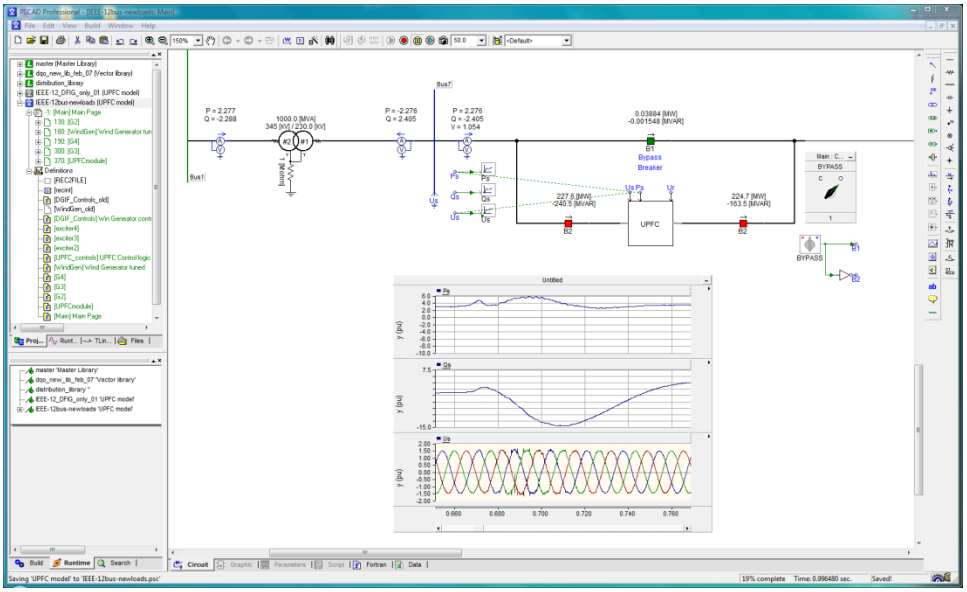
PSCAD Circuit Development

This document provides a discussion of circuit development for PSCAD V4.2.1. For a complete description of the PSCAD circuit development, please see the online help within the PSCAD environment, or view the PDF documents contained in the help directory of the PSCAD CD-ROM.

PSCAD® is the professional's simulation tool for analyzing power systems transients. It is also known as PSCAD®/EMTDC™. EMTDC™ is the simulation engine, which is now the integral part of PSCAD®. PSCAD® is most suitable for simulating the time domain instantaneous responses, also popularly known as electromagnetic transients of electrical systems.

The PSCAD® Graphical Interface greatly enhances the power and usability of the simulation environment. It allows the user to schematically construct a circuit, run a simulation, analyze the results, and manage the data in a completely integrated graphical environment.



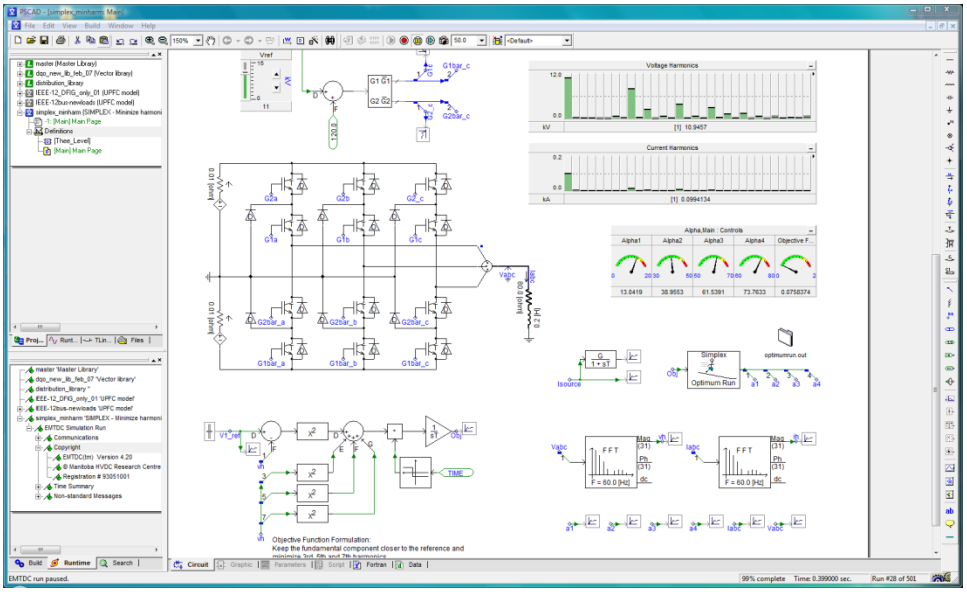
The following are some of the common components found in systems studied using PSCAD®:

- Fixed and variable resistors (R), inductors (L), capacitors (C)
- Mutually coupled windings, such as transformers, saturable inductors
- Frequency dependent transmission lines and cables
- Current and voltage sources
- Switches and breakers with optional pre-insertion resistance
- Diode, thyristor, GTO, IGBT, and other power electronic switching devices
- Analog and digital control functions, Laplace functions and signal generators
- AC and DC machines, exciters, governors, stabilizers and inertial models
- Meters and measuring functions
- Generic DC and AC controls
- HVDC, SVC, FACTS and Power Electronic Converters and their control circuits

The PSCAD® environment has been designed with users in mind; care and attention has been paid to ensure that operations are smooth, fast, and intuitive.

