Star - Device Coordination
ARTTS - Relay Testing & Simulation
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
The Most Comprehensive Device Protection & Coordination Analysis Solution

ETAP Star device protection and coordination program provides an intuitive and logical approach to Time Current Characteristic (TCC) analysis with features and capabilities such as graphical user interface, true-to-the-form protective devices modeling, extensive Verified & Validated (V&V) device library, embedded analysis modules, and integrated, rule-based design.

Using intelligent one-line diagrams, comprehensive device libraries, and a three-dimensional database, ETAP Star offers insight into troubleshooting false trips, relay mis-operation, and mis-coordination.
Protective Device Coordination & Selectivity

Capabilities
- AC & DC coordination
- ANSI & IEC coordination & protection standards
- Phase & ground coordination modes
- Graphically adjustable device settings
- Comprehensive V&V device libraries
- Integrated with one-line diagram
- Intelligent alert view for troubleshooting
- Embedded short circuit analysis
- Embedded motor acceleration analysis
- Modeling of multi-function & multi-level relays
- Virtual animation of sequence-of-operation playback
- Normalized plots shifted based on fault contributions
- Flexible user-definable display & plot options
- Extensive damage curve modeling & plotting
- Professional time current characteristic plots
- Detailed device setting reports
- Built-in interface with relay test set

Protective Device Handling
- High impedance & percentage differential relay (87)
- Phase, ground, & directional overcurrent relay (51/50, 67)
- Detailed implementation of voltage restraint & control relay (51V)
- Comprehensive modeling of electronic & hydraulic reclosers (79)
- Overload relay - CT based & Inline relays (49)
- Comprehensive relay interlocks
One Action Resulting in a Complete Solution

Features

• Illustrate system wide coordination
• Click & drag curves to adjust settings
• Automatic current & voltage scaling
• Customizable TCC curve layout with embedded one-line diagram
• Automatic layout of the one-line diagram in Star TCC View
• Integration of short circuit analysis with protective devices
• Motor starting curves based on motor acceleration studies
• Integration of arc flash analysis results on Star TCC View
• Multi-axis time current curves
• Automated color sequencing of curves
• Graphical curve tracker with cross lines & time gap tools
• Time difference calculator
• Adjustable magnifying-glass zoom view

Benefits

• Enables system engineers to easily & efficiently perform protective device coordination studies
• Provide an accurate & realistic operating characteristic, time, & state of protective devices
• Offers insight into troubleshooting false trips, relay mis-operation, & mis-coordination
• Aids system engineers & planners to quickly realize possible design issues & make informed decisions

Intelligent Alert View

With ETAP Star you can troubleshoot your device coordination studies for any Star View. The Alert View button on the Star View provides a summary of alerts or messages (low priority alerts) that provides hints as to how and why a particular device curve is not being displayed or missing information regarding a device.
Star Plot Options

Star Plot Options tool provides all the necessary options to customize the display of the Star TCC curve. You can customize the display of current and time axes, legend, grid, curve plotting properties, and more.

Graphical Adjustment

Device curves can be graphically adjusted in the Star View. Handles are provided on the device characteristic curves to identify adjustable regions. Available ranges for a selected curve can be displayed and identified by clicking the Hide/Show Range button. The available ranges are grayed out when an adjustable curve is selected.
Integration of Arc Flash Analysis & Star View

ETAP Arc Flash is a fully integrated module that takes advantage of all the capabilities already built into Star. The program calculates the individual arcing current contributions and arc fault clearing time of all the protective devices involved in the arc fault by interfacing with Star.

The calculated and allowable incident energy curves can be plotted in Star View as a function of time and current.

Generator Decrement Curve

Star provides plotting of the generator decrement curve and display both the symmetrical and asymmetrical decrement curve based on generator no-load or full-load conditions. Excitation system field forcing capability, used to speed up the response of the generator, is also considered when plotting the generator decrement curve.
Multiple Motor Starting & Damage Curves

A motor starting curve can be plotted on a Star view for the purpose of determining overload settings for motor protection devices. Constant Terminal Voltage can be used to plot the motor starting curve based on a constant voltage at the motor terminal.

The motor curves have been enhanced by including stator damage curve or running overload curve into Star. Stator curves can be plotted based on multiples of machine full-load amps or actual amp values.

Device Setting Report

Star Device Coordination Reports Manager provides comprehensive and customizable device setting reports. The manager allows you to preview and print the protective device setting data, using the Crystal Reports® formats.
Sequence-of-Operation

Star Sequence-of-Operation evaluates, verifies, and confirms the operation and selectivity of the protective devices for various types of faults for any location directly from the one-line diagram and via normalized TCC curve views.

Sequence-of-Operation provides a system wide solution for an accurate and realistic operating time and state of protective devices, such as relay, fuse, circuit breaker, trip devices, contactor, etc. The operation time is calculated for each protective device based on its settings, time current characteristic, and interlocks for a specified fault location and type.

