

Power Education Toolbox (P.E.T): An Interactive Software Package for State Estimation

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State Estimation

State estimation software typically incorporates a series of applications which are related to the:

- analysis of network observability,
- measurement classification,
- pseudo measurement creation,
- detection and identification of errors
- optimization of an objective function that is defined in terms of the measurement residuals.

Desired Features

- To have a single software platform that supports many analysis functions that can be easily activated for the same power system.
- The study network will be built independent of the applications and changes to network topology and parameters will be seen by all applications operating on that network.
- In order to facilitate cross-over between the results of one application and inputs to another, a file sharing system is used.

Motivation

- Provide a tool for researchers and educators who may wish to develop and test new algorithms for state estimation, bad data processing, network observability and other related functions.
- Make the network database format as transparent to the user as possible so that input data files can be automatically generated in the required format by different applications.

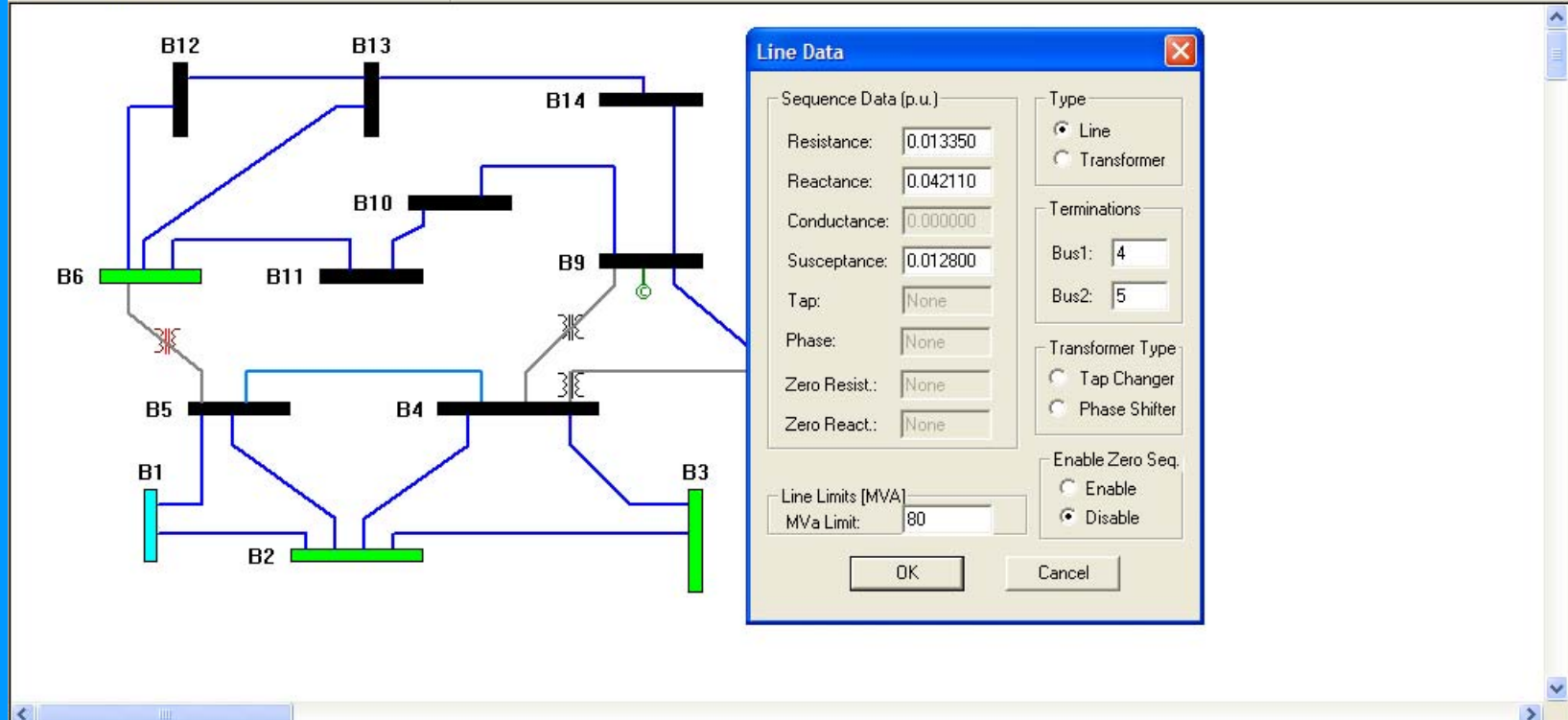
Data Exchange

- The software is designed intentionally in such a way that applications use external files to exchange data and information among them.
- Applications have access to two types of files:
Files containing static network data.
Files containing the solution provided by another application.

