Network Analysis

Short Circuit - ANSI
Short Circuit - IEC
Load Flow
Motor Acceleration
Power System Enterprise Solution

ETAP is the most comprehensive analysis platform for the design, simulation, operation, control, optimization, and automation of generation, transmission, distribution, and industrial power systems.
Customize ETAP to fit your needs, from small to large power systems

ETAP Enterprise Suite provides one solution to your power system design, analysis, and operation needs. ETAP offers a comprehensive suite of analysis modules that can be configured to suit your specific needs. This modular approach allows you to purchase only the modules you need.

Featured in this brochure
As Easy as 1, 2, 3

Save hours of tedious hand calculations and take the guesswork out of short circuit studies by automating the process with multiple calculation and result analysis tools within ETAP.

The Short-Circuit module makes it easy to go from selecting elements from the comprehensive libraries of short circuit current ratings to performing dozens of different types of short circuit analysis with the purpose of finding the worst-case device duty. Built-in intelligence allows it to automatically apply all ANSI / IEEE or IEC factors and ratios required for high- and low-voltage device duty evaluation. Determine fault currents and automatically compare these values against manufacturer short circuit current ratings. Overstressed device alarms are automatically displayed on the one-line diagram and reports.

The Short-Circuit module seamlessly integrates with device coordination and performs arc flash hazard calculations.
Device Duty Calculation & Evaluation for Single & Multiple-Phase Systems, Panel, & UPS

ANSI and IEC standards are used for calculating short circuit current for parts of the network below main panels, subpanels, UPS, and phase adapters. Device duty calculation compares the calculated fault current from these networks for evaluation of protective devices and automatically generates critical and marginal alerts based on user-defined alarm limits.

Capabilities

- Automatic 3-phase device evaluation
- Device evaluation based on total or maximum through fault current
- Automatically adjust conductor resistance & length (both lines & cables)
- Global or individual device impedance tolerance adjustments for maximum & minimum fault currents
- Include / exclude fault impedance modeling for unbalanced faults
- Include / exclude shunt admittance for branches & capacitive loads (unbalanced faults)
- Graphical or tabular bus fault selections
- Automatically determine fault currents at motor terminals without the need to add additional buses
- Phase-shifting transformers
- Grounding models for generators, transformers, motors, & other loads
- Motor contribution based on loading category, demand factor, or both
- Extract manufacturer published data from the libraries for thousands of devices
Features

- 1-phase & panel systems device evaluation
- Determine maximum & minimum short circuit fault currents
- Calculate ½ cycle, 1.5–4, & 30 cycle balanced & unbalanced faults (3-phase, L-G, L-L, L-L-G)
- Check momentary & interrupting device capabilities
- Check closing & latching capabilities
- Evaluate symmetrical or total rated circuit breakers
- Special handling of generator circuit breakers for system & generator faults
- Interrupting duty as a function breaker contact parting time
- Standard & user-definable contact parting time
- Automatically includes No AC Decay (NACD) ratio
- User options for automatic adjustment of HVCB rating

Standards

IEEE C37.04 Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current including Supplements: IEEE C37.04j, IEEE C37.04g, IEEE C37.04h, IEEE C37.04i

IEEE C37.010 Standard Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current

IEEE C37.010b Standard and Emergency Load Current-Carrying Capability

IEEE C37.010e Supplement to IEEE C37.010

IEEE C37.13 Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE C37.013 Standard for AC High-Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis

IEEE C37.20.1 Standard for Metal Enclosed Low-Voltage Power Circuit Breaker Switchgear

IEEE 399 Power System Analysis – the Brown Book

IEEE 141 Electric Power Distribution for Industrial Plants – the Red Book

IEEE 242 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems – the Buff Book

UL 489_9 Standard for Safety for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures

Reporting (ANSI & IEC)

