Revision of Lab Experiments

Power System Analysis Toolbox (PSAT)

Aim:

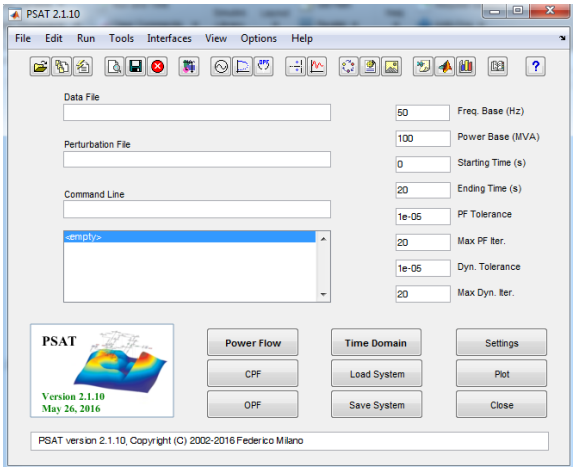
In this lab we will learn about how to use PSAT. In this lab we will give a simple introduction to get you "up and running" with the program.

PSAT:

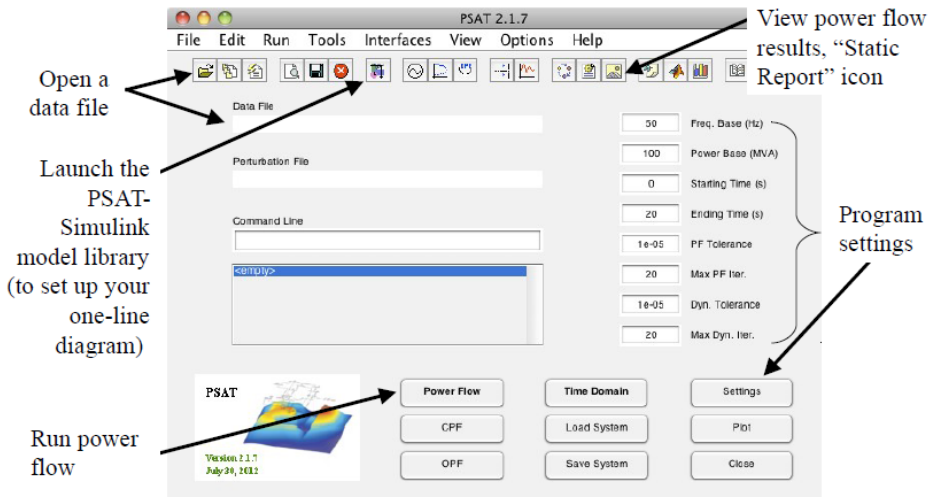
PSAT is an open source power system analysis toolbox for Matlab developed by Dr. Federico Milano. It can be used for power system analysis and control, learning, education and research.

Executing the PSAT in GUI (Graphical user interface) Mode:

Once PSAT has been installed type in the Matlab Command Window:
>> psat
After a splash window, the "Main GUI" will appear in your screen:



Options and settings you will be using:



Case Study and Data Preparation:

You should prepare your system data in tables for easy input into PSAT:

System Data:

Bus	V	P_g(KW)	Q_g(KVAR)	P_d(KW)	Q_d(KVAR)	Type
1	1.00	-	-	50	30.99	Slack
2	-	0	0	170	105.35	PQ
3	-	0	0	200	123.94	PQ
4	1.02	318	-	80	49.58	PV

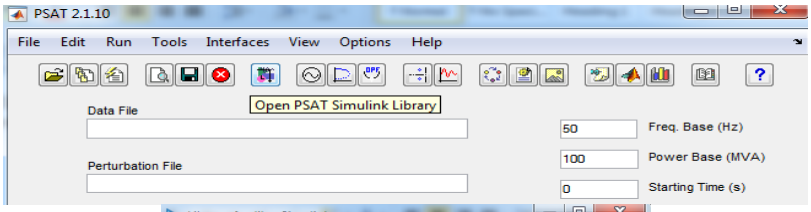
Line Data:

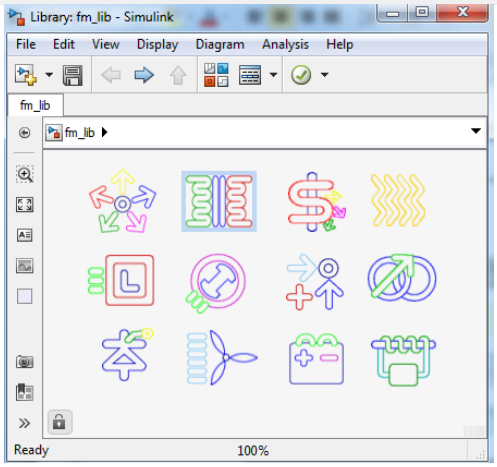
From Bus	To Bus	R(PU)	X(PU)	B(PU)
1	2	0.01008	0.0504	0.1025
1	3	0.00744	0.0342	0.0775
2	4	0.00744	0.0342	0.0775
3	4	0.01272	0.0636	0.1275

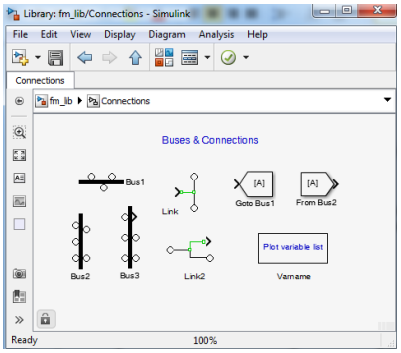
After you finish drawing your one-line diagram, you must save the file and load it to PSAT via the "Data File" field in the PSAT Main GUI. This will translate your Simulink diagram to a PSAT readable data file.

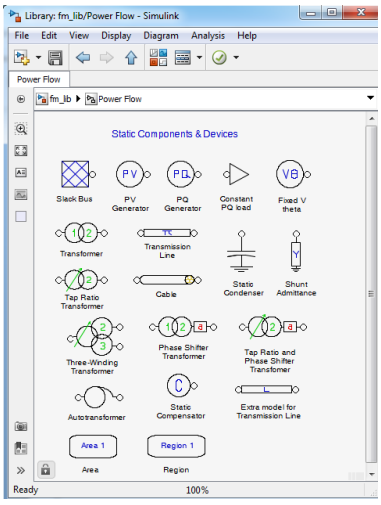
Using the Power Flow Components:

Click on the Simulink icon of the PSAT Main GUI. The Simulink model library will appear. You only need to use two of the sub libraries.





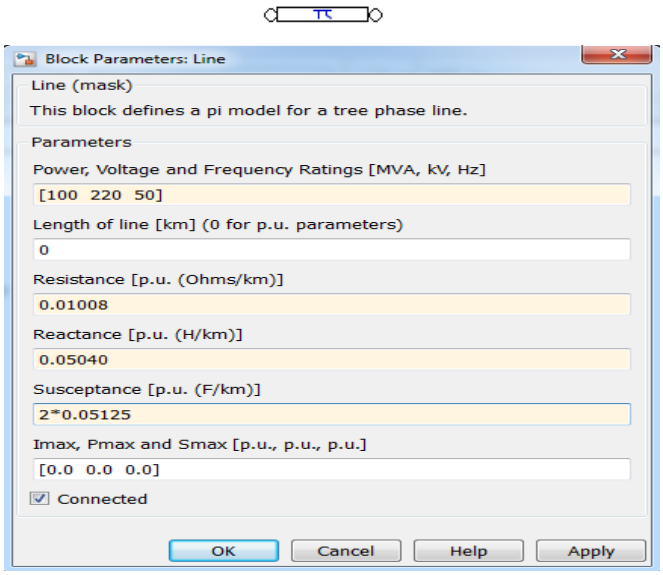




Drag and drop the components you need to use in a blank Simulink file.
Drag and drop the transmission model to a blank Simulink File. Double click on the component and introduce all the data.

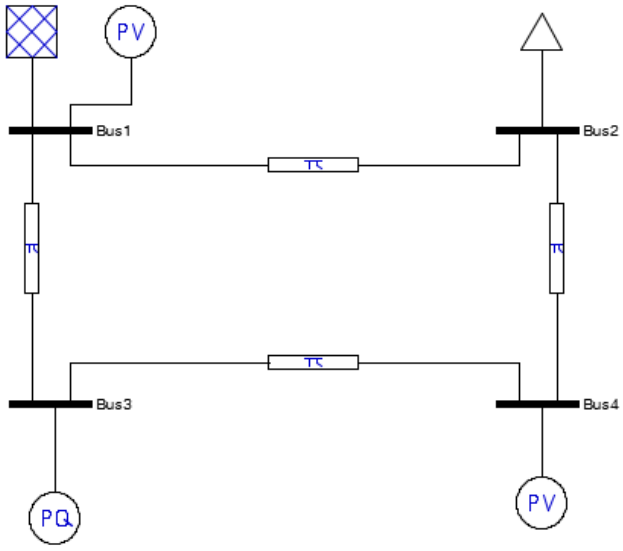
Line data:

From Bus to Bus	R	X	S
1-2	0.01008	0.05040	2*0.05125



Final One-Diagram:

Keep adding each of the remaining elements of the one-line diagram. If you have doubts on what to enter for each field of any element, you should first refer to the manual. If you don't have data for any specific field, use standard values. The final result looks similar to the one shown below.