Data Entry

test14.pet - Power Education Toolbox

File Edit View Mode Element Measurement Analysis Options Help



Line Data

Sequence Data (p.u.)

Resistance: 0.013350

Reactance: 0.042110

Conductance: 0.000000

Susceptance: 0.012800

Tap: None

Phase: None

Zero Resist.: None

Zero React.: None

Line Limits [MVA]

MVA Limit: 80

Type

Line

Transformer

Terminations

Bus1: 4

Bus2: 5

Transformer Type

Tap Changer

Phase Shifter

Enable Zero Seq.

Enable

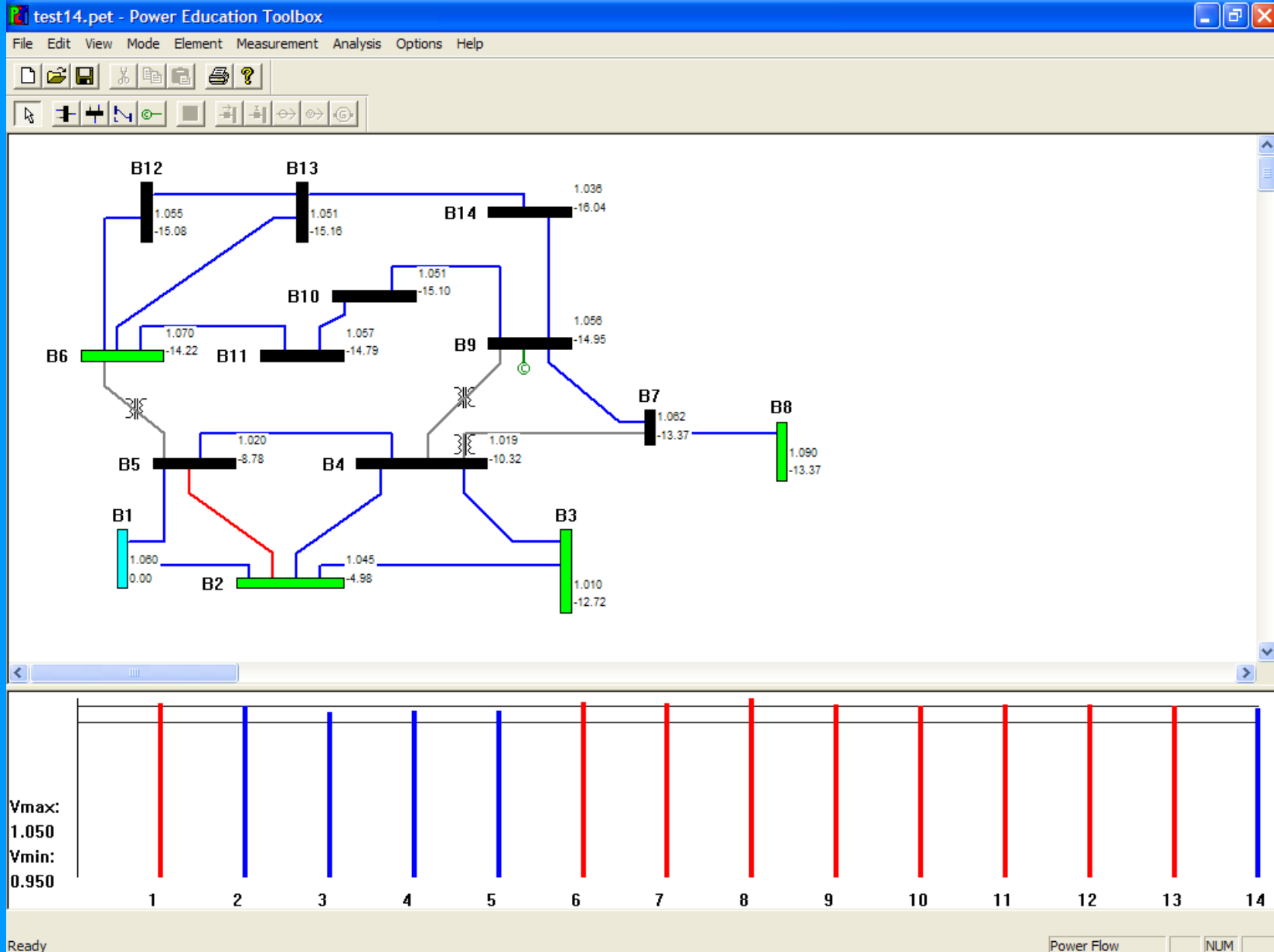
Disable

OK Cancel

Ready

Network Edit NUM

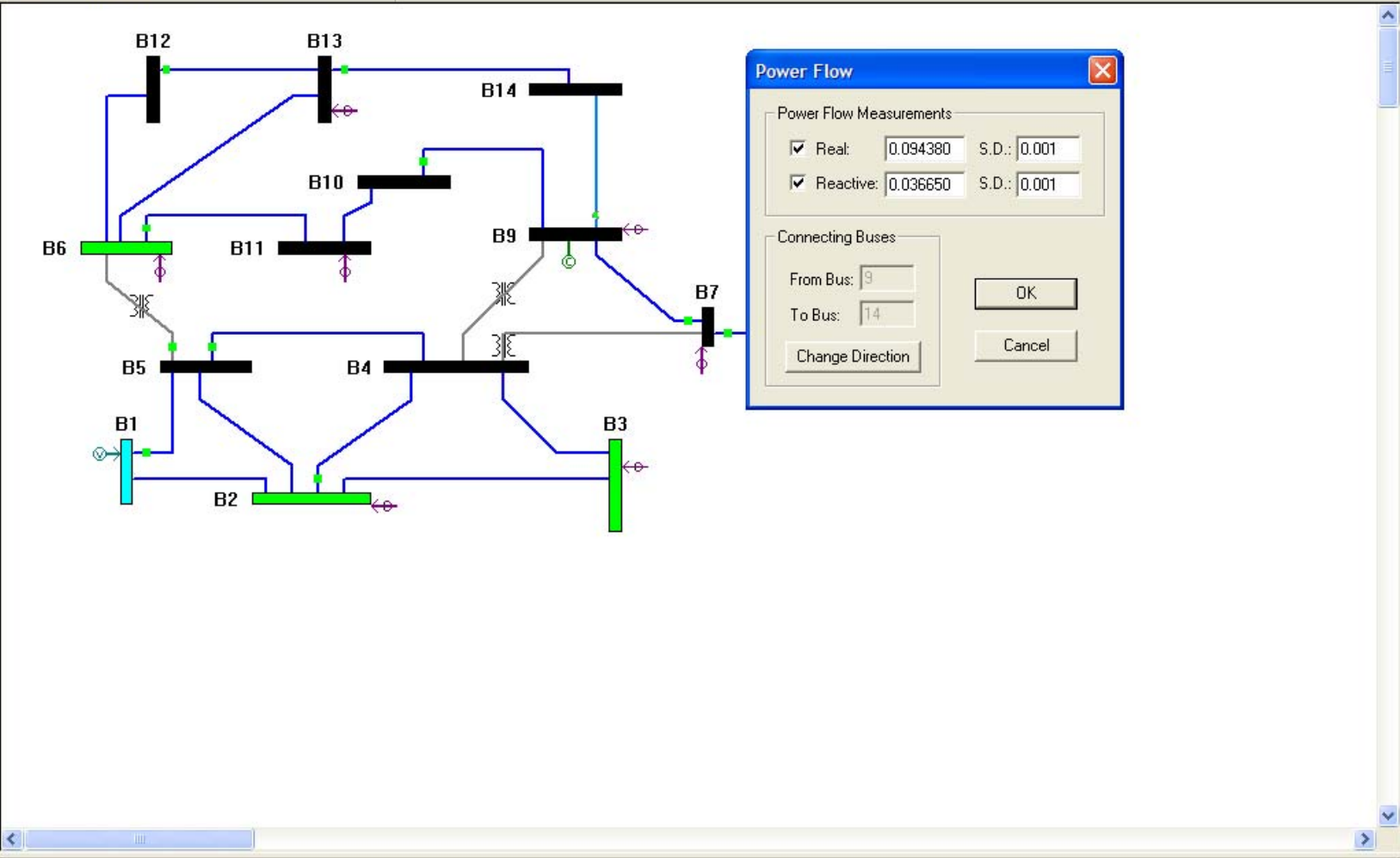
Power Flow Solution



Measurements

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File Edit View Mode Element Measurement Analysis Options Help