Enhanced Workspace

New views allow you to navigate with more detailed runtime information and files. Most plotting and online control display design, as well as navigational operations can now be performed directly from the tree view. For example, output and control channels may now be dragged and dropped directly from the tree view onto a plot or control panel on the drawing canvas.



PSCAD: A COMPREHENSIVE DESIGN AND ANALYSIS ENVIRONMENT

All input, output, and program operations are accessible from the PSCAD® Environment. Output can be stored for later analysis by other tools, graph data can be copied and pasted into Excel right from the graph frames, and graphics can be copied by WMF and pasted directly into MS Word to aid report creation.

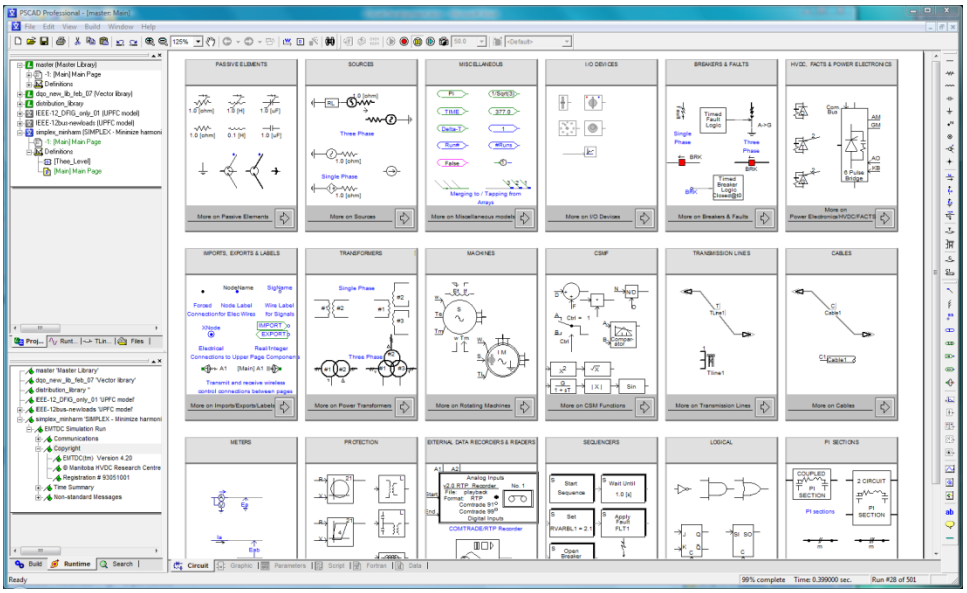
The Workspace

The workspace is used to manage many cases and libraries on one integrated environment. The PSCAD Graphical User Interface provides a comprehensive set of tools to perform:

- Drawing canvas where the circuit is developed, component parameters are set, interactive controls and output plots are all combined into one simulation environment
- Button bars for commonly used components
- Search tools to quickly find data or errors
- Output window to view messages and textual output from EMTDC or Line Constants
- A fully integrated Component Editor to develop your own component and custom libraries
- Full F95 Fortran support and support for the Fortran Debug Environments to assist you in locating those pesky bugs

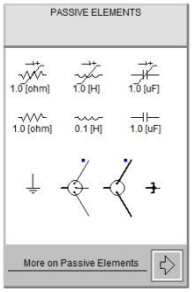
Comprehensive Master Library

The master library of PSCAD®, with over 280 flexible and validated components, allows our users to build advanced nonlinear models of the power system combining generation, transmission, power electronics, distribution, and most importantly control circuits into one or several large models.



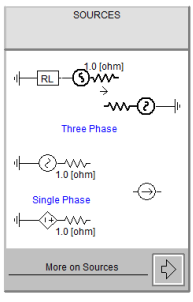
A PSCAD model exhibits many of the same behaviours as a real power system – so much so that engineers and technicians must exercise care in building a simulation model. Components must be correctly wired and appropriate settings provided for proper and expected operations.

Some of the following are key elements contained in our master library.



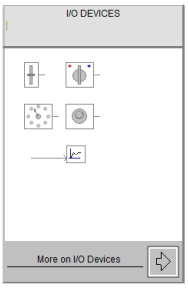
Passive Elements

The master library contains many fixed and variable resistors (R), inductors (L), capacitors (C), loads, filters, buses, wires, transpositions, and 3-phase breakout components. All of these components can be assembled in arbitrary fashion. Electrical components are modeled together and solved in EMTDC, and control components are assembled into Fortran statements and are bound to the EMTDC executable.