Remarks on Per Unit Values in PSAT:

The default power base is 100 MVA. This value can be changed in the main PSAT window.
• Buses define the voltage base in kV.
• Per unit values of each device are defined based on the power and voltage nominal rates of the device.

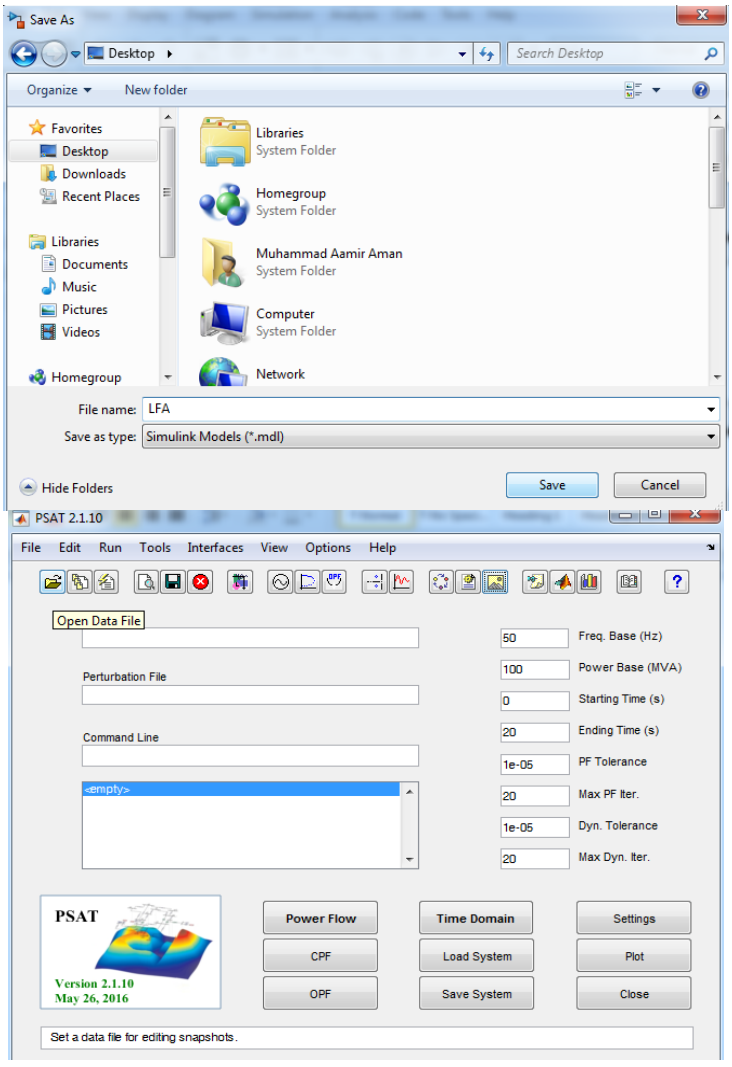
• Before running the power flow analysis the per unit value of each devices are converted to the system power base and to the voltage base of the bus at which the device is connected.

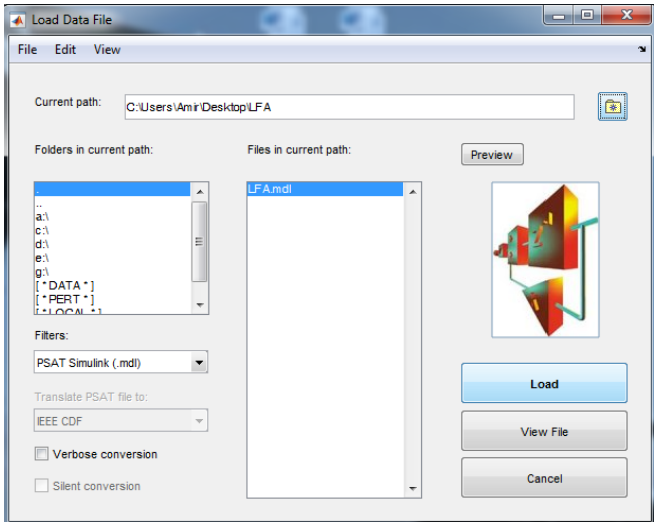
Very Important Remarks:

Power bases always refer to three phase apparent powers and are expressed in MVA.
• Voltage bases always refer to line-to line values and are expressed in kV.
• Impedance and admittance values are always per phase.

