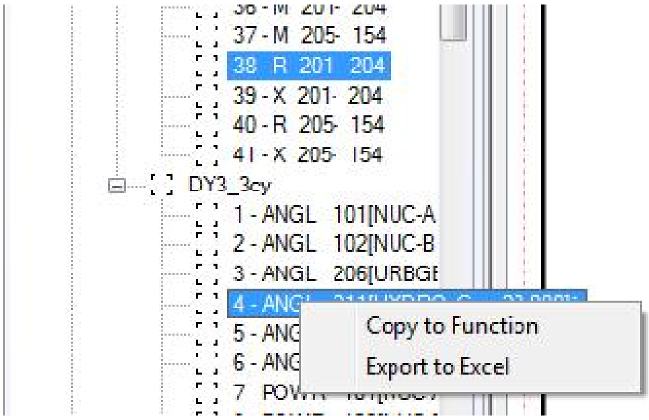
Export selected channels from a single file

Expand the nodes for the channel file. Then Ctrl-Select the required channels and choose Export to Excel from the popup menu.



Export select channels from multiple files

The procedure described above can also be used to export select channels from multiple files simultaneously. Make sure the required file nodes have been expanded so the necessary channels are visible to select.

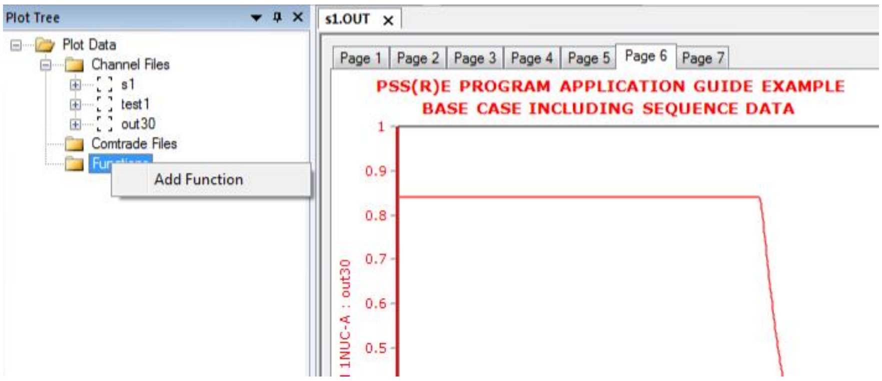


Once the user selects Export To Excel, a filename can be entered. All of the above combinations can be recorded and apply to both .out and .outx files. Data from a particular channel file is placed within a tab with the same name as the channel file.

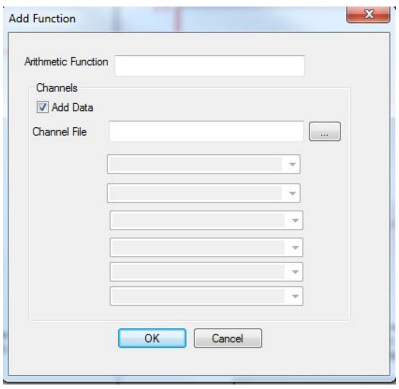
Functions

To display the Add Function Dialog, use the following steps:

1. Right click the functions node on the Plot Tree. Select Add Function.



2. The Add Function Dialog (see below) is used to enter an arithmetic function expression, select a channel file and associate channel data with each of the variables in the arithmetic function. If you do not wish to associate channel data with a variable immediately, uncheck the Add Data box.

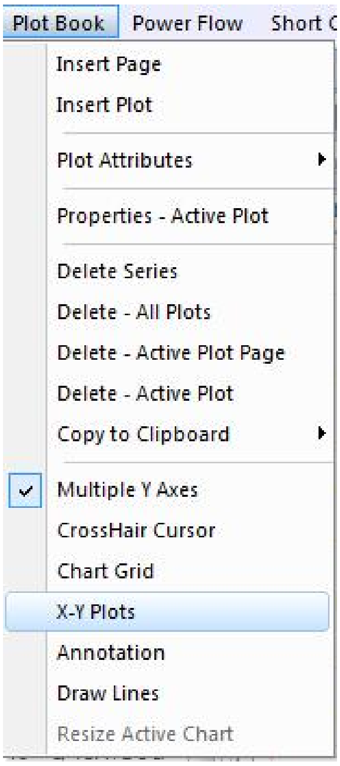


3. Once an expression has been entered and a channel file selected, each of the variables in the function can be assigned channel data by using the drop down list of channel names.

