# EEDrawNet User Guide

v1.0

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# 1 General

EEDrawNet is a software program for building digital electric power systems, such as the system shown in Fig 1.1, and conducting complex power system calculations and analyses. After building a digital virtual model of an electric power system, the system can be effectively investigated, studied, illustrated and monitored. EEDrawNet is a powerful tool for getting the work done.

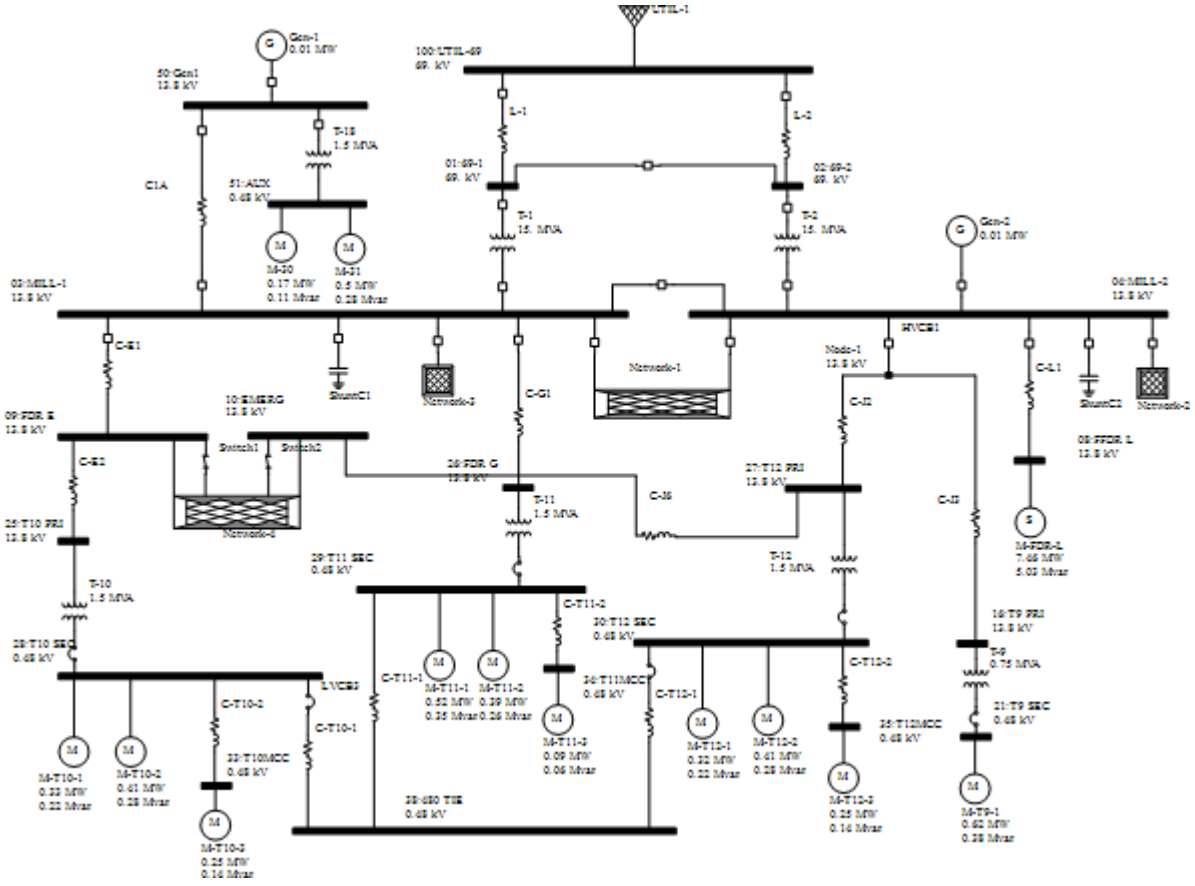


Fig 1.1 A Power System One-line Drawing

# 2 Drawing and Data

## 2.1 Basic Tools

After installing EEDrawNet, double-click on the application to start the program. The following window should appear:

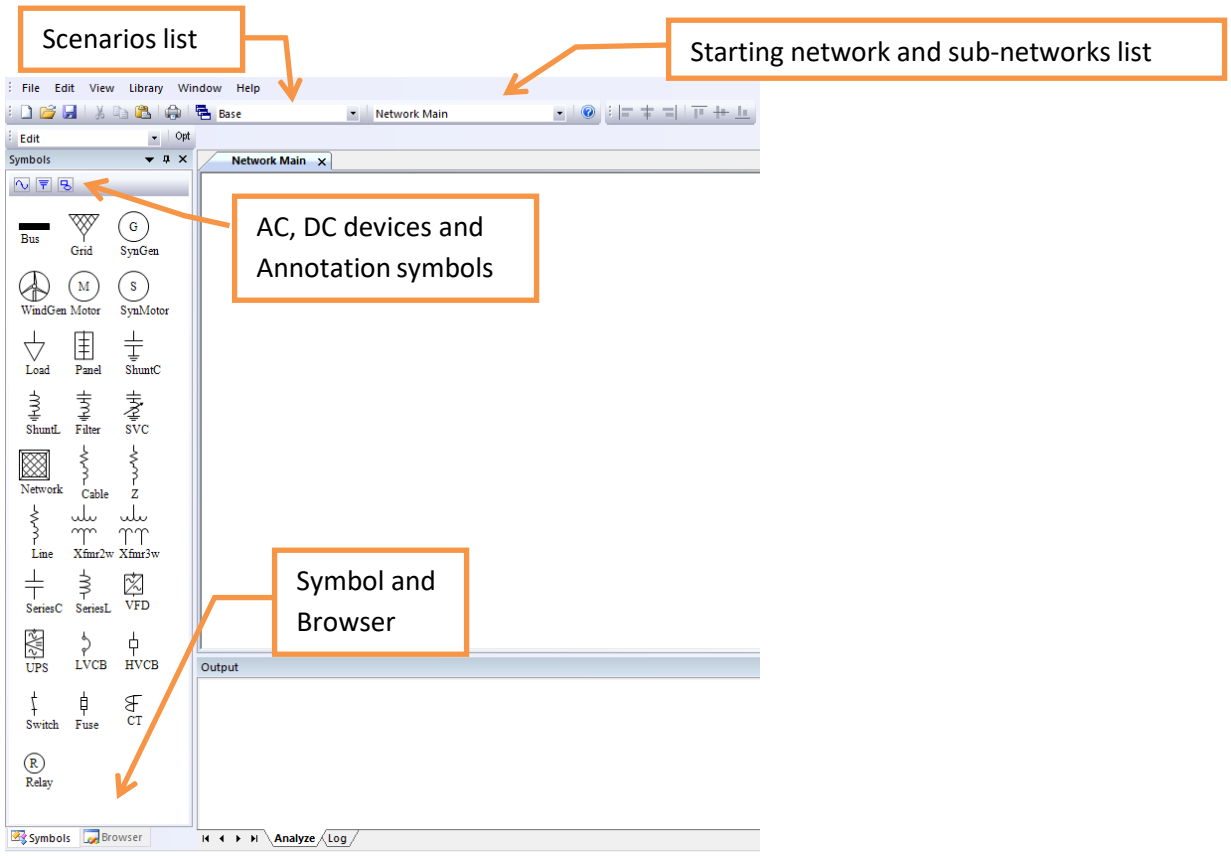
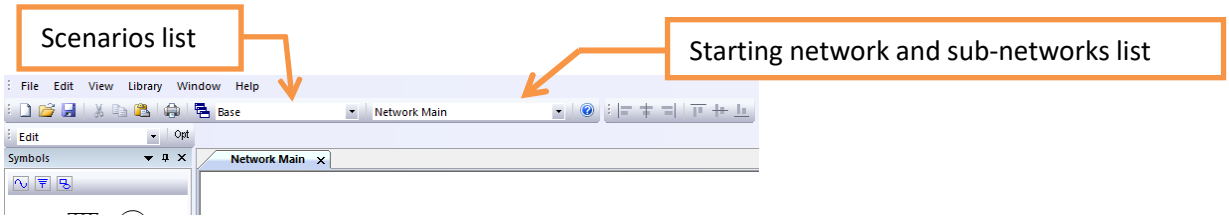