Load the model to PSAT:

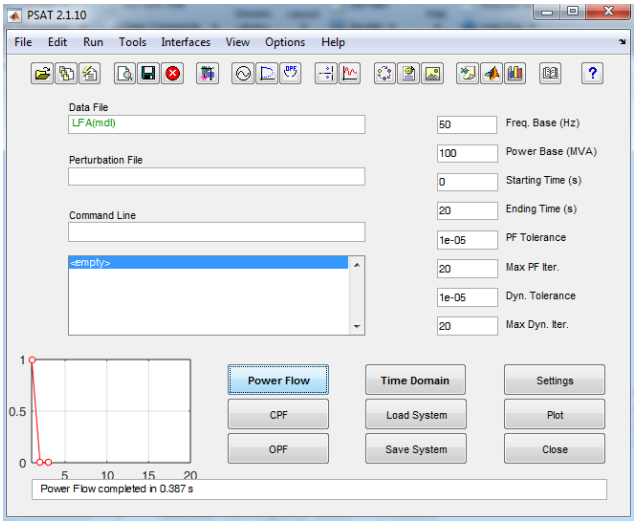
Save the Simulink model, after saving the model load it to PSAT via the "Data File" field of the MATLAB.





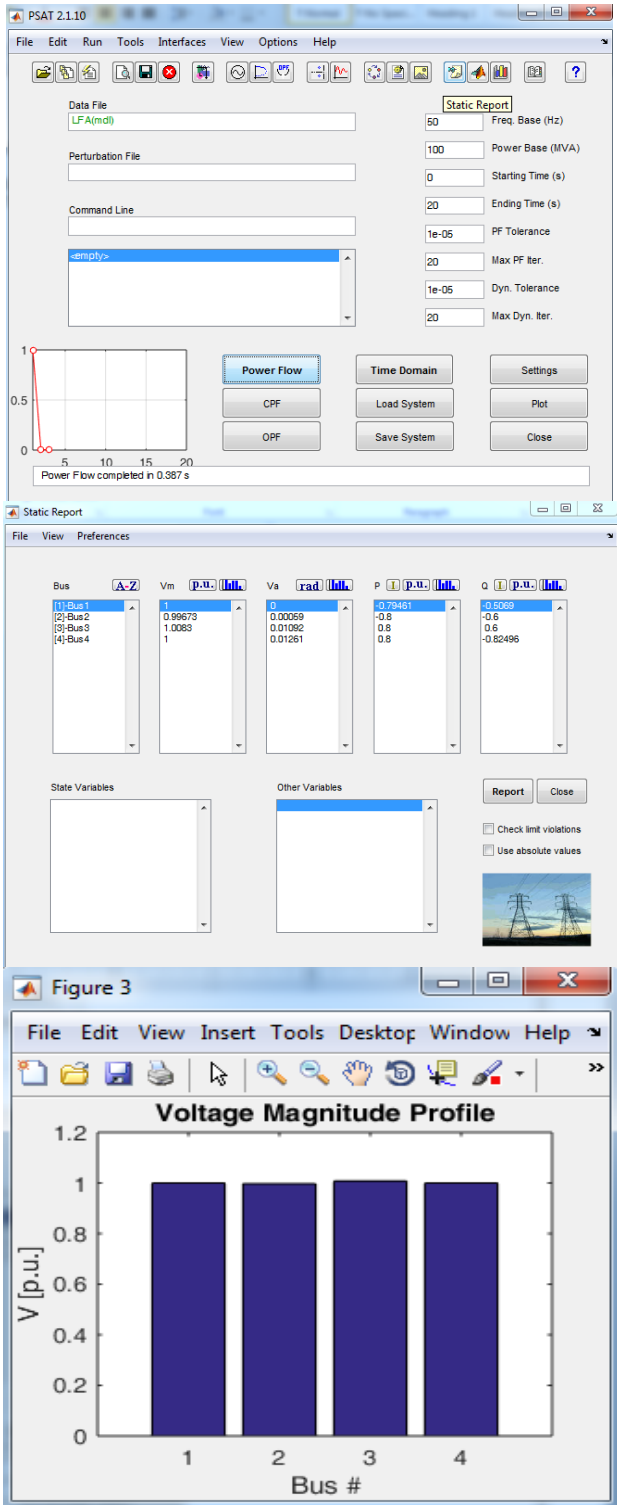
Running Power Flow:

Remember to adjust the settings to what you desire (Frequency is 50 Hz in the Pakistan)
• Click on the "Power Flow" icon.
• A small window in the Main GUI will show you the iteration process; you will know when the program has converged to a solution.