- Load terminal fault current reporting
- Automatically flag marginal & critical overstressed devices
- Individual fault current contributions for I_{sym}, I_a, & 3I_b
- Phase & sequence voltage profiles (V_a, V_b, V_c, V_1, V_2, & V_0)
- Phase & sequence current profiles (I_a, I_b, I_c, I_1, I_2, & I_0)
- Phase & sequence impedances
- Alert view to display critical & marginal limit violations
- Export one-lines with short circuit results to third party CAD applications
- Input data, detailed individual & total short circuit contributions, & summaries
- Enhanced state-of-the-art graphic display of results for balanced & unbalanced faults
- Export output reports to your favorite word processor or spreadsheet
- Full color customizable Crystal Report® viewers

Reporting: Load terminal fault current reporting
IEC Standards

Features

- 1-pole / 2-pole short circuit device duty for 1-phase panel / UPS systems
- Unbalanced L-G, L-L, & L-L-G faults analysis
- Transient IEC 61363 short circuit calculations
- Compares device ratings with calculated short circuit values
- User-definable voltage C factor
- Service or ultimate short circuit current ratings for LVCB breaking capability
- User-definable R/X adjustment methods for \( I_p \) (method A, B, or C)
- Phase-shifting transformers
- Negative or positive impedance adjustments for max/min \( I_p \) & \( I_k \)
- Automatic application of K correction factors (i.e., KT, KG, KSO)
- Automatically determines meshed & non-meshed networks for calculating \( I_p \), \( I_k \), & \( I_{dc} \)
- \( I_p \) for meshed network is adjusted by individual machine contributions for improved accuracy
- Considers both near & far from generator short circuits
- Generates relay test set compatible plots for transient short circuits
- Detailed IEC device duty reports & complete contributions for unbalanced faults

Standards

- IEC 62271-100 High-Voltage Switchgear and Controlgear, Part 100: High-Voltage Alternating-Current Circuit Breakers
- IEC 62271-200 High-Voltage Switchgear and Controlgear, Part 200: AC Metal-Enclosed Switchgear and Controlgear for Rated Voltages Above 1 kV and up to and including 52 kV
- IEC 62271-203 High-Voltage Switchgear and Controlgear, Part 203: Gas-Insulated Metal-Enclosed Switchgear for Rated Voltages Above 52 kV
- IEC 60282-2 High-Voltage Fuses, Part 2: Expulsion Fuses
- IEC 60909-0 Short Circuit Currents in Three-Phase AC Systems, Part 0: Calculation of Currents (including 2002 Corrigendum 1)
- IEC 60909-1 Short Circuit Currents in Three-Phase AC Systems, Part 1: Factors for the Calculation of Short Circuit Currents According to IEC 60909-0
- IEC 60909-4 Short Circuit Currents in Three-Phase AC Systems, Part 4: Examples for the Calculation of Short Circuit Currents
- IEC 60947-1 Low Voltage Switchgear and Controlgear, Part 1: General Rules
- IEC 60947-2 Low Voltage Switchgear and Controlgear, Part 2: Circuit Breakers
- IEC 61363-1 Electrical Installations of Ships and Mobile and Fixed Offshore Units, Part 1: Procedures for Calculating Short Circuit Currents in Three-Phase AC
Create & Validate System Models with Ease & Accuracy

With ETAP’s advanced Load Flow module, you can create and validate your system model with ease and obtain accurate and reliable results. Built-in features like automatic device evaluation, summary alarms / warnings, result analyzer, and intelligent graphics make it the most efficient Load Flow program available today.

ETAP calculates bus voltages, branch power factors, currents, and power flows throughout the electrical system. ETAP allows for swing, voltage regulated, and unregulated power sources with multiple power grids and generator connections. It is capable of performing analysis on both radial and loop systems. ETAP allows you to select from several different methods in order to achieve the best calculation efficiency and accuracy.