Fig 2.1 A New Empty Project

You are now ready to construct a virtual power system. Each new system comes with a default project file name, which you can change anytime under "File" → "Save As".

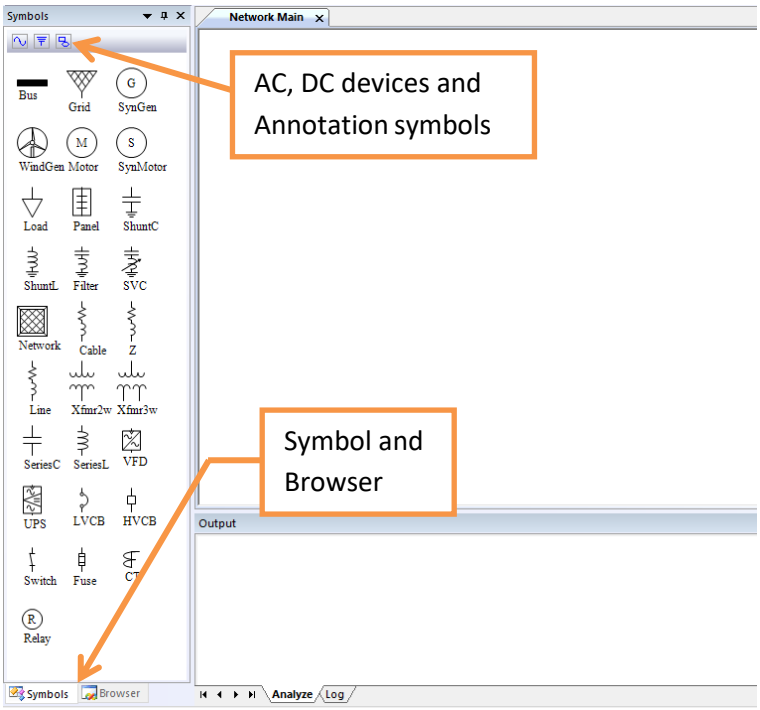
At the top of the window, you will see two drop-down lists titled "Base" and "Network Main".




The "Base" list is the scenarios list. Each scenario can have different device statuses (on/off, or in-service/out-of-service), and page-wide datablock or protective device statuses (hide/show). The "Network Main" list contains all pages, including the starting network and all sub-networks

of a complex power system.

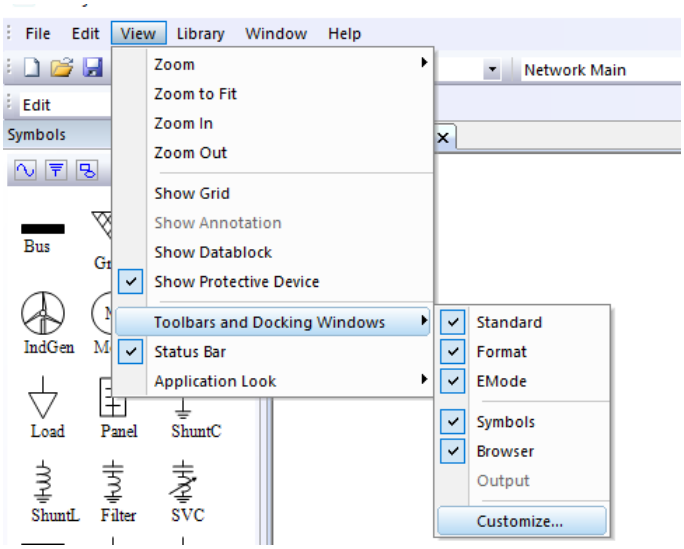
On the left side, you will see the “Symbols” and “Browser” windows.




The “Symbols” pane includes “AC”, “DC”, and “Annotation” symbols for assembling power systems. The “Browser” pane lists all the components in the main network and all sub-networks.

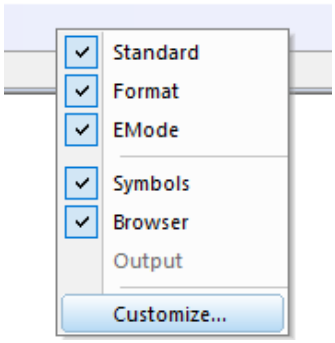
In case the toolbars do not show properly, you can reset the toolbars as follows:

Either Select “View” → “Toolbars and Docking Windows” → “Customize…”, OR

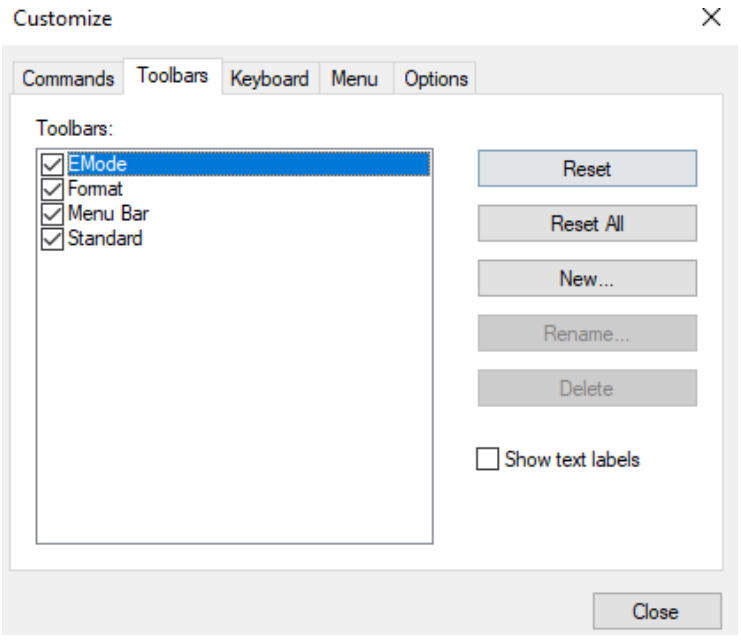



Select the toolbar frame area with your cursor and right-click → “Customize…”

Right-click menu:




In the “Customize…” dialog box, select the “Toolbars” tab, and click the “Reset All” button.