Viewing the Power Flow Results:

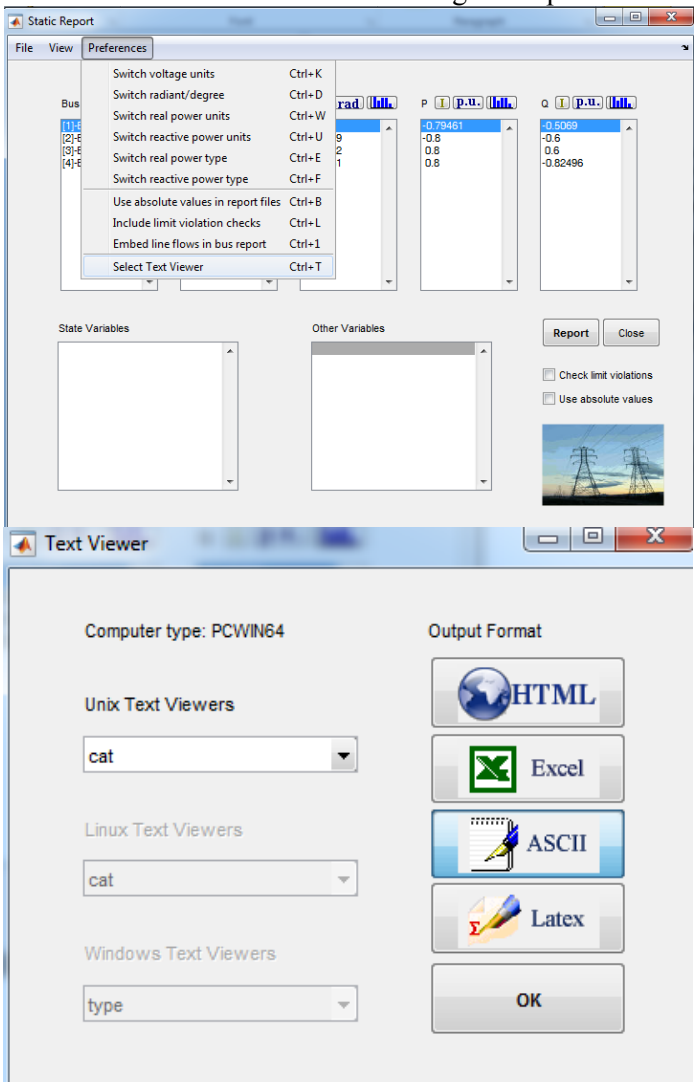
Click on the "Static Report" icon.
• The "Static Report GUI" will appear in your screen.



Generating a power flow Report:

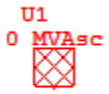
To generate a power flow report, click on the “Report” icon on the “Static Report” GUI.

• A text file will appear in your screen with the solution details.
• You can also set your preferences, such as Text Viewer in the “Preferences Menu”.
• You can also check limit violations and include shunts through the options below the “Report” button.

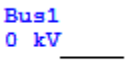


Load Flow Analysis of Single line diagram

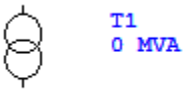
In this lab we will first implement/design the single line diagram in ETAP and then calculate load flow analysis. In the right side of etap we have element toolbar. Click on the Power grid icon one time and drag it.



Now click on the bus and drag it in the workspace.

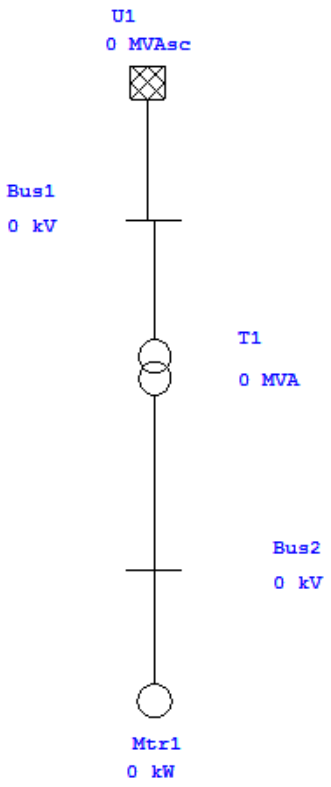


Now click on the two winding transformer.