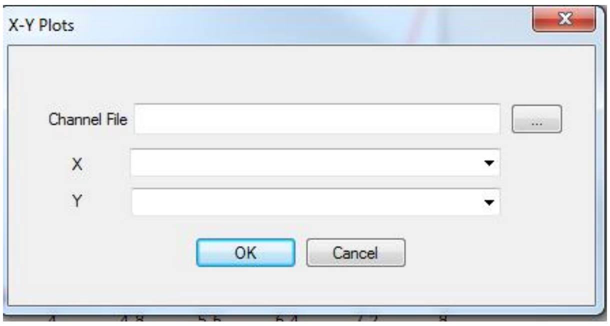
X-Y Plots

In addition to time plots, it is now possible to incorporate X-Y plots into the PlotBook.

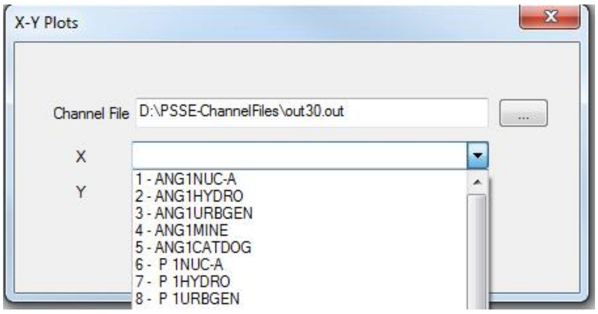
1. To use the X-Y plots functionality, select the option from the PlotBook Menu



2. The X-Y Plots dialog allows the user to select a channel file and associate channels from that file for the X and Y axes.



3. Once the channel file is selected, a drop down list appears allowing the user to select any channel from that file for the X and Y axes respectively.

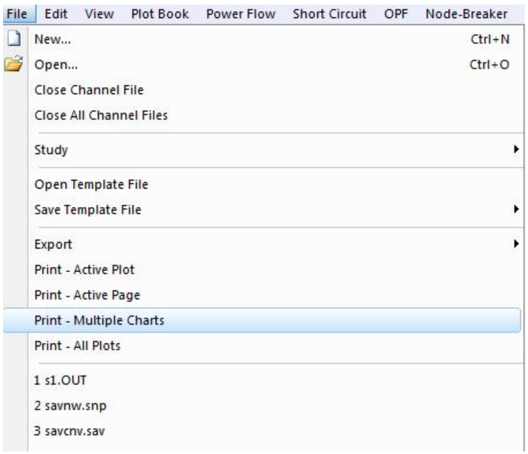


4. The X-Y plot is then displayed on a new page within the PlotBook. This activity can also be recorded.

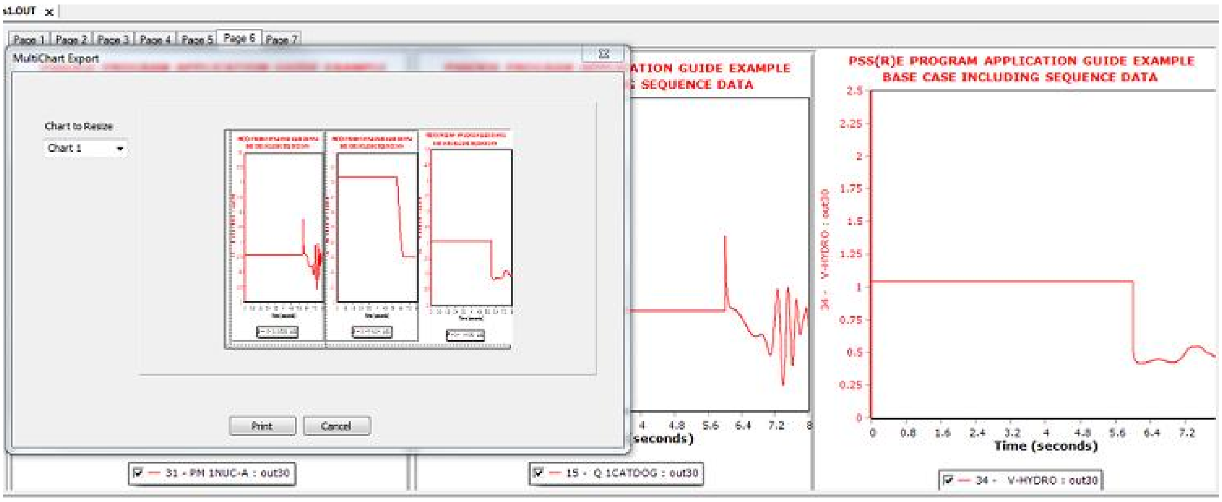
Multiple Plots to a single PDF

Multiple plots can be printed to a single PDF or hardcopy output using the following steps:

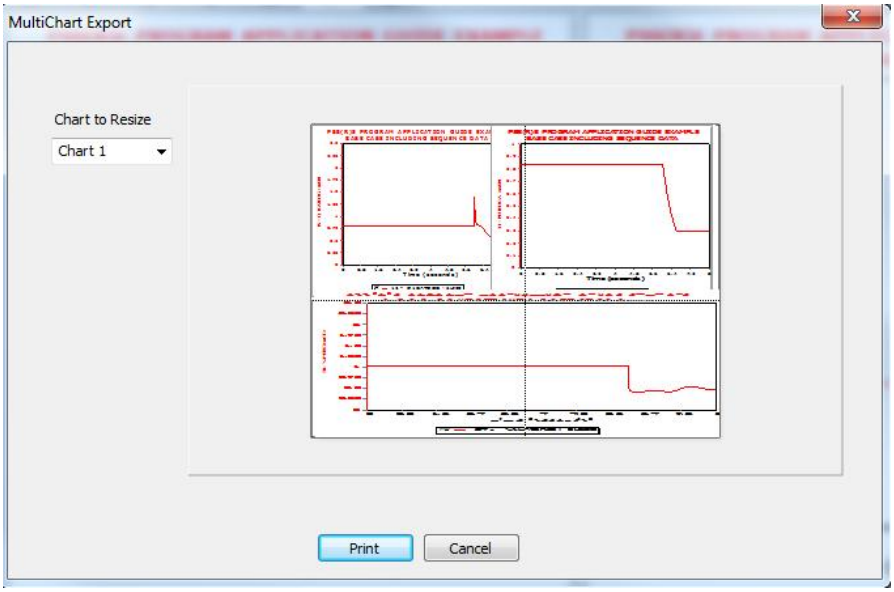
1. From the File menu, select Print – Multiple Charts.



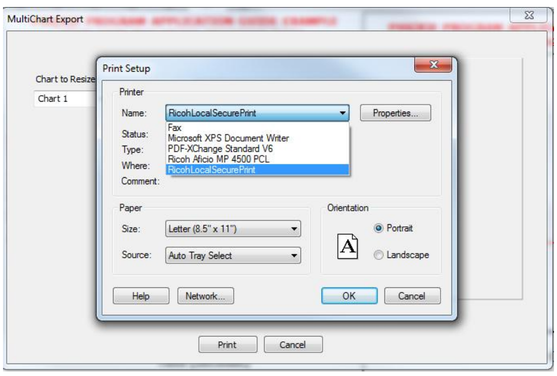
2. All the plots on a single page will be displayed in the MultiChart Print Dialog. Select a chart to resize from the dropdown list. A dotted line marking the horizontal and vertical extents of the selected chart will be visible. Drag these extents up or down to resize and position the chart on the page relative to the other charts.



3. In the example above, Charts 1 and 2 have been resized to fit within the top half of the page and Chart 3 sits across the bottom of the page.



4. Select ‘Print’ to print to a PDF or any printer on your network.



Line Properties (Lineprop) Integration with PSSE

Users can now launch the Line Properties utility from within the PSSE application, rather than having to use each as a standalone program. Results from the Lineprop application can now immediately be updated in PSSE instead of needed manual interaction.

Launching the Lineprop utility

The following are steps required to launch Lineprop from within the PSSE application. Refer to Figure 1 for visual representation.

1. A valid study must be loaded in the PSSE application prior to launching Lineprop
2. Select the “Branch” tab for the current study
3. Right clicking in the spreadsheet view displays a new option: “Calculate line impedances…”
4. Clicking “Calculate line impedances…” will launch the Line prop utility.