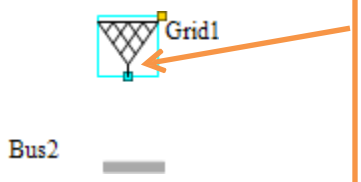
## 2.2 Add Symbols to Drawing Area

There are various ways to copy symbols from the “Symbols” pane to the drawing area:

- Select a symbol in the “Symbols” pane and left click on the desired place in the drawing.
    - You can create multiple copies of the same symbol without going back to the “Symbols” pane by holding down the “Ctrl” button and clicking repeatedly.
- Select multiple symbols in the “Symbols” pane by holding the “Ctrl” key and left clicking on the desired place in the drawing area.
    - You can create multiple copies of the same set of symbols by holding down the “Ctrl” button and clicking repeatedly.
- Click and drag a symbol from the “Symbols” pane to the drawing area.

To unselect all symbols in the “Symbols” pane, either 1) click in the empty area of the “Symbols” pane, 2) click in the toolbar area, or 3) press the “Esc” key.

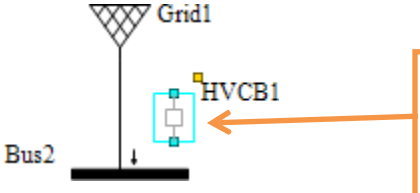
## 2.3 Make Connections




Click and drag the symbol to make the connector handle touch the bus. Just before the touch, press the “Ctrl” key and they will connect.

OR

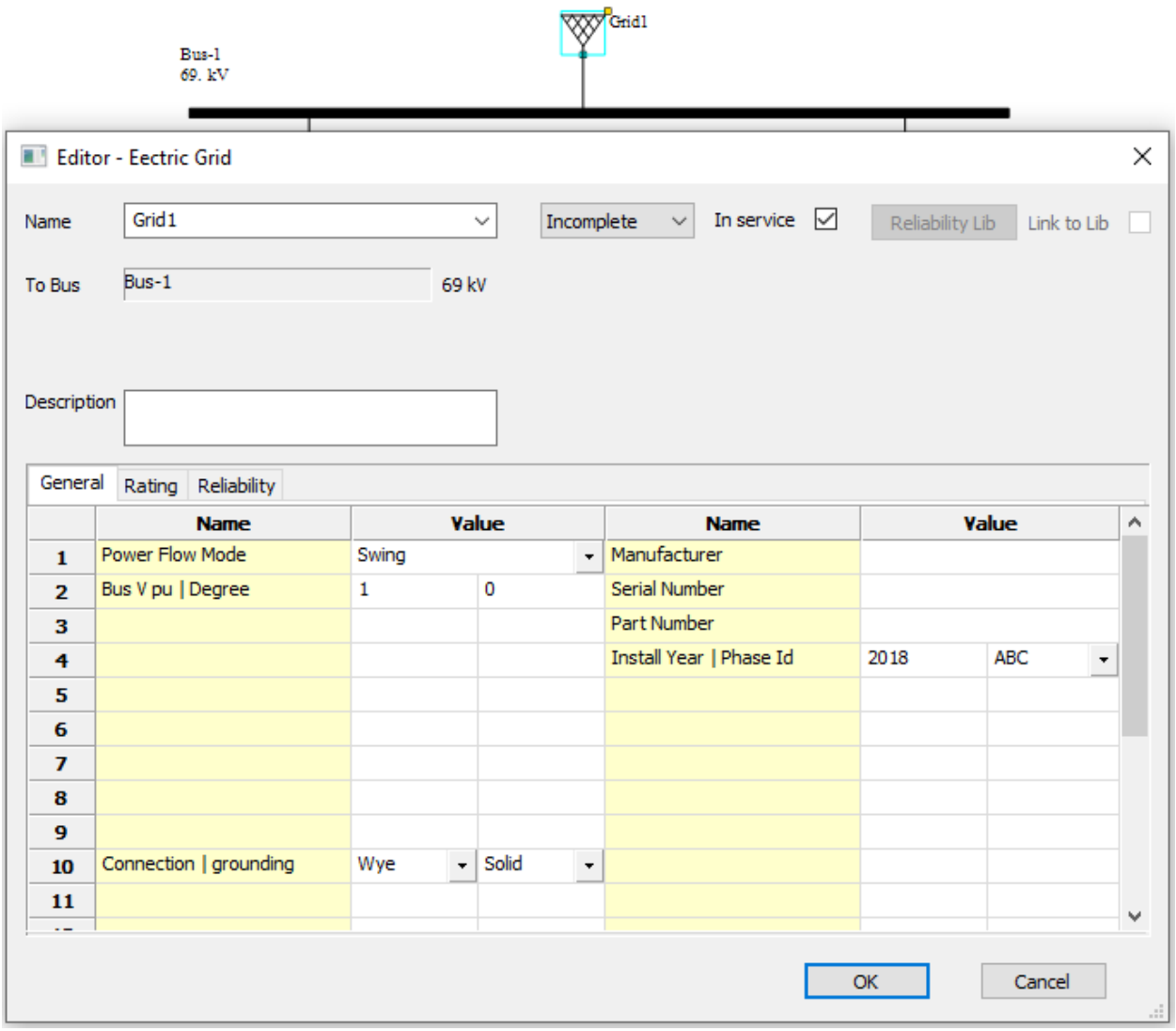
Point the curser to the handle, click and drag (a line will appear) to the bus



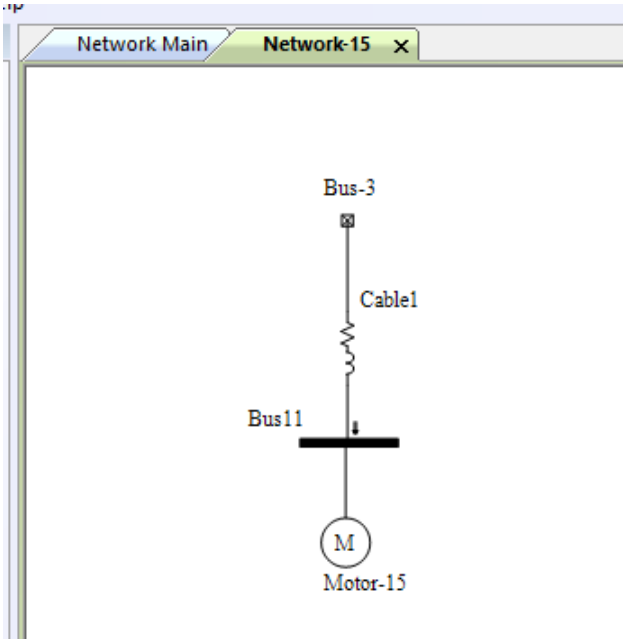

For protective devices, simply move the device to touch the connector line while holding down the ‘Ctrl’ key.

## 2.4 Double Clicking Symbols

By double-clicking most symbols (except for the **Network** or **Port** symbol), you will open the device editor dialog box. Here, you can enter power engineering data. This dialogue box can also be opened by right-clicking the Properties menu.

