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

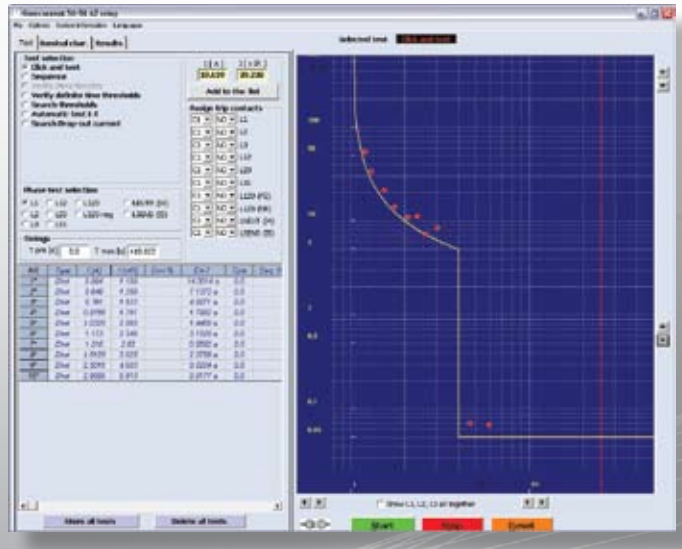
Test, Simulate, & Calibrate Relays, Meters, & Transducers

Manual & Fully Automatic Testing

'Click & Test' Feature for Quick Testing

Playback Transients from Fault Studies & Recorders

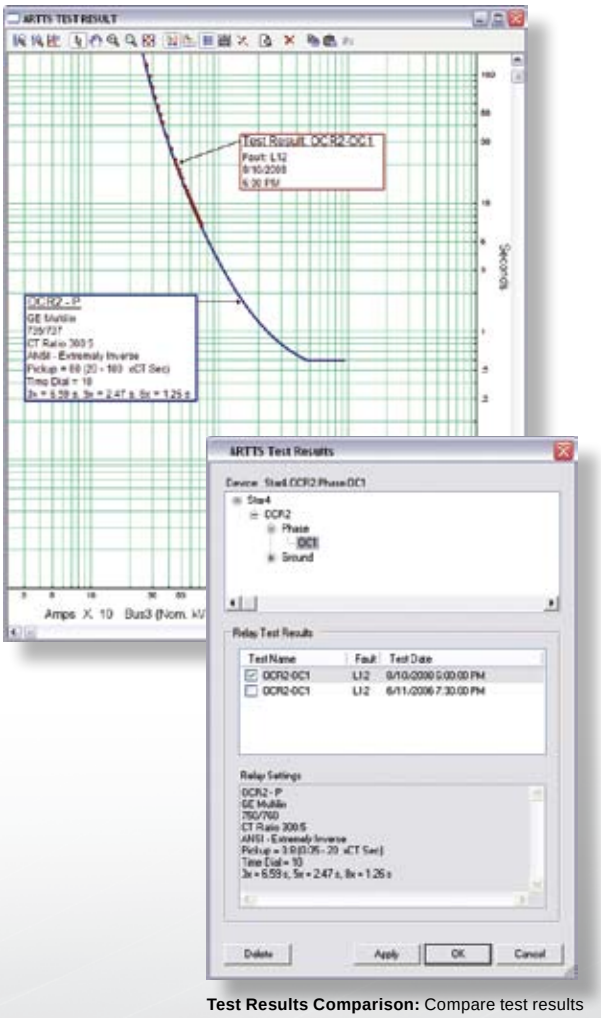
Export to Comtrade Format



Testing, Calibrating, & Simulating Relays

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.