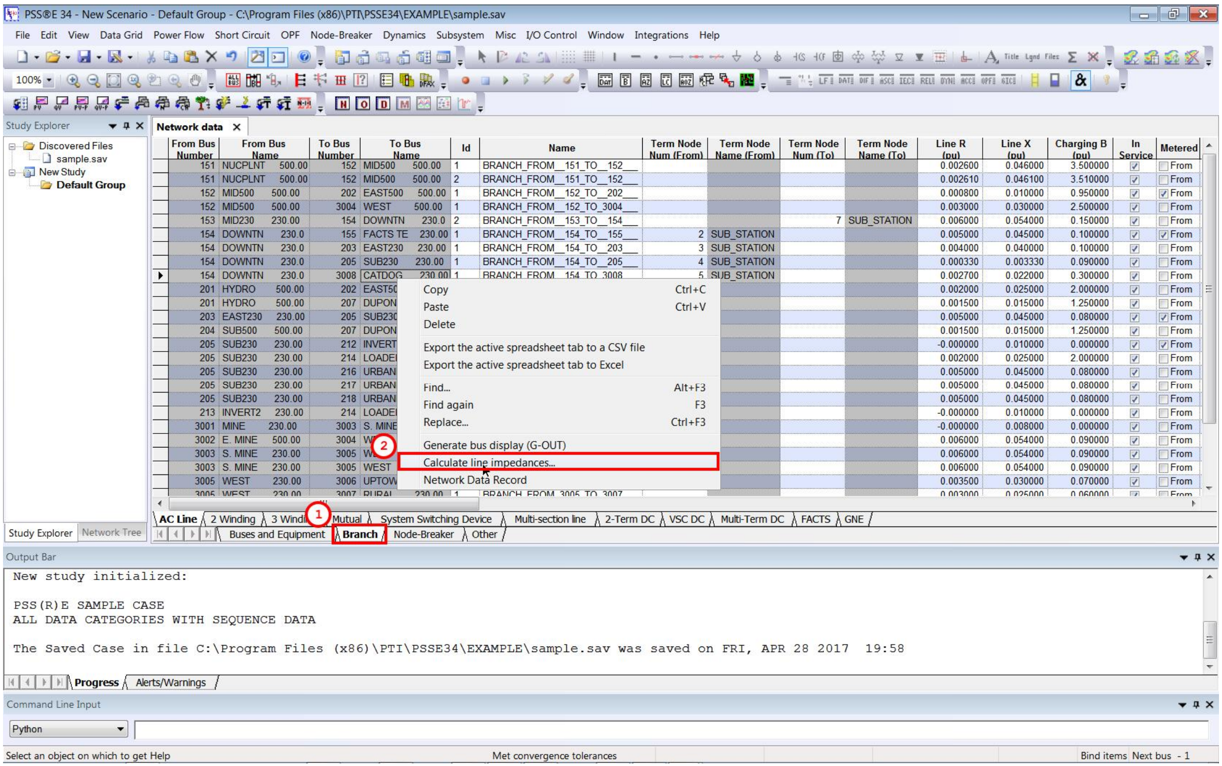


Figure 1 – Launching Lineprop from PSSE

Using the Lineprop utility

Functionality from the standalone Line Properties utility remains the same. There have been several additions to assist in transferring results calculations between Lineprop and PSSE.

The initial view, after opening a corridor file, will look similar to figure 2:

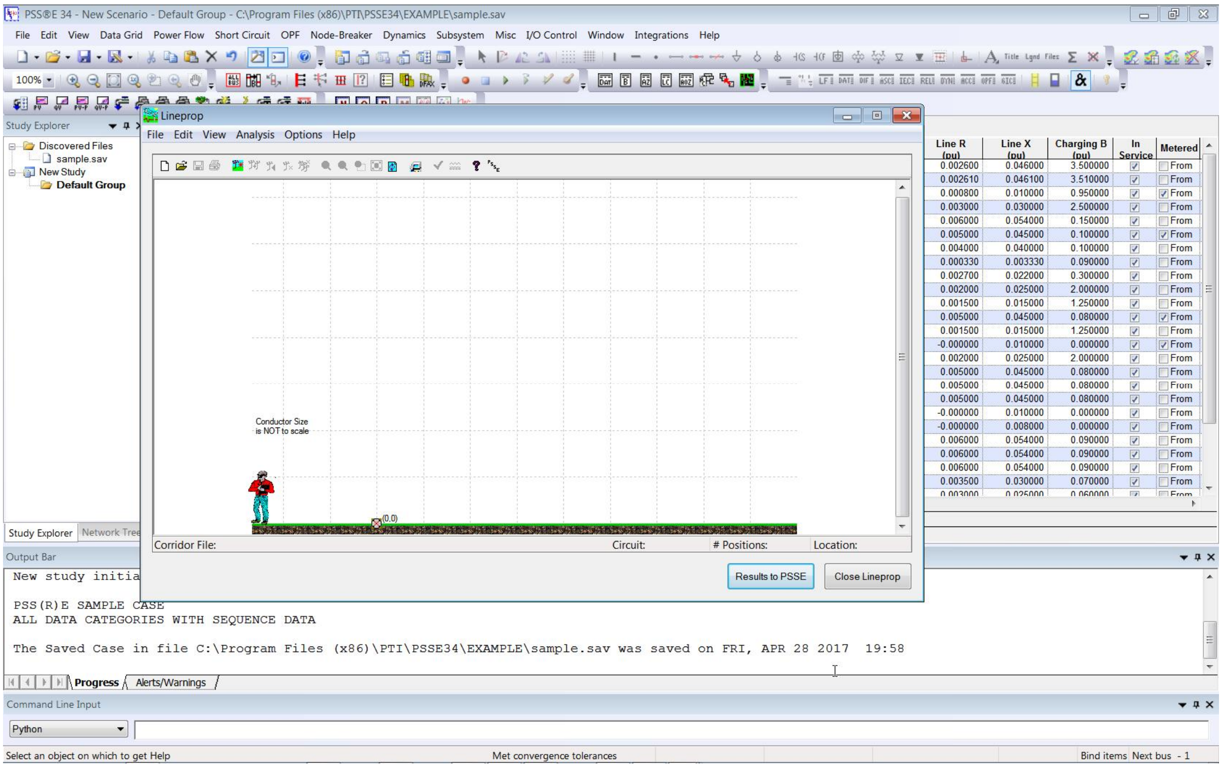


Figure 2 - Lineprop Application

Sending Results from Lineprop to PSSE

There are two methods of sending line impedance results from Lineprop to PSSE.

Option 1:

1. A valid corridor file must exist and have the necessary options specified for impedance calculations
2. Clicking the “Results to PSSE” button will complete the following actions:
    a. Calculations for line impedances for the circuits provided in the corridor file
    b. Replicating the results on the “Branch” tab within PSSE, providing that the specified tobus, frombus, and circuit id values are valid per circuit (see Figure 5 for these new additions)
    c. If valid, results are automatically updated. Otherwise a message detailing the error will be displayed.