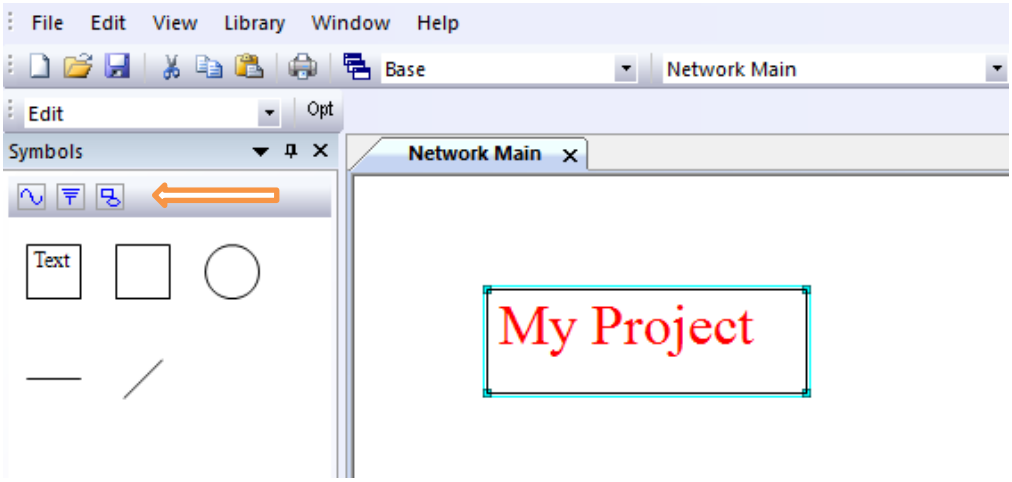


Double-clicking a **Network** symbol will lead to the sub-network page. Double-clicking a **Port** symbol will lead back to the page of the sub-network. To change the name of a **Network** symbol, right-click and select 'Properties'.




## 2.5 Annotation Symbols

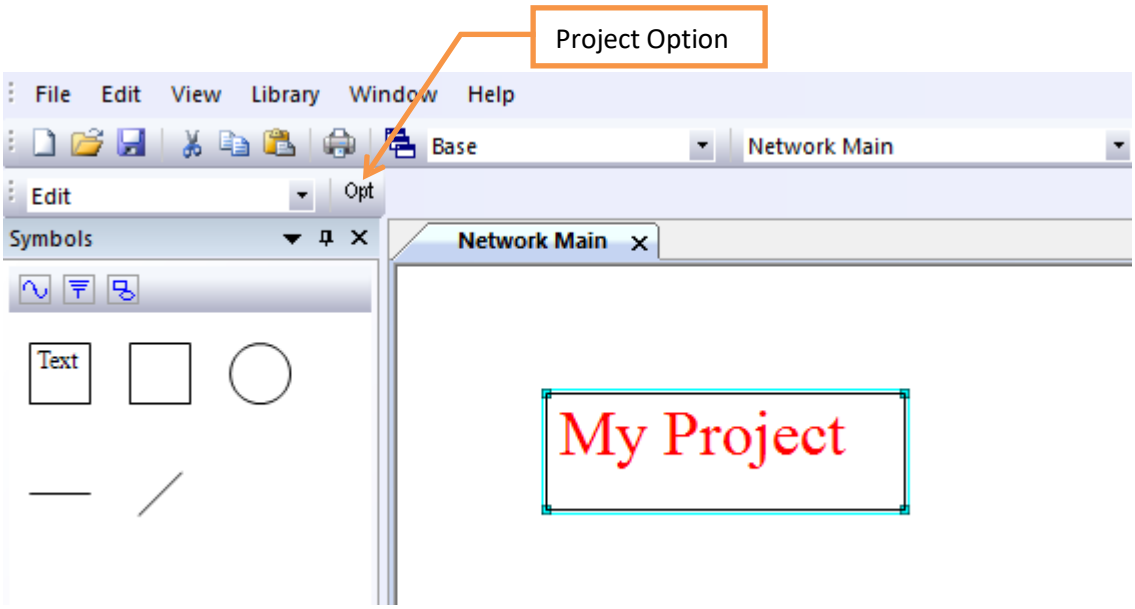
In Annotation symbols, you will find a few basic shapes, as shown below. You can add descriptive text to your project by dragging the "Text" symbol to the desired area. Once the textbox is positioned correctly, you can double-click on the box to edit its contents.



## 2.6 Menus and Mouse

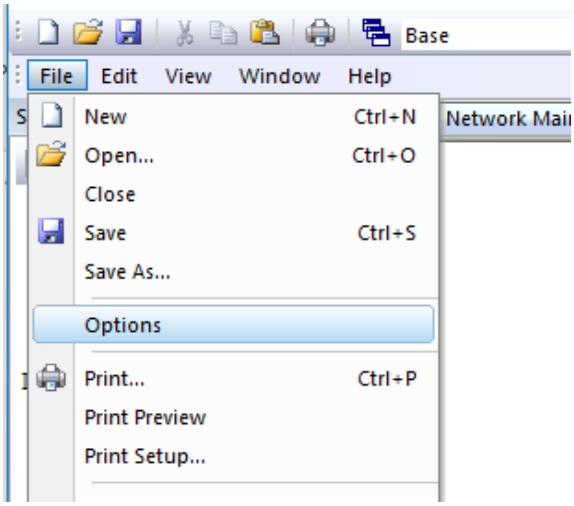
### Options

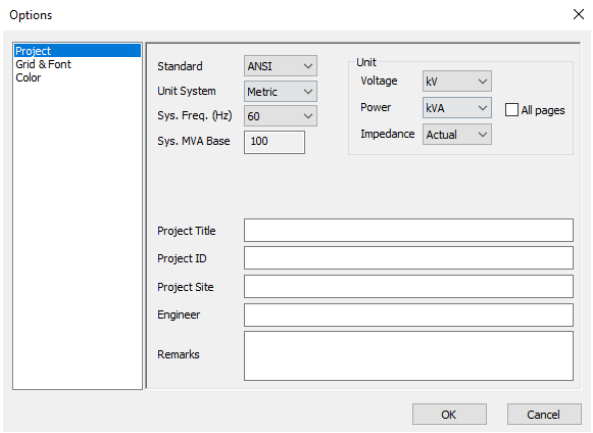
In 'Edit' mode, the 'Opt' button leads to the project option dialog box.

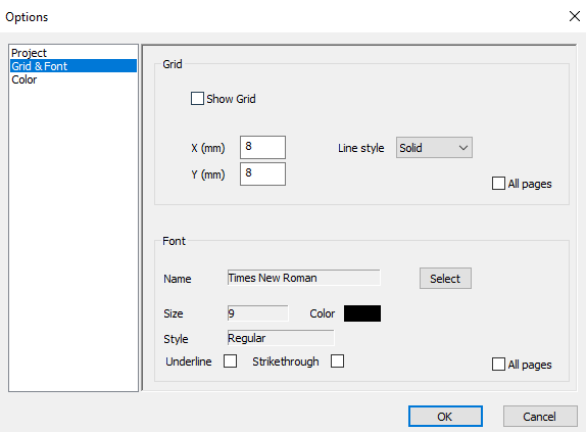


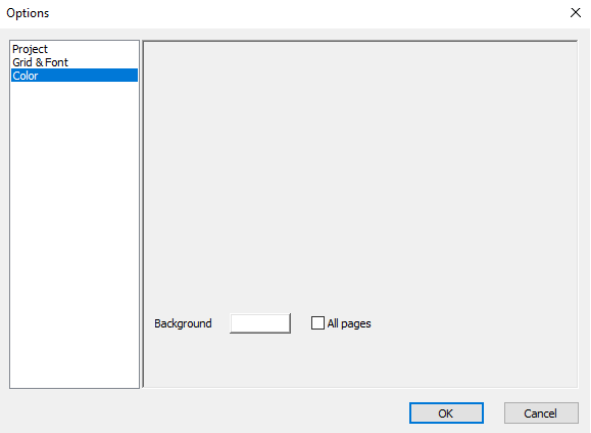

This box can also be accessed from the "File" menu, or from the right-click menu when no devices are selected.