Test Results Comparison: Compare test results with published curves

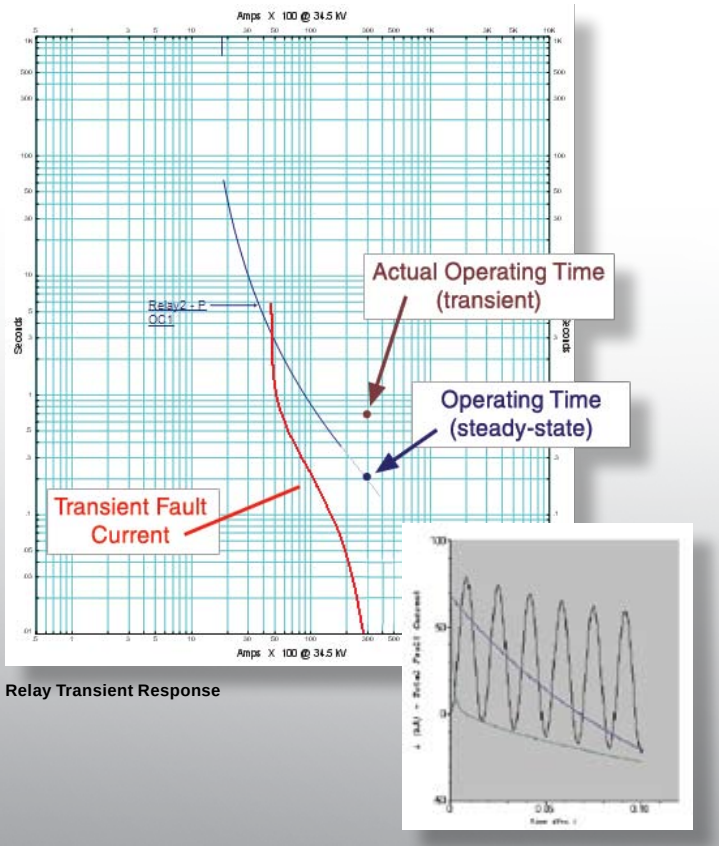
Relay Test Set Interface

- 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

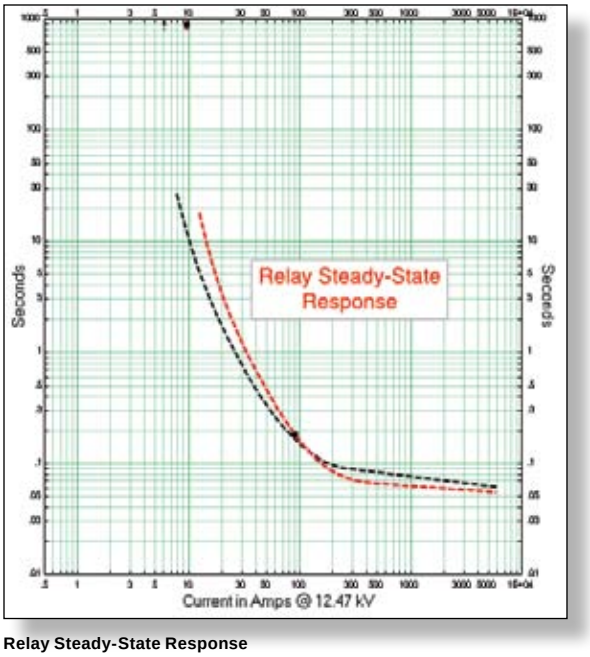
Relay Actual Response

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.



Relay Transient Response



Relay Steady-State Response

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.

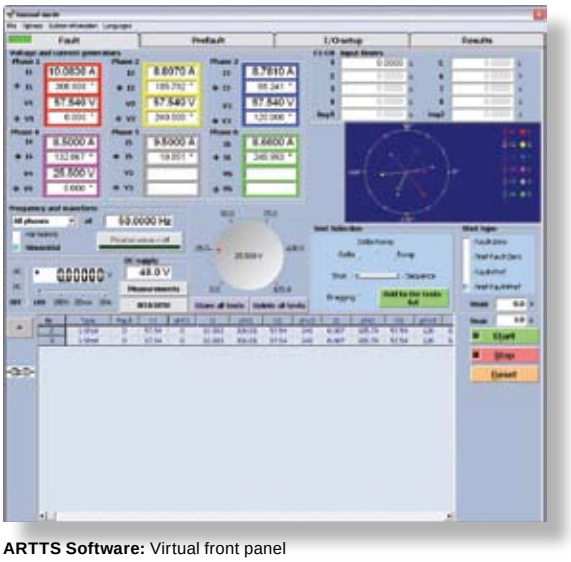
The waveforms are generated from ETAP and are pragmatically played into the relay through ARTTS. This allows for verification of the relay operation under conditions matching actual system faults. By comparing these sets of curves, Star visually indicates the discrepancies and deviation between the actual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