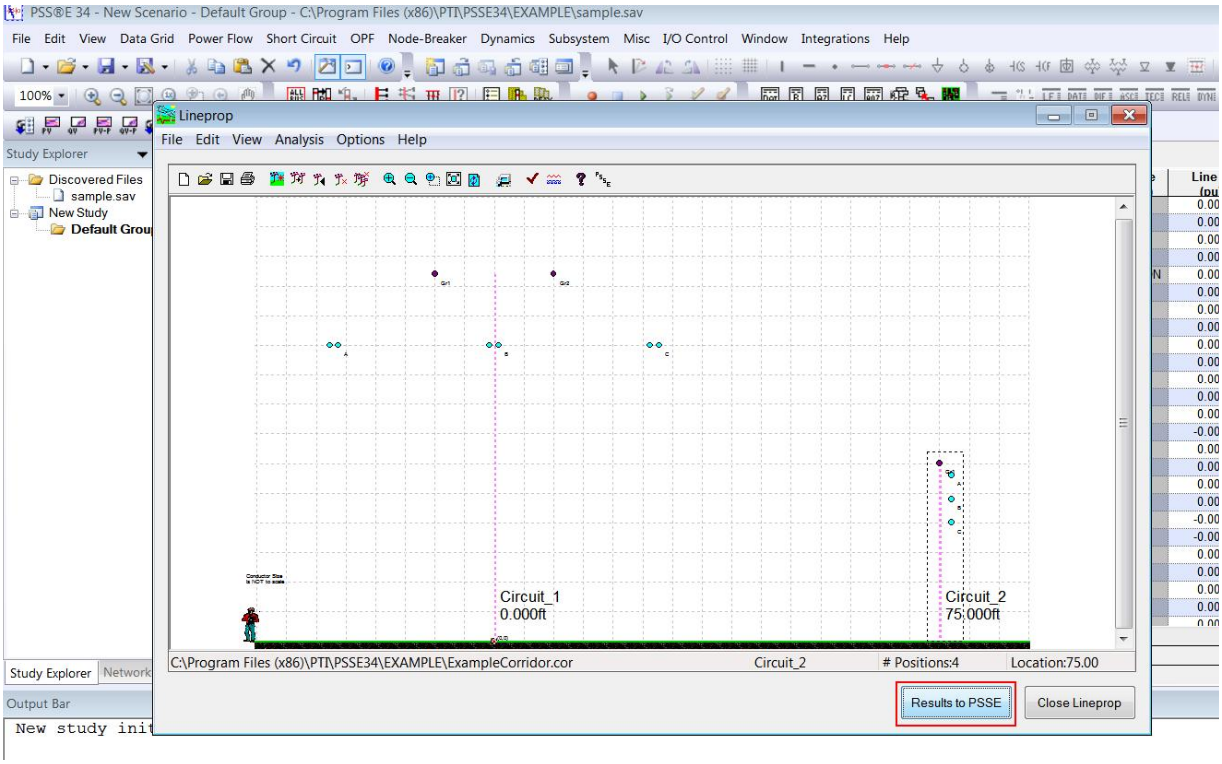


Figure 3 - Sending Results via Button

Option 2:

1. A valid corridor file must exist and have the necessary options specified for impedance calculations
2. Click the "Analysis" menubar option inside Lineprop
3. Clicking "Push Impedance Values to PSSE" will complete the following actions:
    a. Calculations for line impedances for the circuits provided in the corridor file
    b. Replicating the results on the "Branch" tab within PSSE, providing that the specified tobus, frombus, and circuit id values are valid per circuit
    c. If valid, results are automatically updated. Otherwise a message detailing the error will be displayed.

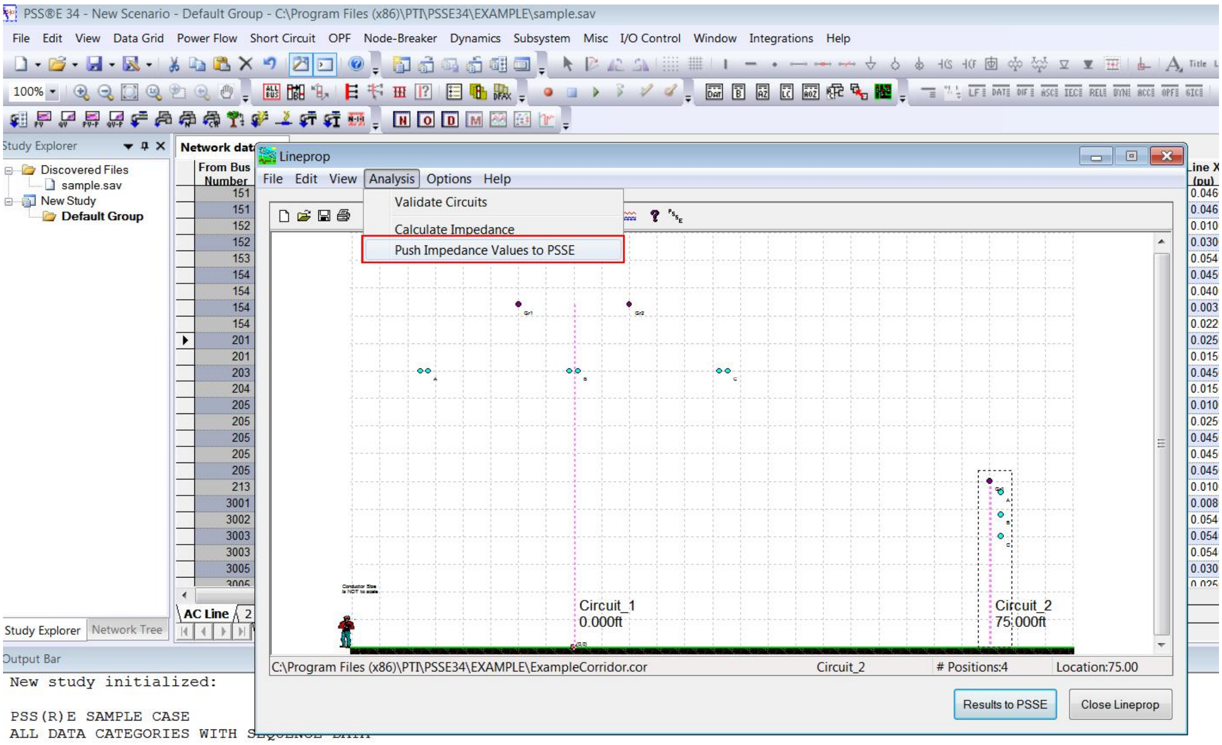


Figure 4 - Sending Results via Menu

Lineprop Additions:

There have been several additions to assist in transferring results calculations between Lineprop and PSSE.