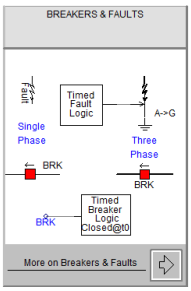
Sources

A large variety of voltage and current sources are available for use in your simulations. Included are three phase and single phase voltage and current sources, including fixed, variable, or externally controlled. Manual sliders or signal generators can be connected to these sources to produce any type of signal.



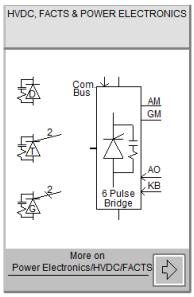
Input/Output

The master library contains special I/O components in the form of sliders, switches, dials, and buttons. These components are used to manually control your simulation by connecting and controlling voltage levels, control gains, breaker and fault status, etc. Various output components and constructs are also available.



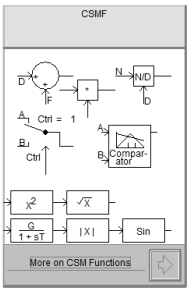
Breakers and Faults

Three phase and single phase breakers and various faults, plus associated timing utilities.



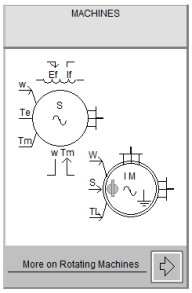
Power Electronics

Various power electronic elements are contained in this module of the master library. The ability to simulate nonlinear power electronics elements is a core technology of the PSCAD tool set. GTOs, Thyristors, Transistors, IBGTs, Diodes, Lightning Arrestors, 6-pulse bridges, and interpolated firing pulse generators form the basis of the technology. A generic SVC model and HVDC controls are also available.



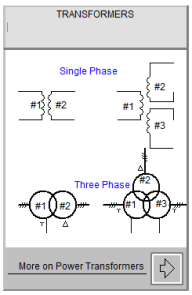
CSMF Controls Functions

Both analog and digital controls are available allowing a user to construct any arbitrary control system, simple or complex. These control systems interact with the power system, and vice versa providing a power method to study control system behaviour.



Machines

This module contains various synchronous 3-phase machines, squirrel cage induction machines, wound rotor induction machines, doubly fed induction machines, and IEEE exciters, governors, and power system stabilizers.



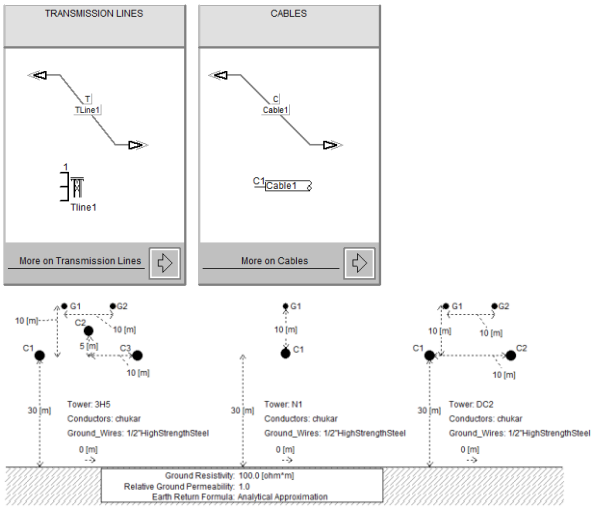
TRANSFORMERS

This module contains our single and 3-phase transformers, autotransformers, and universal magnetic equivalent core transformer models with both IEC and ANSI representations. Several of the transformers offer on-load tap changer capability.

TRANSMISSION LINES AND CABLES

The most difficult modeling challenge of any time domain simulation program is to model Transmission Lines and Cables. Although conceptually simple, the science to effectively model the Frequency Dependent nature of a transmission line or cable requires the convergence of many mathematical techniques.

The library includes full frequency dependent traveling wave transmission line models in both the phase and modal domains. A Bergeron transmission line model is also provided which was the first travelling wave model ever developed and useful for 50 or 60 Hz studies.



SEQUENCER COMPONENTS

Sequencer components are part of a special group of control elements, which can be combined together to form a 'Sequence of Events' based on timers, delays and/or other conditions.

MULTIPLE RUN

This component provides a visual programmable method of running a simulation many times for "what if" analysis. Multiple parameters are controllable and many values can be recorded to determine best run.

Optimum Run

Optimum Run takes advantage of new advancements in multiple run optimizations. It comes with Hookes-Jeeves, Golden Section, and Simplex optimization methods to intelligently reduce the number of multiple runs required. A genetic optimization algorithm is forthcoming in the next release of PSCAD.