The diagram shows a power system with 14 buses (B1-B14) connected by lines and transformers. A 'Power Flow' dialog box is open, showing the following settings:

| Power Flow Measurements | | | |
|---|----------|-------|-------|
| <input checked="" type="checkbox"/> Real: | 0.094380 | S.D.: | 0.001 |
| <input checked="" type="checkbox"/> Reactive: | 0.036650 | S.D.: | 0.001 |

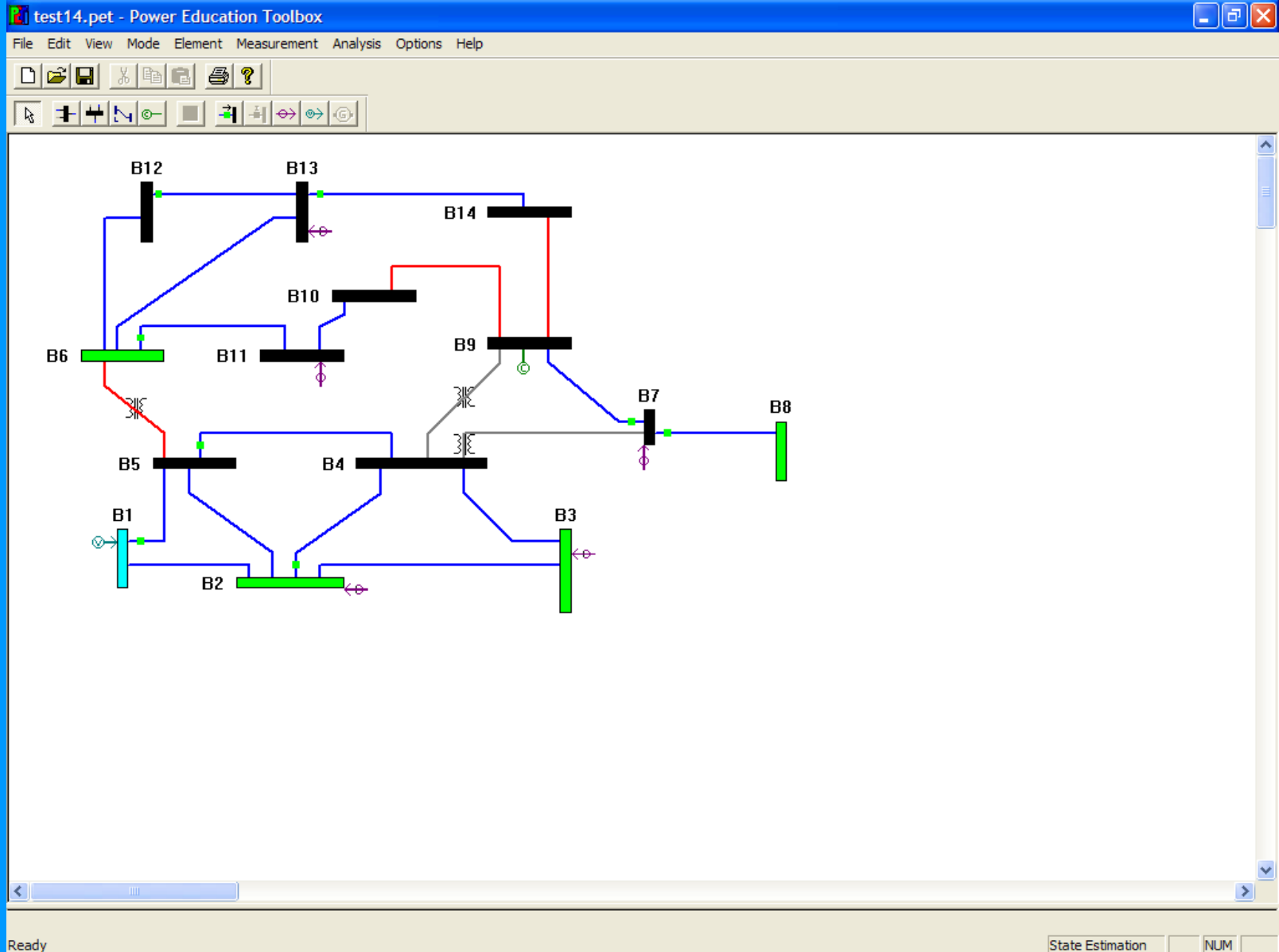
Connecting Buses:

| | | |
|-----------|----|--------|
| From Bus: | 9 | OK |
| To Bus: | 14 | Cancel |