Intelligent Graphics: State-of-the-art graphical display of results including voltage drop, load terminal voltage, branch losses, and transformer LTC settings.
Most Efficient Load Flow Program Available

Study Options
- Option to update initial conditions
- Phase-shifting transformers
- Auto-adjust LTC / regulator settings
- Power factor correction
- Saves solution control parameters for each scenario
- Make changes to your system & re-run studies instantly
- Conduct unlimited “what if” studies within one database
- Calculate bus voltages, currents, & power factors
- Bus / transformer / cable reactor overload warnings
- Calculate power flows
- Update loading for DC load flow
- Voltage drop calculations
- Five levels of automatic error checking

Capabilities
- Simulate multiple loading & generation conditions
- Automatically adjust transformer tap & LTC / regulator settings
- User-controlled convergence parameters
- Compare & analyze multiple reports using result analyzer
- Include effect of phase-shifting transformers
- View results graphically
- Evaluate critical & marginal limit violations
- Solve 3-phase & 1-phase system load flow simultaneously
- Isolated 1-phase source modeling

Flexible Operation
- Diverse operating conditions
- Multiple loading categories
- Multiple demand factors
- Different model of lumped loading
- Unlimited configurations
- Different nameplate data
- Global & individual bus diversity factors

3-Phase and 1-Phase Power Flow: Calculate power flow for 3-phase, 1-phase, panel, and UPS systems simultaneously

Automatic Device Evaluation: Automatically generate critical and marginal alerts for overstressed 3-phase and 1-phase systems
Simultaneous Analysis of Different Scenarios

Load Flow Result Analyzer
ETAP Load Flow Result Analyzer is a time-saving tool that compares and analyzes multiple reports in a single view. You can compare the results of general information about a project or more specific information such as the load flow results for buses, branches, loads, or sources.

- Understand results of multiple studies in one glance
- Compare & view multiple load flow results in a single view
- Analyze & compare reports from multiple projects
- Create a base line report & quickly identify deviations for all cases
- View multiple bus, branch, load, & source results
- Advanced alert & warning feature identifies & highlights overstressed components
- Easily find components on one-line diagrams from the analyzer view
- Export summary view into Microsoft® Excel for maximum data flexibility & visualization
Detailed Modeling with Accurate Results

Features
- Newton-Raphson, fast decoupled, & accelerated Gauss Seidel
- Generator governors with isochronous or droop mode
- Generator exciters with AVR or Mvar / PF controllers
- Transformer load tap changers (LTC / regulators)
- Advanced solution techniques for fast convergence
- Multiple loading conditions
- Multiple generation conditions
- Swing, voltage regulated, & unregulated power sources
- Voltage drop calculations
- Load forecasting
- Alert view to display critical & marginal limit violations
- Bus / transformer / cable overload warning
- Single-phase load flow display
- Global & individual bus diversity factors
- Individual demand factors for continuous, intermittent, & spare operating conditions
- Option to update the initial condition from load flow solutions
- Phase-shifting transformer
- Power factor correction
- Multi-report result analyzer
- Unlimited bus capability

Reporting
- State-of-the-art graphic display of results
- Customize output reports using Crystal Reports®
- Generate output reports in any language
- Voltage drops, losses, power flows, power factor, etc.
- Input data, detailed load flows, & summaries
- Export reports to your favorite word processing program
- Graphically display device evaluation results
- Graphically display buses with marginal or critical under / over voltage
- Export one-line diagrams including results to third party CAD systems
- Alert view to display critical & marginal limit violations

Extensive Reporting: Detailed load flow reports and indispensable summaries including branch losses, voltage drop, and loading

Load Flow Analysis | 11
Advanced Technology in Motor Evaluation & Simulation

The Motor Acceleration module enables engineers to thoroughly evaluate the impact of load changes to electric power systems. Motor Acceleration is fully capable of starting one motor or transitioning an entire power system to another state. Sequence-start a series of machines using static or dynamic models, operate Motor Operated Valves (MOVs), and simulate the switching actions of Load Tap Changers. Advanced plotting and time varying graphical display enable engineers to quickly evaluate results and make decisions.
Quickly Evaluate Results & Make Decisions