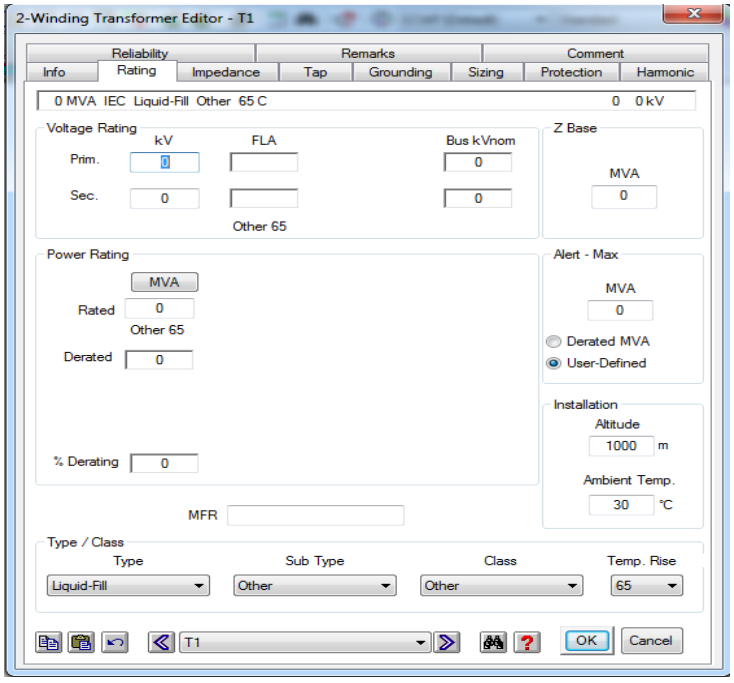


And then drag another bus. Also click on the motor and drag it in the one line diagram.

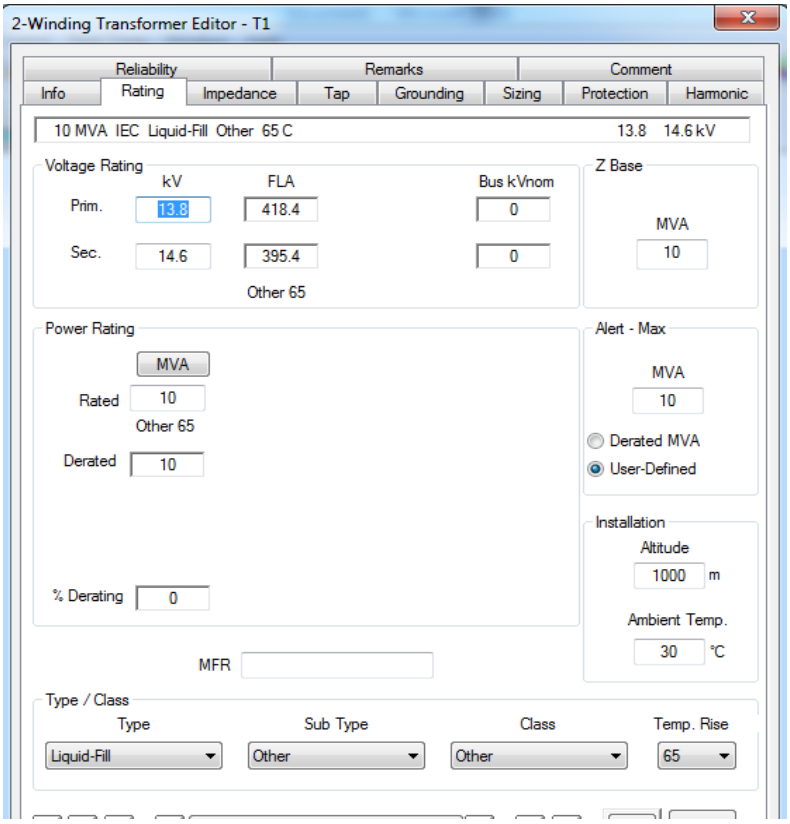
Now to connect the pins we have three separate options. First you can find the connection pin at the end of one element click it once and extend it to the other element you are connecting to. The second way is to click on the element in simple way and drag it to the element you are connecting to. The final way is to double click on the element section and in the info section you have to specify the bus you are going to be connecting to. So you final single line diagram will be like this.