The "Options" dialog box has "Project", "Grid & Font" and "Color" sections, as shown in the following screen captures.





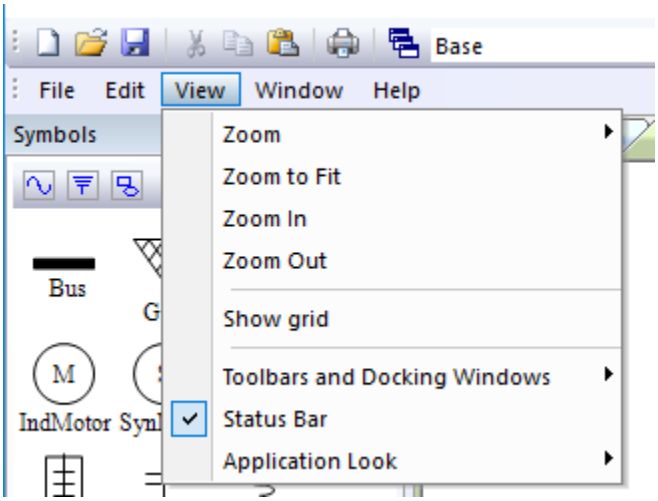




**Pan and Zooming**

To pan, press the middle wheel on your mouse and move your cursor. To zoom, rotate the mouse wheel forward for zooming in, or backward for zooming out.

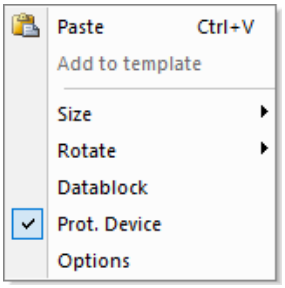
You can also pan by holding down the Shift key while pressing the left mouse clicker.

Under “View”, you will see various options for adjusting your window, including zoom and gridline options.

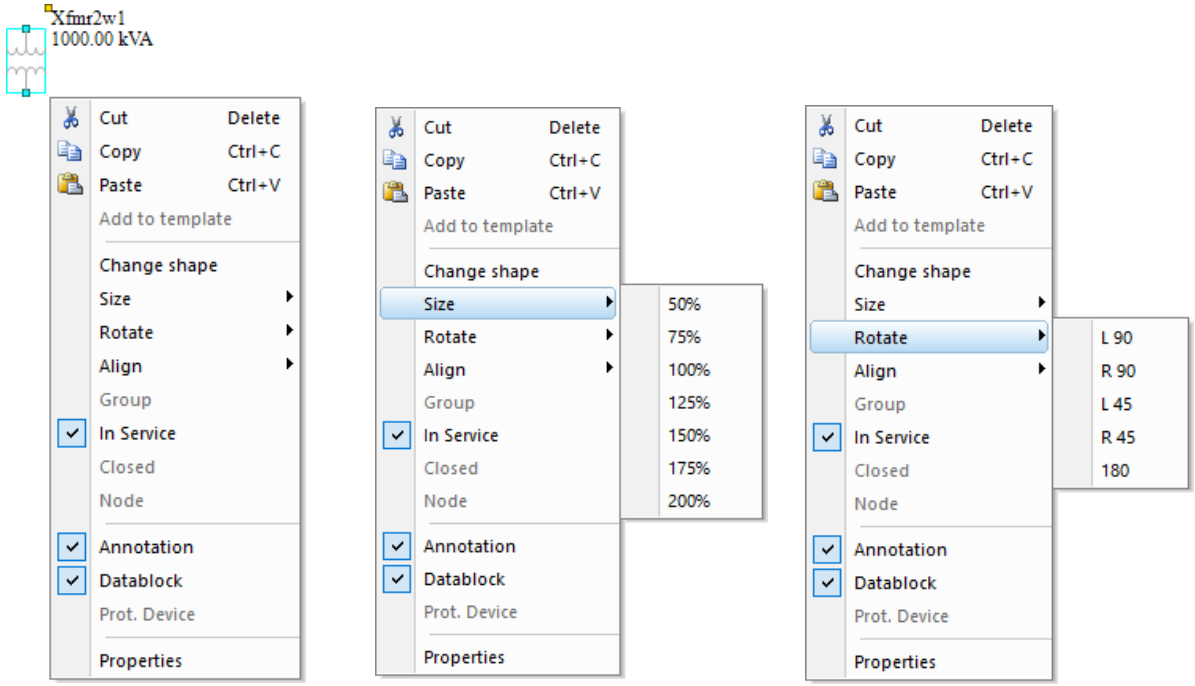


**Right-click Menu**

The following figure shows the right-click menu when no devices are selected. From this menu, you can increase/decrease the size of the symbols, show/hide Datablocks, show/hide Protective devices and access the "Options" dialog box.

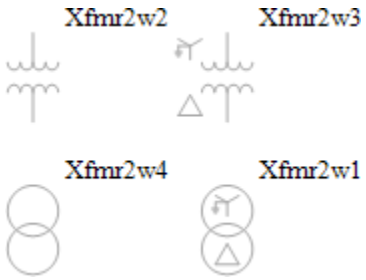



When a device is selected, the right-click menu will instead display as shown below.



Using this menu, you can cut, copy, and delete symbols. Symbols that have been cut or copied are stored on an internal clipboard so that you may paste them back later. The symbols stored in the internal clipboard can be accessed from all projects, not just the project of origin. This means that you can copy symbols from one project to another.