Circuit Definitions

Each circuit should have defined values as shown in Figure 5. These values are used in determining which branch values to update, if applicable, when the user chooses to route results automatically to PSSE. Calculations can be done without these values, but results will not be routed to PSSE without manual intervention.

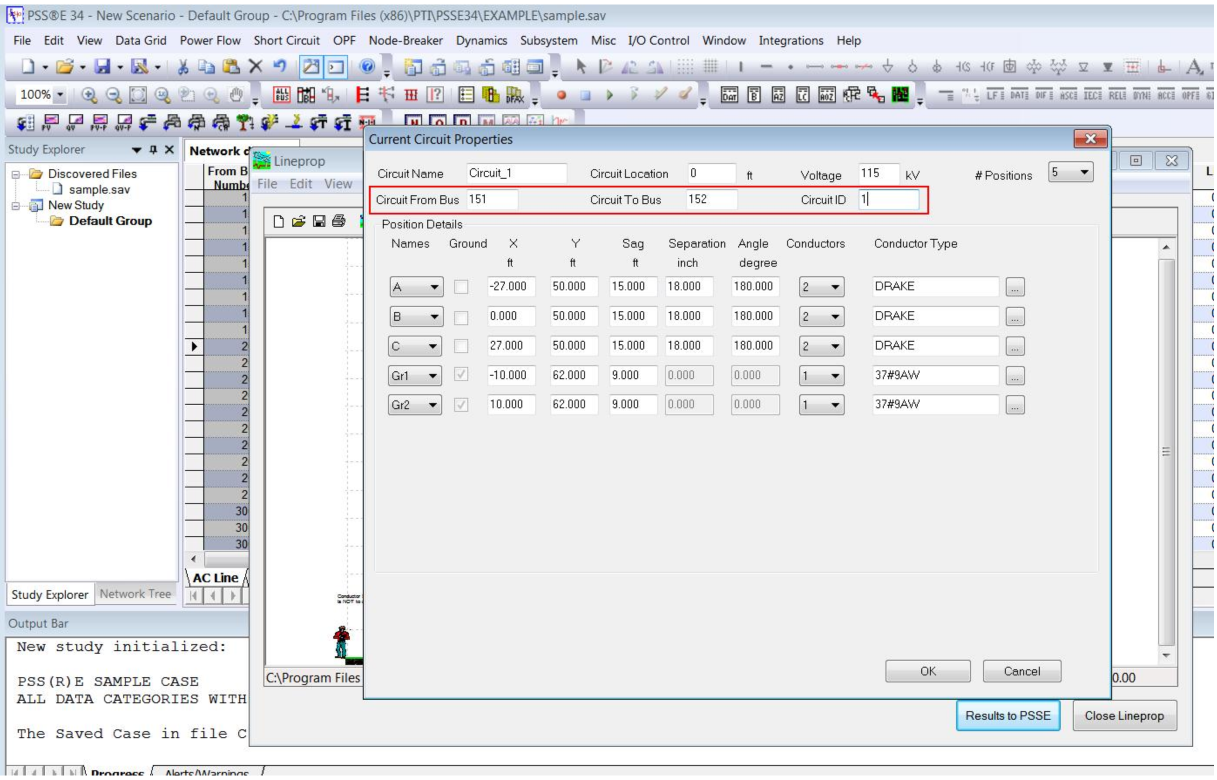


Figure 5 - Circuit Additions

PSSE Circuit Documentation

Functionality for documenting circuits for PSSE from inside Lineprop remains the same, but has been modified to include the circuit changes described above. The *.txt file created will now contain the defined Circuit From Bus, Circuit To Bus, and Circuit ID values, if applicable, to each circuit. Previously this would require manual editing prior to moving values into PSSE data files.