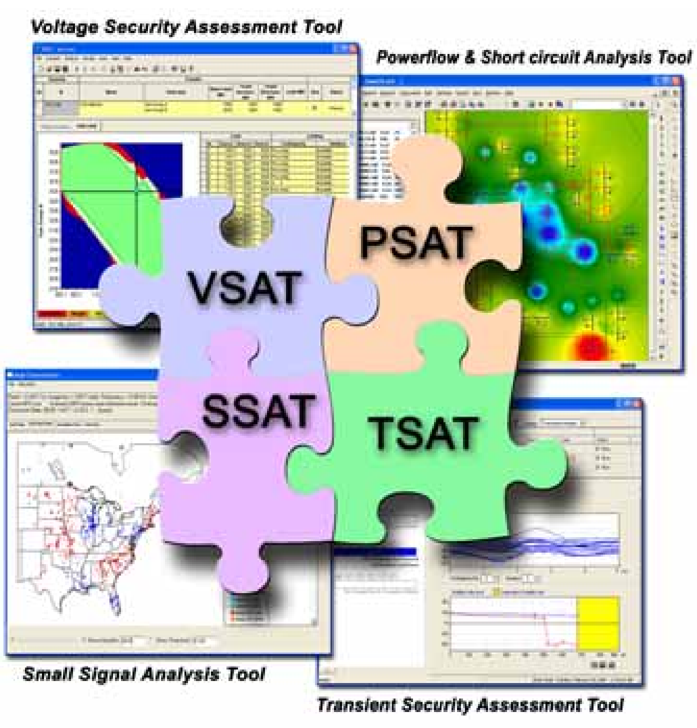
DSA*Tools*™
Dynamic Security Assessment Software

PSAT Powerflow & Short circuit Analysis Tool

PSAT is a state-of-the-art fully graphical powerflow program developed to provide the following functions:

- Full-featured powerflow and short circuit analysis capabilities for performing steady state system analyses required in system planning and operating studies. Such studies include steady-state voltage decline, line/transformer thermal loading, active/reactive power supply problems, contingency analysis, short circuit analysis, static network reduction, etc. For these applications, the program allows the user to easily manipulate the system parameters, quickly and reliably solve the powerflow, and examine the results in comprehensive output tables. It also provides the capability to import and export data in a variety of powerflow formats.

- Powerflow data preparation for input to other DSA*Tools*™ programs. This function entails input of powerflow data in a variety of commonly available formats, adding new network components and models, manipulating the data as required to obtain the desired initial system conditions, checking data quality, solving the powerflow, reporting powerflow solution quality, and providing this data to other applications.



Product Features

- Full graphical user interface
- Comprehensive modeling capabilities
- State-of-the-art solution algorithms
- Sophisticated single-line diagram (SLD)
- Data manipulation via tables or SLD
- Results display on SLD
- Handles a variety of input formats
- Short circuit calculation
- Static network reduction
- Support to macros and Python scripts

- Support to a wide range of models, including conventional network models, true three-winding transformer model, FACTS models, switched shunt models, two and multi terminal HVDC models, negative and zero sequence network models for short circuit analysis.

- Complete single-line diagram (SLD) functionality. SLDs can be readily drawn by using the dragging -and-dropping approach. All system data can be entered and modified via SLD. System data, as well as powerflow solution results can be displayed on SLD. Advanced features such as animation and contouring are available for enhanced result visualization.

- Advanced features, such as support to macro and Python scripts, are available.

PSAT is designed for powerflow analysis, as well as for use with the other components in the **DSA*Tools***™ Suite including VSAT, TSAT, and SSAT. Together they form a powerful analysis package for the comprehensive planning and operation studies needed for today's complex power systems.