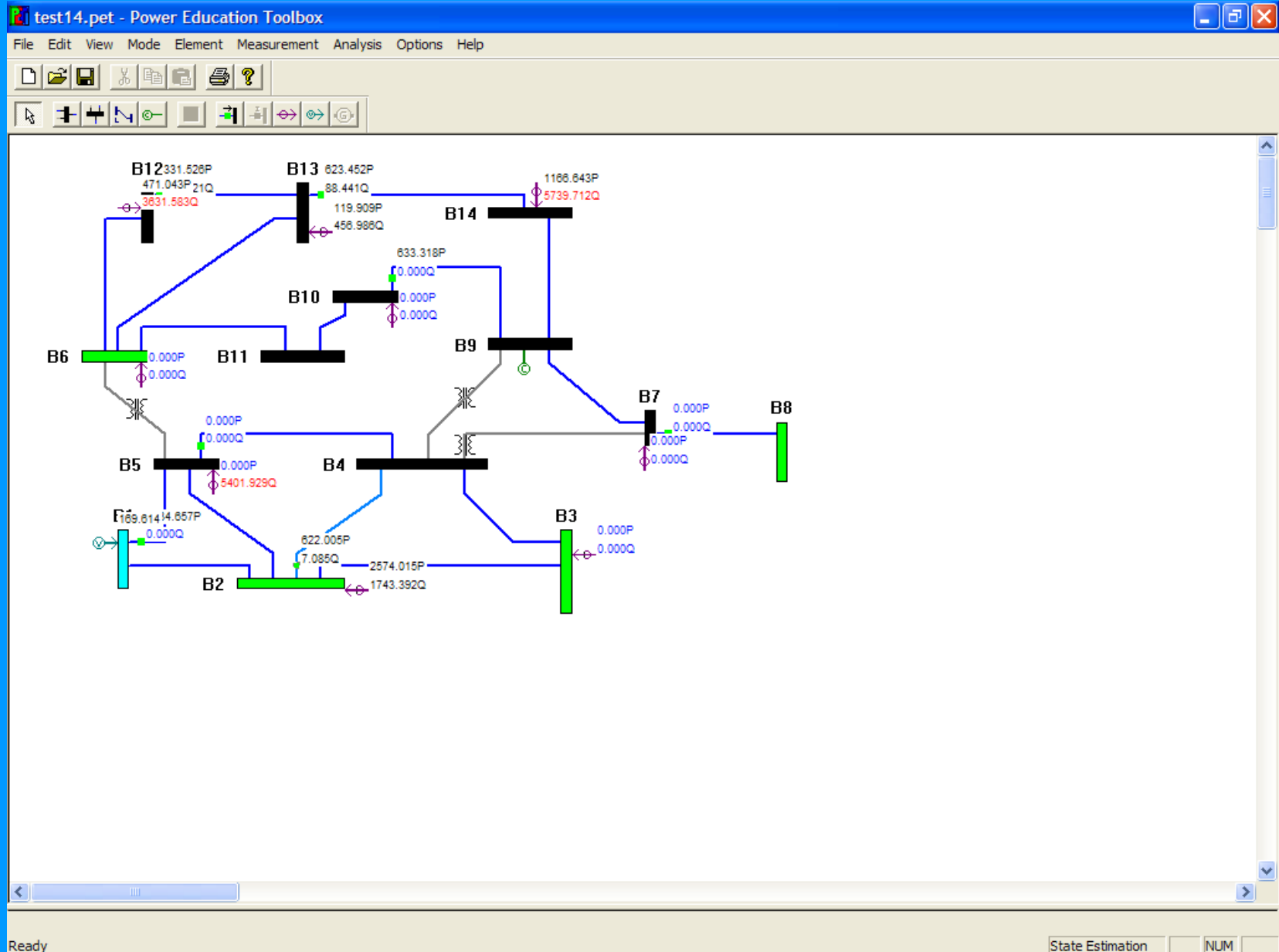
Change Direction

Ready State Estimation NUM

Observable Islands



Bad Data Identification



Software Utilization

- A training tool in courses that cover the subject of state estimation in some detail.
- It is also used frequently in short courses given to planning and operation engineers.
- If users wish to develop new or revised versions of existing algorithms and wish to test them against known systems and scenarios, such algorithms can be incorporated into the software as new applications.
- These applications are expected to use the same file exchange system in communicating with the existing applications.

Conclusions

- Software package developed primarily for educational use.
- The package has two parts:
 - User interface
 - Application functions
- The software has been in the public domain and used by educators, students and engineers for courses involving state estimation and its related functions.