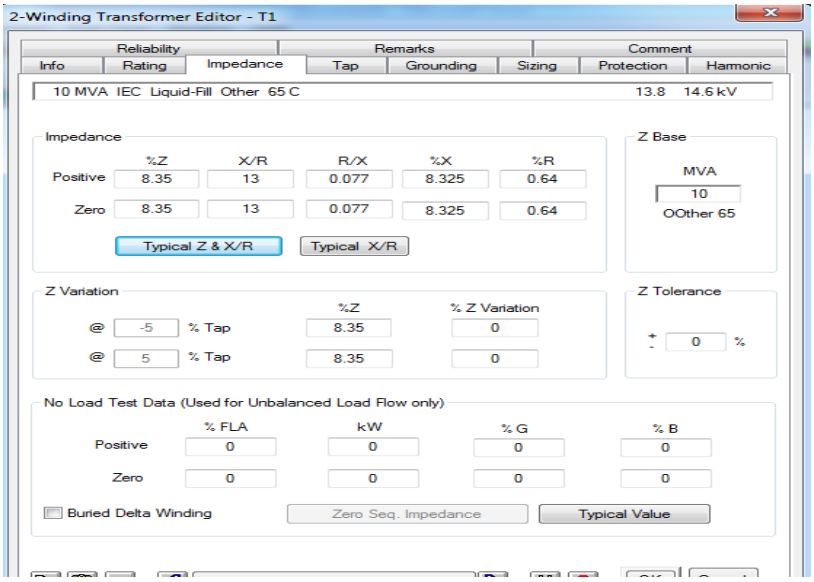
Now after this we enter the data for each element in this single line diagram and to run Load flow calculation. We will first start by entering the data in the transformer by double clicking the transformer icon and then click on the rating tab.



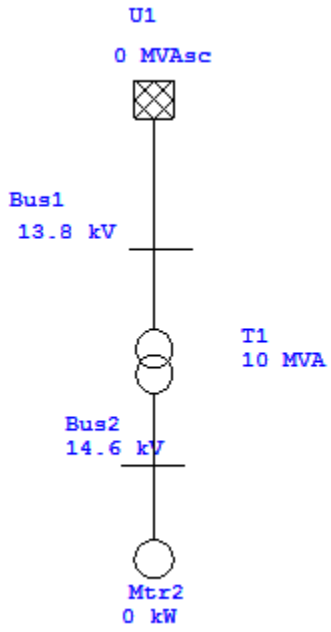
We will enter 13.8 kV in the Primary and for the secondary we will enter 14.6 KV and also enter the rated MVA as 10. When you enter the MVA rating you will notice that the etap automatically set the Max MVA to 10 and calculate the full load amps FLA primary and secondary.



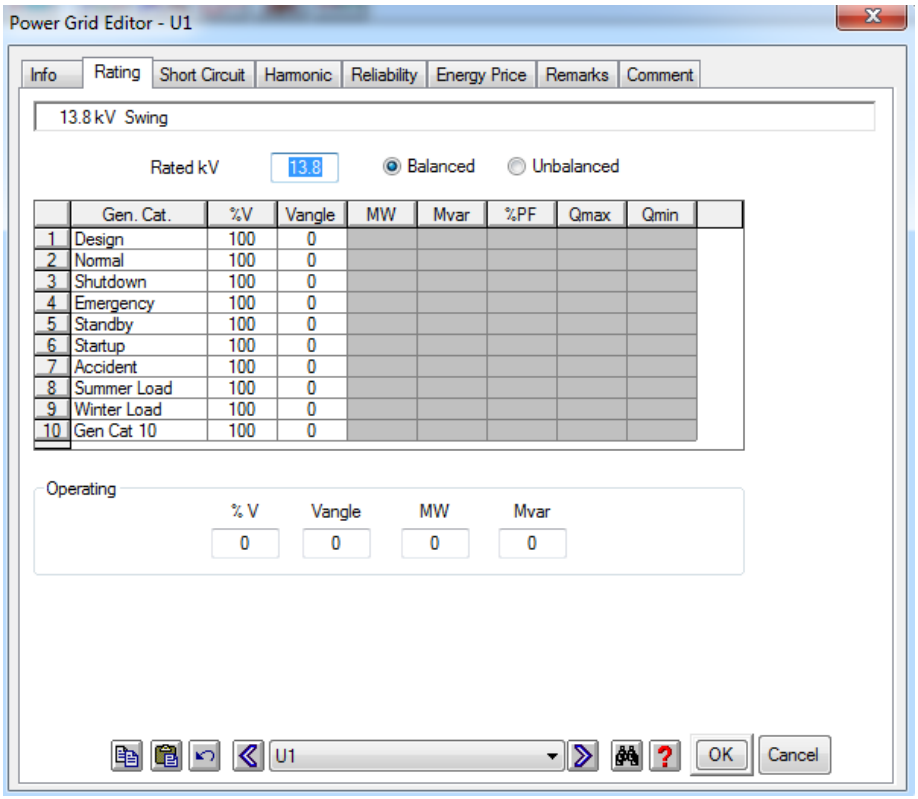
ETAP also provide typical values for various parameters. For example go to impedance page and click on the typical Z & X/R button. You will notice that the etap populate the %Z impedance and X/R ratio for transformer. Next select OK.