Data Entry, Manipulation, and Verification

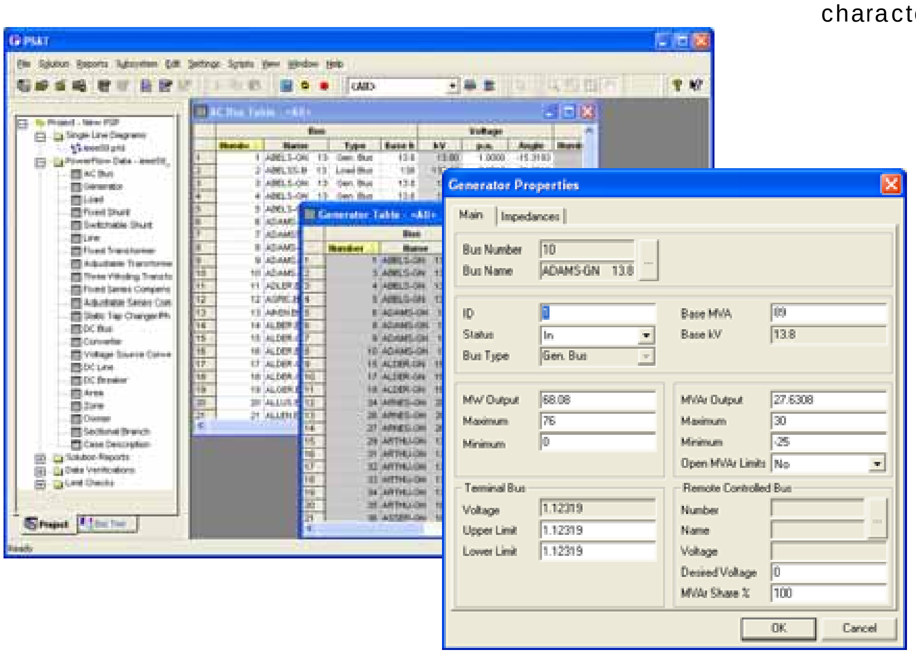
All input data in PSAT can be entered and viewed using data tables. Data tables can be used to display data of all components in the system. The user can customize these tables to show data for a defined subsystem and/or in a specific order. In addition, PSAT has powerful Single-Line Diagram (SLD) capabilities which allow the user to create diagrams by using a few straightforward techniques. Two display modes are available for SLD: system view and bus view, to suit for different applications. The user can customize SLD to indicate component properties by using colors and line thickness.

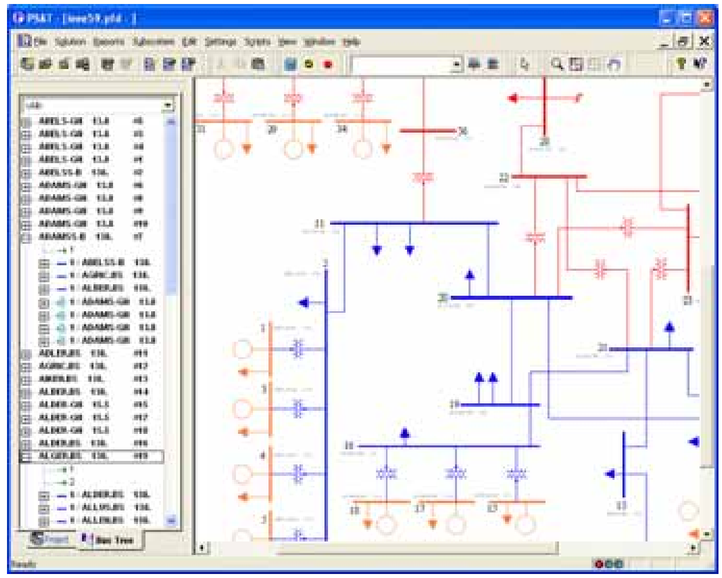
Data changes can also be applied by rules, for example, scaling load, generation, and shunt.

All powerflow data as well as SLDs can be exported to other applications in a variety of formats (such as Excel).

PSAT offers a comprehensive set of data sanity check functions including:

- Network topology checks such as identification of isolated buses, islands, and parallel branches with the same ID.
- System parameter checks such as branches with unusual parameters, transformers with unusual tap ratios, and negative load/generation.
- Other possible data problems such as branches connecting unequal buses, duplicate bus names, buses controlled by more than one device, non-identical parallel transformers.