Functionalities

• User-definable fault insertion location
• View device operation sequence graphically
• Device failure & backup operation
• Detailed relay actions (27, 49, 50, 51, 51V, 59, 67, 79, 87)
• Sequence of event viewer
• Normalized (shifted) TCC curves
• Phase & Ground faults (symmetrical & asymmetrical)
• Flashing protective device via the one-line diagram

Drag & Drop a Fault

• Phase & ground faults
• Display fault currents on the one-line diagram
• Illustrate system wide coordination
• Tabulate operating times via an event viewer
• Customizable reports
Graphical Animation of Protective Device Operation

Coordinate via One-Line Diagram

- Graphically place a fault anywhere on the one-line diagram
- Automatically calculate & display the fault current contributions on the one-line diagram
- Evaluate the operating time & state of devices based on the actual fault current contribution flowing through each individual device
- Graphical animation of protective device operation
- Globally view post fault actions & associated operating time via a tabulated event viewer
- Examine the operation of protective devices via the one-line diagram

Normalized TCC Curve

Normalized (Shifted) TCC mode is an analysis feature in ETAP Star View which is based on Sequence-of-Operation calculation. This analysis mode provides a graphical view of the operation times of protective devices based on their corresponding settings and characteristics for specified fault location and type. Normalized TCC mode graphically displays the TCC curves of protective devices in relation to one and another for a given fault.

Sequence of Event Viewer

The sequence of operation of protective devices are automatically calculated and listed in an Event Viewer, which is dynamically linked with the one-line diagram. This one-step concept utilizes the intelligent one-line diagram and performs a complete set of actions to determine the operation of all protective devices. This includes internal shifting (normalizing) of each TCC curve based on the individual fault contribution level.
Verified & Validated Device Libraries

Extensive Protective Device Library
- Library copy & merge manager
- Most comprehensive & up-to-date protective device information
- Verified & validated libraries using published manufacturer data
- User-definable libraries – easily create & add new devices
- Digitalization points & equation based relays
- True-to-the-form modeling of protective devices
- Legacy as well as state-of-the-art device manufacturer models
- Customized library – user curve library

Protective Device Libraries
- Fuse
- Relay (OCR, OLR, DIF)
- Recloser
- Electronic Controller
- HV Circuit Breaker
- LV Circuit Breaker
- Solid State Trip
- Electro-Mechanical
- Thermal Magnetic
- Motor Circuit Protector
- Overload Heater
Library Merge
ETAP allows merging of library files using the copy and merge functions. The merge function allows you to merge a partial or complete library file from one library to another library, making it simple to manage the library content from various library files.

Accuracy and Reliability
ETAP is the only high-impact electrical engineering software to comply with widely accepted and firmly established quality standards and regulations. Every release of ETAP is verified and validated (V&V) against field results, real system measurements, established programs, and hand calculations in order to ensure its technical accuracy. The V&V process includes the entire ETAP Library including the device libraries.
Advanced Relay Testing & Transient Simulator

Precise, Flexible, Accurate

Fully Integrated Hardware & Software Relay Testing Solution

The ETAP Advanced Relay Testing and Transient Simulator (ARTTS) is a new concept that utilizes hardware and software technologies for testing, calibrating, and simulating relays.

ETAP ARTTS combines the short-circuit and protection device coordination capabilities of ETAP with the relay testing hardware. It provides actual steady-state and transient responses of relays for comparisons with the manufacturers published data. ARTTS is designed to improve system protection, coordination, and reliability, hence decreasing operational and maintenance costs.

Relay Test Set Equipment
Relay Test Set Software
Test, Simulate, & Calibrate Relays, Meters, & Transducers
Manual & Fully Automatic Testing
‘Click & Test’ Feature for Quick Testing
Playback Transients from Fault Studies & Recorders
Export to Comtrade Format
Bridge Between Relay-Testing Hardware & Power System Simulation Technology

ARTTS provides the bridge between the relay-testing hardware and power system simulation technology. While ETAP Star provides a revolutionary method of analyzing and simulating the protective device coordination and protection view via an intelligent one-line diagram, ETAP ARTTS determines the actual operation of protective relays based on steady-state and dynamic transient waveforms and compares the captured relay response with that of manufacturer published curves.

Relay Test Set Interface

- Fully integrated protective relay historical testing & maintenance database with ETAP Star
- Export short circuit data, relays settings to relay test set
- Plot device steady-state response
- Compare relay response with manufacturer published data
- Analyze deviation from nominal values
- Display relay actual transient response
- Analyze relay false trips & mis-operation
- Comtrade export of time domain fault currents & voltages
Relay Actual Response

Steady-State Response

ETAP Star exports the relay settings and parameters to ARTTS for current injection into the relay. Based on the required range of the overcurrent and/or fault current, the relay test set then injects multiple currents (single-phase or three-phase) into the relay in order to reconstruct the relay TCC curve based on the actual relay response. The relay test points are then imported to ETAP Star for plotting and comparison with the manufacturer published data.