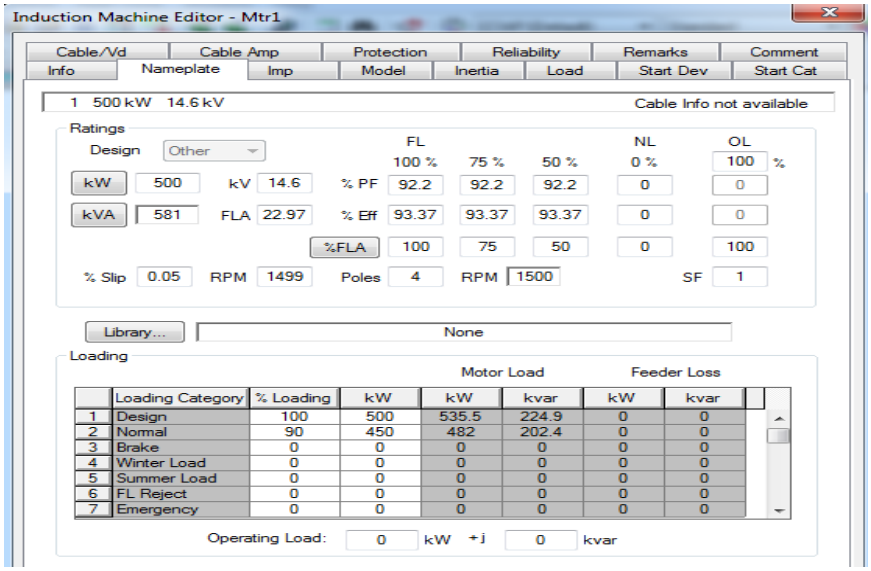
Now you will see that in the single line diagram both the bus 1 and bus 2 values will automatically updated.



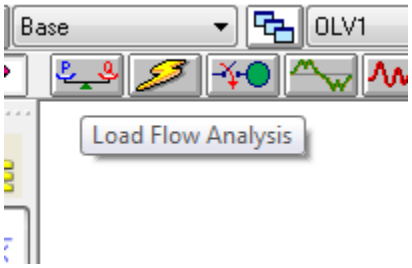
Now enter the data in the Power Grid. Double click the power grid icon and go to its rating page. Here you will see that etap will automatically update the nominal voltage for this element.



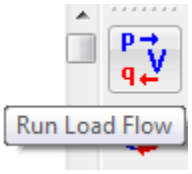
Now double click on the induction machine and go to the name plate page. Here we will see that the rated voltage will automatically be selected as standard rating. Now enter the KW power for this element. The KW power we will be entering is 500. When we enter this value and click outside the box etap will automatically update the Power factor its efficiency the full load amps and the other data.



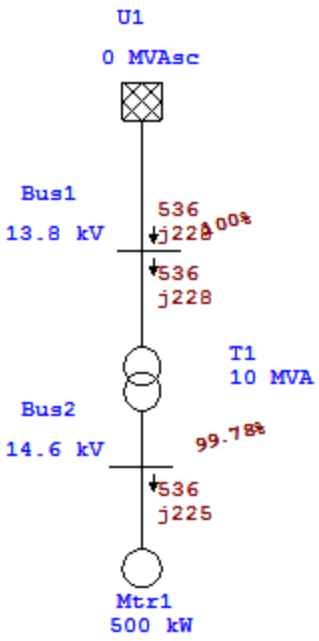
Now we have entered all the necessary data and ready for the load flow analysis. Click on the load flow icon on the left corner.



And then click on the right side corner run load flow analysis.



When you click on it will ask you report name so enter LFA for load flow. Then click OK ETAP will show you the calculation and the result of the single line diagram.


U1
0 MVAsc
Bus1
13.8 kV
536
j228
100%
536
j228
T1
10 MVA
Bus2
14.6 kV
99.78%
536
j225
Mtr1
500 kW