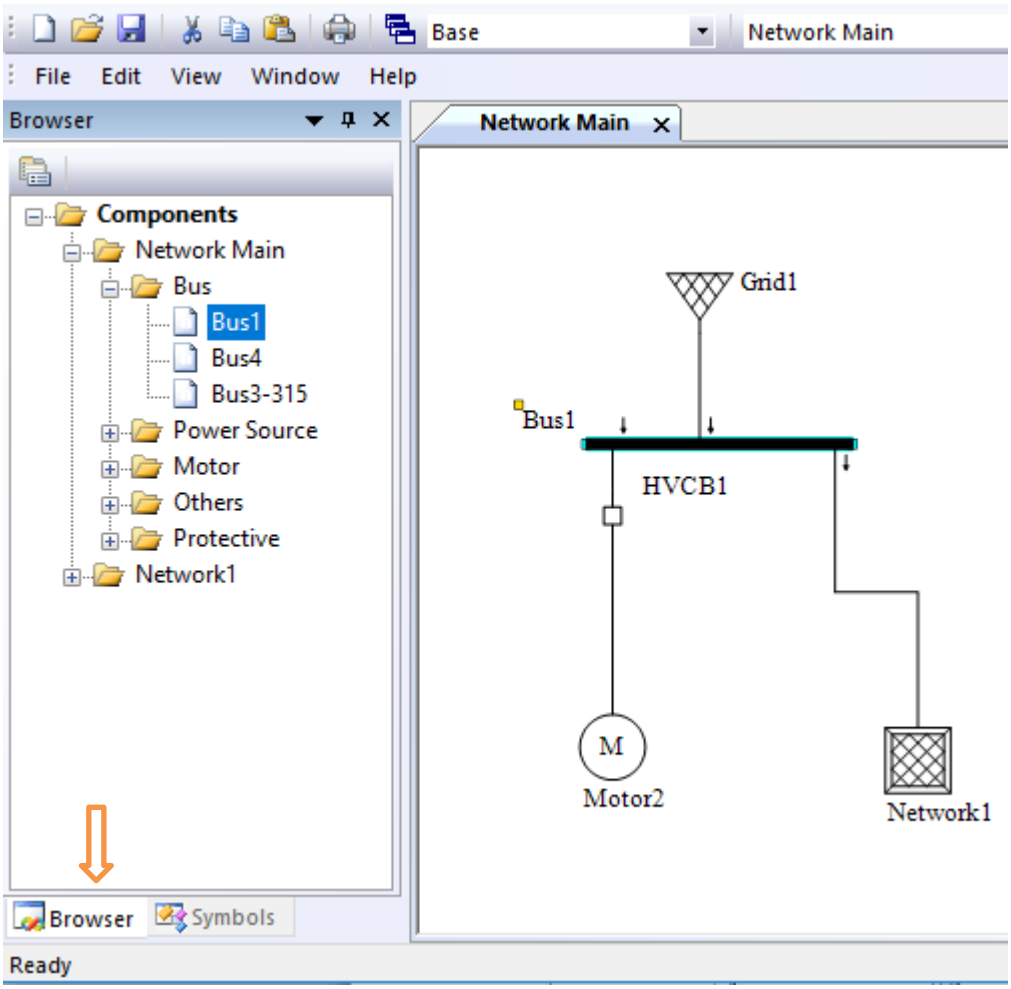
You can also change the shape of a selected symbol using the right-click menu, as demonstrated in the figure below containing various available transformer shapes. Symbol shape can also be changed in the Symbols pane.




The right-click menu also gives you the option to increase/decrease the size of a selected symbol, rotate the selected symbol or sub-system, align the selected symbols, show/hide Annotations, show/hide Datablocks, show/hide Protective devices, group/ungroup a set of symbols, etc.

## 2.7 Browser

When you select the “Browser” tab at the bottom of the window, a list of all the components in the drawing will be displayed.



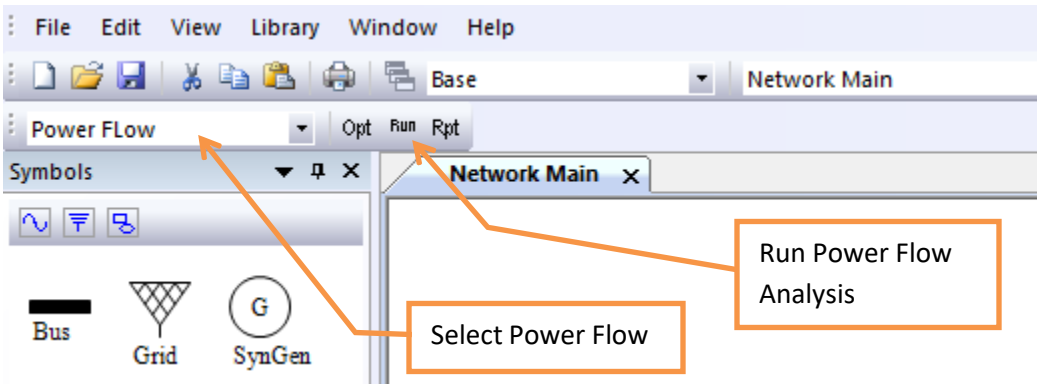

When a device such as “Bus1” is selected, the device will also be highlighted on the drawing, as shown above. If the selected device is not currently in the center of the drawing, it will be moved to the center. If the device is not on the current page, the page containing the selected device will be opened.

Double-clicking on any device will open the device editor dialog box.

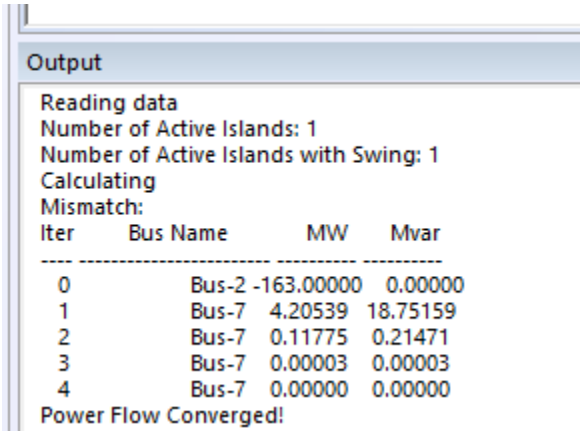
# 3 Analysis

## 3.1 Power Flow Analysis

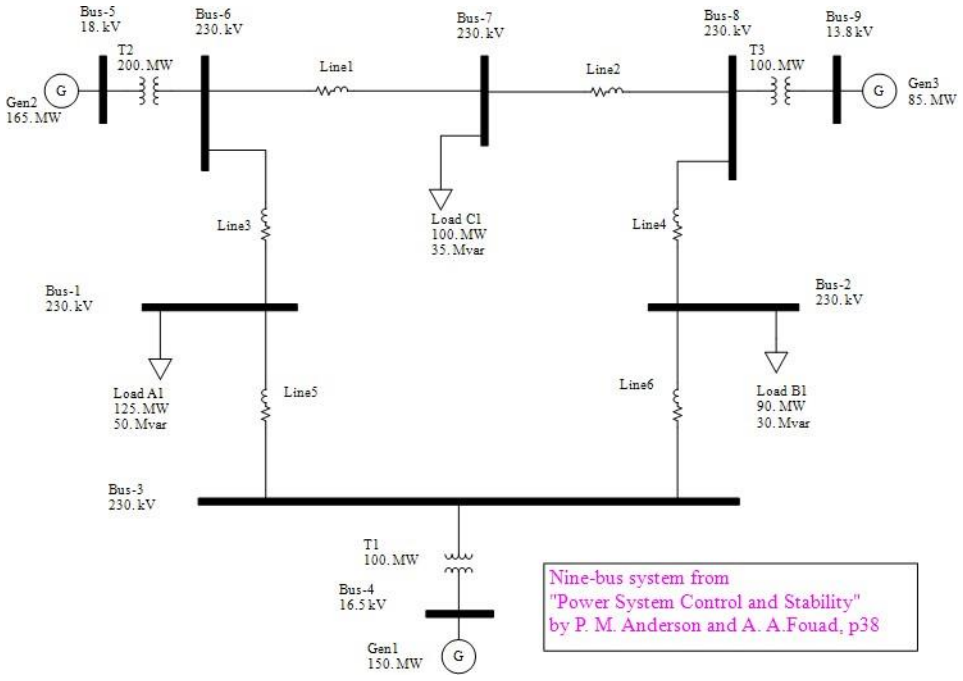
In this version, the power flow analysis program covers only AC components (excluding components such as UPS and VFD). To conduct a power flow analysis, select “Power Flow” from the mode combination dropdown list and click “Run”.