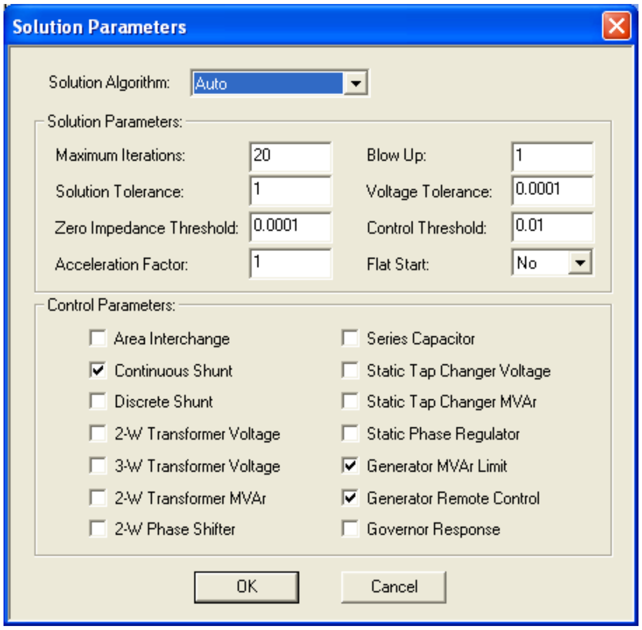




Modeling

PSAT provides a full range of conventional powerflow models as well as advanced models such as:

- **Generators**: The model allows local or remote voltage control within reactive power limits.
- **Loads**: Voltage dependency of load may be modelled by a combination of constant current, constant impedance, constant MVA, and functions of voltage with non-integer exponents.
- **Switchable Shunts**: The model allows local or remote voltage control by adjusting shunt admittance discretely, continuously or according to a droop characteristic (for SVC).
- **HVDC Links**: Two-terminal and multi-terminal HVDC systems are represented in PSAT with comprehensive converter models and flexible dc network configurations.
- **FACTS Devices**: Popular FACTS devices, such as SVC, STATCOM, TCSC, TCTCT, TCPST, and UPFC, can be modeled in PSAT.
- **Other models:** Phase shifter, three-winding transformers, sectional branches, etc.

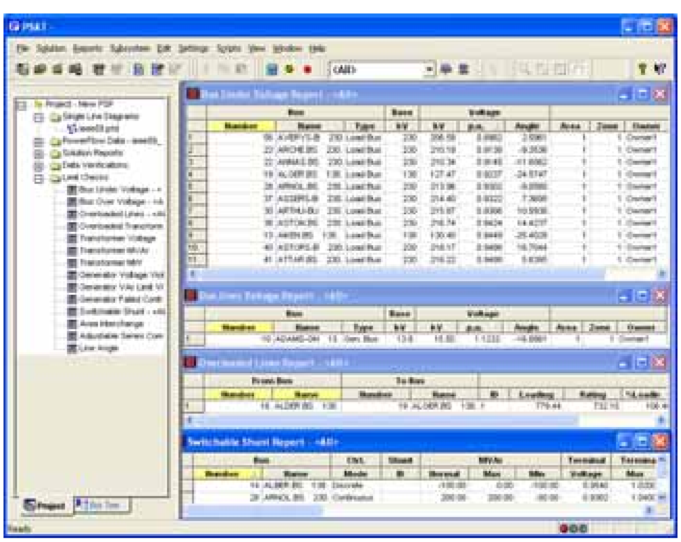


Powerflow Solution Techniques

In PSAT, the following powerflow solution algorithms are available:

- Fast Decoupled
- Newton-Raphson
- Automatic: The Fast Decoupled method is used first and the solution method is switched to Newton Raphson, if necessary, to achieve faster convergence.

During powerflow solutions, various powerflow controls can be enabled, such as switchable shunt and ULTC adjustments, area interchange control, FACTS controls, etc. PSAT uses an advanced Global Linear Programming technique for adjustment of devices controlling active and reactive power flows so as to improve the convergence of the powerflow solution.



Powerflow Solution Reporting

After a powerflow solution, the user can select from a wide array of output reports including:

- Mismatches of the solved powerflow.
- Individual component summaries, such as voltages, flows, etc.
- Subsystem summaries, such as load, generation, losses.

In addition, a number of solution checks can be performed, including:

- High/low bus voltages.
- Branch/transformer overloads.
- Failed or violated generator controls.