Motor Acceleration

Capabilities
- Accelerate / stop multiple motors
- Dynamically model motors & loads
- Create unlimited sequence of events
- Compare the response from various motor starters
- Simulate load ramping of starting motor
- Transition loading of entire system
- Vary generator / grid operating parameters
- Visualize results with extensive alerts & warnings
- Simulate transformer LTCs / voltage regulators
- Simulate MOVs with five operating stages

Comprehensive Modeling
- No voltage or system connection limitations
- Induction / synchronous motor dynamic models
- Typical & user-defined load models
- Global or individual LTC time delays
- Transformer phase shift
- Motor acceleration with VFD & soft starters
- Starting devices: auto-transformer, capacitor, rotor / stator R or X, Y/Δ, partial winding, etc.
- Voltage, current, or torque controlled soft starters
- Five levels of automatic error checking

Motor Starting Time-Slider: View time domain results graphically

Dynamic Modeling: Complete modeling of machines and connected load
Reporting

- Graphical display of time-varying results
- Auto-alert abnormal conditions with marginal or critical levels
- Graphically display buses with marginal or critical voltage levels
- Comprehensive plots with operation details
- Export one-line diagrams including results to third party CAD systems
- Export to your favorite word processing program

Comprehensive Reporting: Customizable output reports using Crystal Reports®

Automatic Result Validation / Alert

- Motor start failure
- Under-voltage for starting motor / MOV
- Under-voltage buses per bus type & voltage level
- Overloaded generator & prime mover
- User-defined marginal & critical alert limits

Libraries & Models

- Double-cage (dependent circuit)
- Double-cage (independent circuit)
- Single-cage (without deep-bar)
- Single-cage (deep-bar)
- Characteristic motor model
- Polynomial & characteristic load models

Realistic Operation: Simulate load and generation transitioning
Comprehensive & Reliable Tools for System Analysis

Features

- Multiple motor / load acceleration / stop & sequencing
- Switch on / off static loads & capacitors
- Open / close MOVs with five operating stages
- Include transformer LTC / voltage regulator action
- Generator / grid operating parameters & load profiles
- Multiple loading conditions & generation levels
- Different loading categories for pre-start conditions
- Motor load ramping
- Group actions
- Individual actions
- Start / stop by group
- Group start globally or by individual bus
- Start, stop, & restart in a single run
- Fast bus transfer using load transitioning
- Unlimited actions in each event
- Unlimited events in one simulation
- Unlimited simulations stored in study cases
- Change & rerun studies instantly
- Motor nameplate library
- Motor circuit model library
- Motor characteristic model library
- Polynomial based load model library
- Curve based load model library
- Integrated with motor parameter estimation
- Automatic alert & warnings
- Simulate motor starters including soft-starters
- VFD for starting & running operation
- Comprehensive & flexible plots & reporting
- Execute multiple preset simulations at one-click with Study Wizard

Plots

- Motor
- MOV
- Static Load
- Capacitor
- Generator
- Bus
- Slip / Speed
- Terminal / bus voltage
- Torque
- Electrical power
- Mechanical power
- Terminal / Line Current
- Generator / grid current, power, & power factor
- Frequency
- Volts per Hertz

Customized Results

- Include multiple axes
- Display multiple motors simultaneously
- Zoom to any detail
- Export data to Microsoft® Excel
- Change text & axes
- Line, bar, 3-D, & scatter plots
etap.com

Quality Assurance Commitment
ETAP is Verified and Validated (V&V) against field results, real system measurements, established programs, and hand calculations to ensure its technical accuracy. Each release of ETAP undergoes a complete V&V process using thousands of test cases for each and every calculation module. ETAP Quality Assurance program is specifically dedicated to meeting the requirements of:

ISO 9001:2009
10 CFR 21
10 CFR 50 Appendix B
ANSI/ASME N45.2
ANSI/N45.22
ANSI/IEEE 730.1
CAN/CSA-Q396.1.2

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