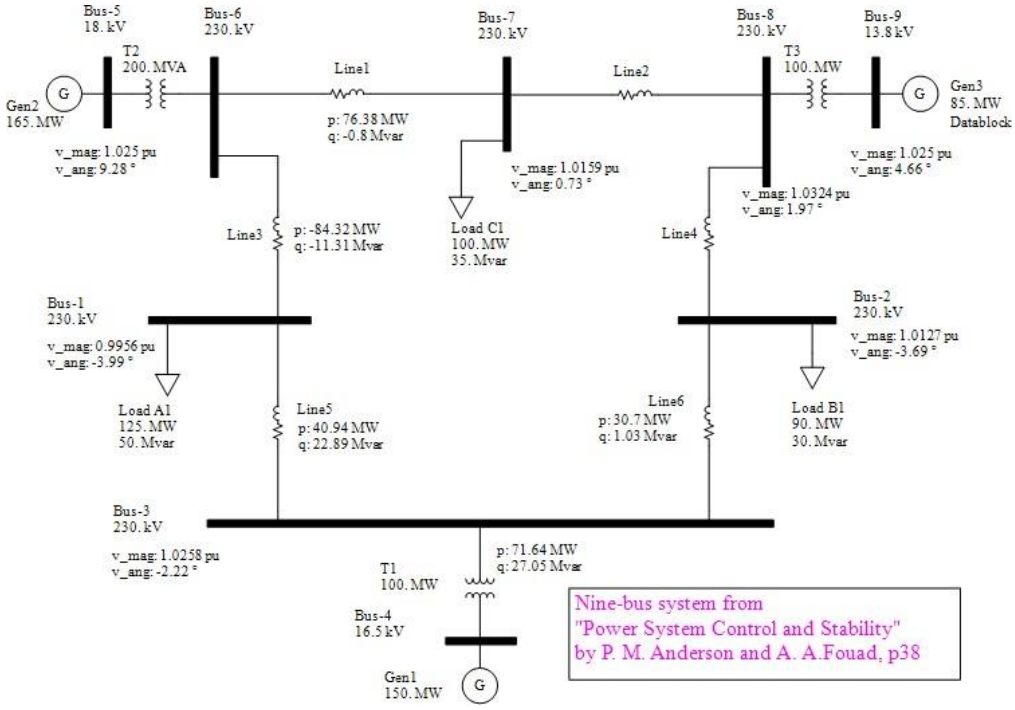

The power flow analysis program will output calculation information in the Output pane window, as shown below.



The following is a model built based on the nine-bus power system (as seen in “Power System Control and Stability”, by P. M. Anderson & A. A. Fouad, page 38):

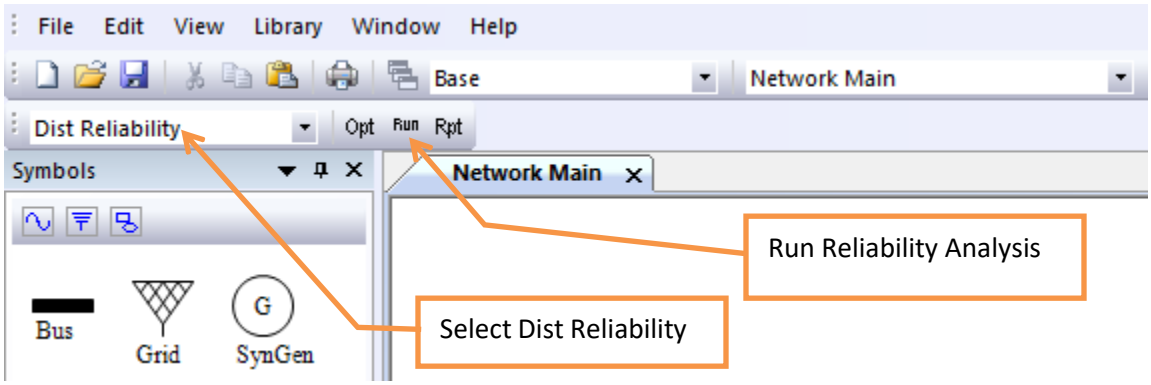



After running a power flow calculation, the results will also be displayed on the drawing, as shown below. As you can see, the results below match the above calculations from the book.

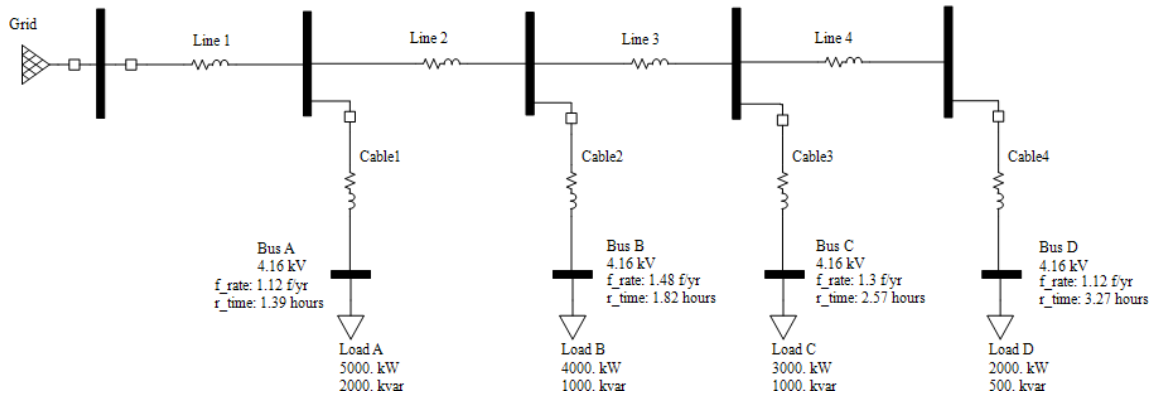


## 3.2 Reliability Analysis

The reliability analysis program covers all AC and DC components. This means that you can build a complete AC and DC integrated power system, and conduct a reliability analysis for the system.




Roy Billbinton and Ronald N. Allan,
"Reliability Evaluation of Power Systems"
page 230~235.