Powerflow solutions can be shown on SLD. Any criterion violations can be indicated on SLD with custom colours.

```
#--Python script to rename busses --
import math
import string
error = psat_error()
comp = psat_comp_id(ctype.bus)
#subsys_inc_bus(1,10000)
while get_next_comp (comp, error):
 n = get_int_prop(comp, prop.number, error)
 fltVal = get_real_prop(comp, prop.basekv, error)
 if fltVal < 60.0:
  f,i = math.modf(fltVal)
  if f != 0.0:
   newName = "Bus "+'%(#)5s'%{"#":str(n)}+"
   "+'%(#).1f'%{"#":fltVal}
   set_str_prop(comp, prop.name, newName, error)
  else:
   newName = "Bus "+'%(#)5s'%{"#":str(n)}+"
   "+str(int(i))
   set_str_prop(comp, prop.name, newName, error)
```

Macro and Scripts

The macro feature in PSAT allows all activities performed in a PSAT session to be recorded in a text file. The recorded macros can be edited and played back.

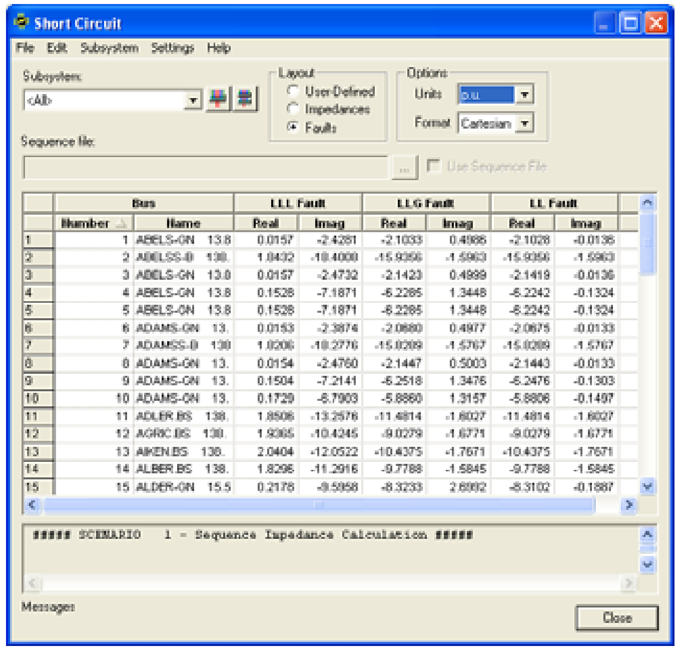
PSAT provides a set of function API compatible with Python scripting language. The user can create Python scripts that call these functions to execute various powerflow tasks.

Data Import and Export

PSAT has it's own powerflow data structure and format which can be stored either in ASCII or binary files. This powerflow data can be used by any of the **DSA*Tools***™ programs.

PSAT has the capability of importing and exporting the powerflow data in a variety of commonly used formats, including PSS/E, PSLF, IEEE, BPA, etc.

Other Features



The following analysis features are also included in PSAT:

- Power system components can be identified using bus numbers, bus names, or equipment names.
- MW and MVAR flow animation on SLD.
- Contour plot on SLD for bus voltage magnitudes and angles.
- Short-circuit calculations.
- Static network reduction.
- Comparison of powerflow cases.
- Analysis of power systems of up to 100,000 buses.
- Runs on MS Windows 2000/XP/Vista/7 platform.

Other Powertech Services

- Evaluation of transfer capability and security limits
  - Powerflow analysis
  - Transient Stability analysis
  - Small-Signal Stability analysis
  - Voltage Stability analysis
- Post-mortem analysis of system disturbances
- Frequency control assessment
  - Islanding studies
  - AGC & governor performance
  - Design and evaluation of under-frequency load-shedding schemes
- Increasing transfer capability
  - Control-tuning and design
  - Load shedding schemes
  - Reactive compensation planning
  - Special protection system design and verification
- Assessment of planning alternatives
- Custom modelling & dynamic model reduction
- Reliability Assessment of power systems
- Generator field testing, model development & validation
- Load characteristic measurement and model development
- Custom software and model development
- Training

In addition to extensive power system study capabilities, Powertech has a $50 million lab and test facility which includes high voltage, high current, and high power labs, as well as capabilities in hydrogen technologies, chemistry, metallurgy, and materials engineering.

For more information contact

Powertech Labs Inc.
12388-88th Ave
Surrey, British Columbia
CANADA V3W 7R7

Phone (604) 590-7500
Fax (604) 590-6656
Email DSAinfo@powertechlabs.com
Web www.dsatools.com

Powertech
www.powertechlabs.com