Transient Response

The ability to simulate relay response under steady-state and transient conditions during both fault and normal system operating conditions provides the necessary tools for protection engineers and technicians to confidently determine and evaluate the design and operation of protection system. Steady-state fault current provides only a snapshot operation of the relay based on sustained current. Transient fault simulation is necessary to determine the actual response time of the relay based on the distributed through fault containing AC and DC decay current.

The waveforms are generated from ETAP and are pragmatically played into the relay through ARTTS. This allows for verification of the relay operation under conditions matching actual system faults. By comparing these sets of curves, Star visually indicates the discrepancies and deviation between the actual (field setting) versus design (intended / ideal) device response characteristics.
ARTTS Software Modules

Integrated Software

ARTTS software is an advanced control software program for accessing all functions of the Automatic Relay Testing and Transient Simulator. This powerful software can be used for manual and fully automatic testing of protective relays, energy meters, and transducers.

The ARTTS software modules are extremely easy to use with intuitive graphical user interface and realistic representations of panel control and vector quantities. The ARTTS Wizard allows the user to easily and quickly select the most appropriate software program for the required application. The ‘Click and Test’ feature of the software makes relay testing more efficient and saves test time. Test sequences can be created and customized using the Sequence editor. Test results can be saved and customized using the report manager to suit user output requirements.

Features

- Intuitive graphical user interface
- Virtual front panel control
- Graphical vector control
- Ramp test with ability to sequence tests for ramping any parameter up or down at the same time
- Threshold test for automatic determination of thresholds (current, voltage, frequency, & phase angle)
- Rate of change (gradient) tests for frequency, voltage, current, phase-angle, & \(V_{dc} (\Delta x / \Delta t)\)
- Sequence editor
- Test of distance relays with direct import of relay characteristic with RIO format
- Test of distance relays with simulation of all types of faults: single-phase, two-phase, two-phase-to-ground, & three-phase
- Report manager for test report customization
- Export results in Windows® application formats
ARTTS-6

Capabilities

• Multi-tasking capability designed for testing protective relays, energy meters, & transducers
• Test 24 different relay types
• Playback transient signals from ETAP fault simulation, digital-fault recorders, & numerical relays
• High accuracy - typically .02%; 0.1% guaranteed
• Relay settings validation
• Advanced software program for manual & fully automatic testing
• Realistic representation of panel control & vector quantities
• Click & Test feature for efficient, quick testing
• Two-way synchronized data exchange
• Intuitive graphical user interface
• Virtual front panel control
• Graphical vector control
• Up to nine currents & seven voltages outputs plus auxiliary DC supply
• Customizable test report format
• Self-calibrating capability

Test Any Protective Relays

<table>
<thead>
<tr>
<th>Relay Type</th>
<th>IEEE No.</th>
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<td>Distance Relay</td>
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<td>Under/Over-Voltage Relay</td>
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<td>Field Relay</td>
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<td>Reverse Phase Current Relay</td>
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<td>Phase Sequence Voltage Relay</td>
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<tr>
<td>Incomplete Sequence Relay</td>
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<tr>
<td>Instantaneous Overcurrent Relay</td>
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<td>Inverse Time Overcurrent Relay</td>
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<td>Power Factor Relay</td>
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<td>Voltage Balance Relay</td>
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<td>Ground Detector Relay</td>
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<td>Phase Angle Out-of-Step Relay</td>
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<tr>
<td>Tripping Relay</td>
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</tr>
</tbody>
</table>
Automatic Relay Test Set

AC/DC Current Outputs
- Six independent current sources with a common neutral
- Independent adjustment of current outputs
- Continuous duty cycle
- 28 bit waveform resolution
- Capable of stepping or ramping the current
- Programmable rate of change (± 0.001 A/s to ± 999 A/s)
- Current accuracy: ± 0.1% of the value, ± 0.02% of the range
- 0.1% total maximum distortion
- Automatic protection for overload conditions

AC/DC Voltage Outputs
- Four independent voltage sources with a common neutral
- Independent adjustment of voltage outputs
- Continuous duty cycle
- 28 bit waveform resolution
- Stepping or ramping output voltage
- Programmable rate of change (± 0.001 V/s to ± 999 V/s)
- Voltage accuracy: ± 0.1% of the value, ± 0.02% of the range
- 0.1% total maximum distortion
- Automatic protection for overloads & counter-feed
- Fourth voltage output

Specifications
Multi-tasking automatic test set designed for testing protection relays, energy meters, & transducers.
- Output: 6 x 15A (80 VA) , 4 x 300V (80 VA), 1 x 260 VDC
- High accuracy: 0.1%, 0.05% (HP)
- Analog measurement inputs
- IEC 61850 protocol interface
- USB & RS232 port
- Controlled by laptop PC or local control by PDA
- Lightweight: 18 kg (39.7 lb)
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 9001:2000
10 CFR 21
ASME NQA-1
CAN/CSA-Q396.1.2

10 CFR 50 Appendix B
ANSI/ASME N45.2
ANSI/IEEE 730.1
ANSI N45.22

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