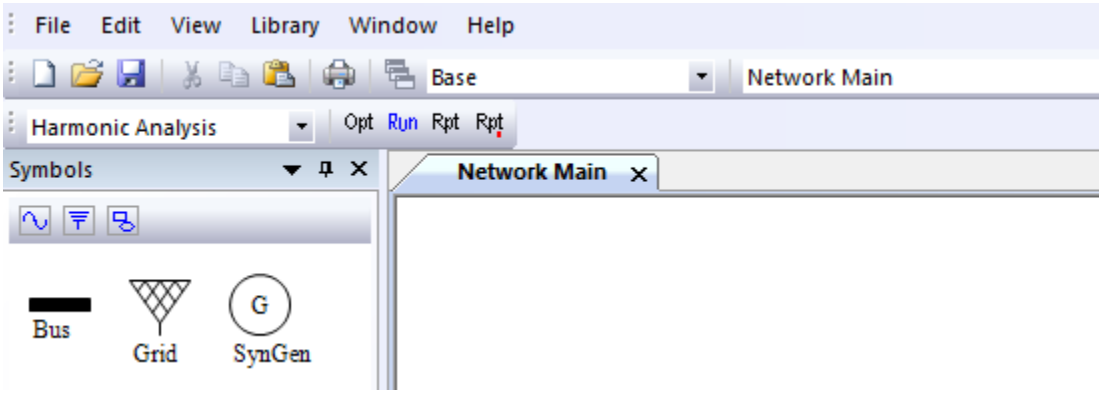


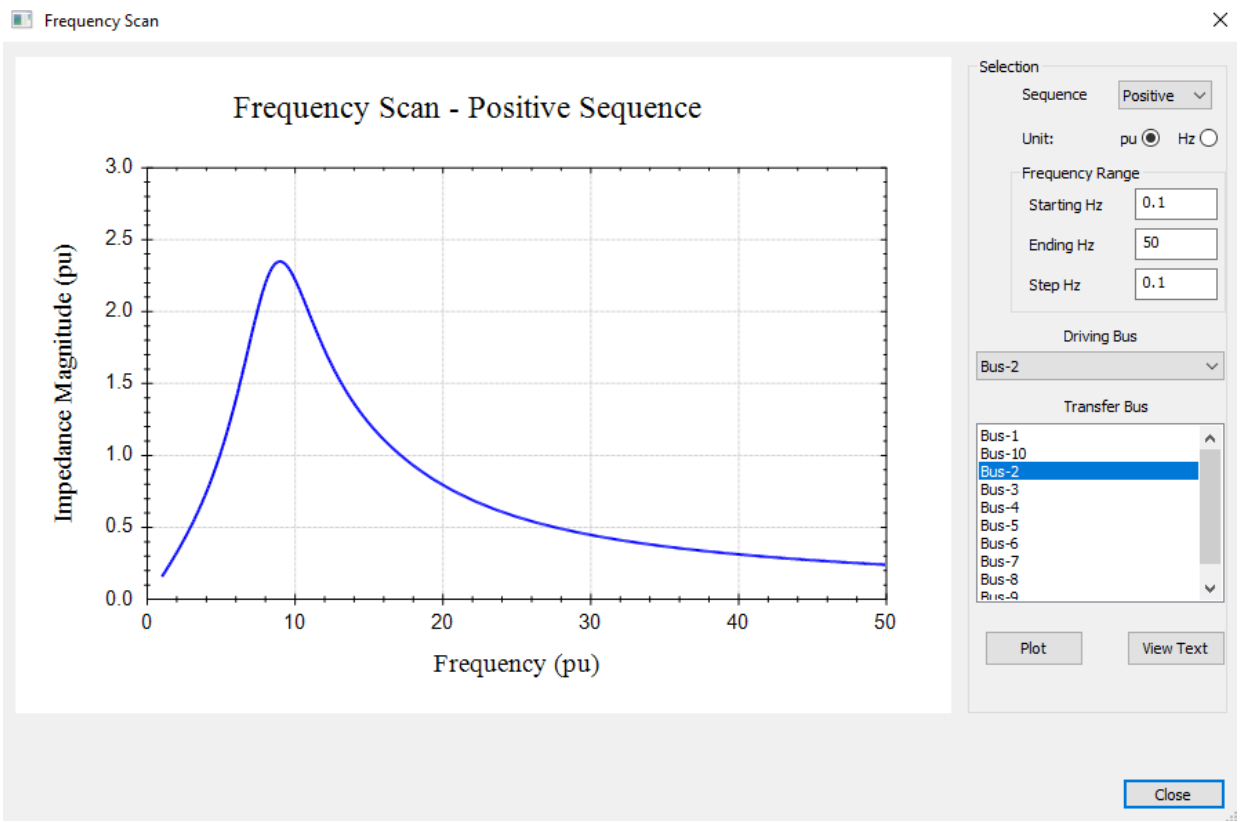

```
                    Load Point Indices
                    ==================

    Load Point Name       λ (f/yr)   r (hours) U (hours/yr) Availab. (%) EENS (MWh/yr) ECOST (k$/yr)
------------------------ ---------- --------- ------------ ------------ ------------- -------------
Bus A                       1.120000    1.3929     1.560000   99.9821918         7.800      29.75325
Bus B                       1.480000    1.8216     2.696000   99.9692237        10.784      41.16742
Bus C                       1.300000    2.5746     3.347000   99.9617922        10.041      38.58728
Bus D                       1.120000    3.2652     3.657000   99.9582534         7.314      28.21399

                System Indices - Bus-9
                ======================

  SAIFI =      1.258 interruptions per customer year
  SAIDI =      2.629 hours per customer year
  CAIDI =      2.090 hours per customer interruption
  ASUI  =  0.0003002, ASAI = 0.9996998
  EENS  =       35.939 MWh per year
  ECOST =      137.722 k$  per year
```

## 3.3 Harmonic Analysis

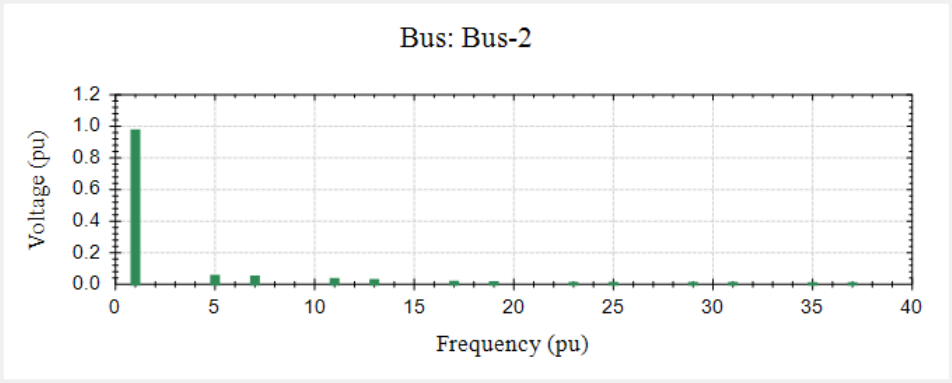
The harmonic analysis program conducts frequency scan and harmonic indices calculations for AC power systems.

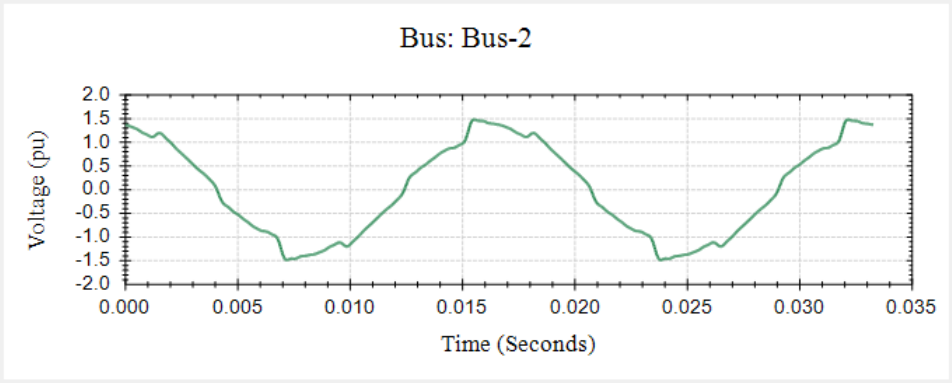
In the “Option” dialog box, select “Frequency Scan” or “Harmonic” Indices calculations.



Harmonic Spectrum




Selection

Frequency Unit: pu

Bus Voltage Unit: pu

(•) Buses ( ) Branches

Bus-1
Bus-2

Plot | View Text

All Voltages / Currents

Total Harmonic Indices

Close