ARTTS Software Modules

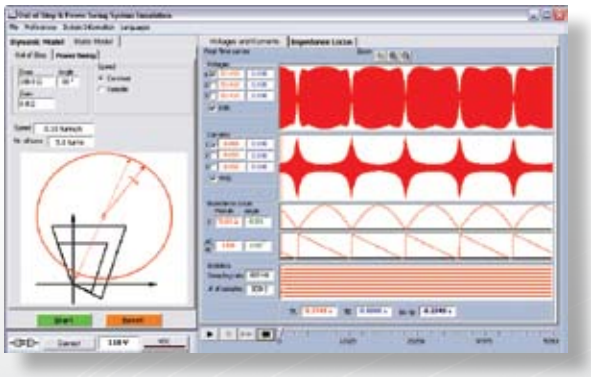
Integrated Software

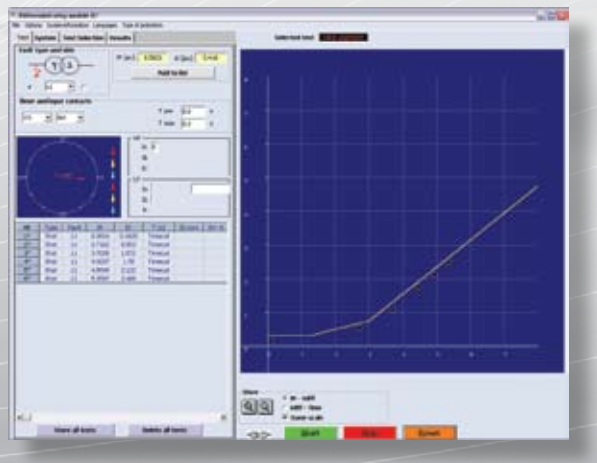
ARTTS software is an advanced control software program for accessing all functions of the Automatic Relay Testing and Transient Simulator. This powerful software can be used for manual and fully automatic testing of protective relays, energy meters, and transducers.

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.



ARTTS Software: Virtual front panel





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

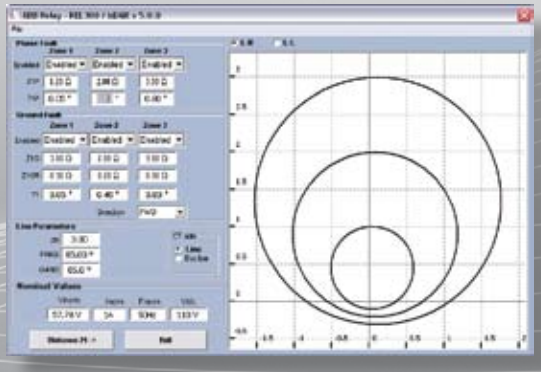
ARTTS-6

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

Relay Type	IEEE No.
Distance Relay	21
Synchronizing Device	25
Under/Over-Voltage Relay	27/59
Directional Power Relay	32
Field Relay	40
Reverse Phase Current Relay	46
Phase Sequence Voltage Relay	47
Incomplete Sequence Relay	48
Instantaneous Overcurrent Relay	50
Inverse Time Overcurrent Relay	51
Power Factor Relay	55
Voltage Balance Relay	60
Ground Detector Relay	64
Directional Overcurrent Relay	67
Phase Angle Out-of-Step Relay	78
Automatic Reclosing Relay	79
Frequency Relay	81
Pilot Wire Receiver Relay	85
Lockout Relay	86
Differential Protection Relay	87
Voltage Directional Relay	91
Power Directional Relay	92
Tripping Relay	94



Distance Relay Test Module

Automatic Relay Test Set

AC/DC Current Outputs

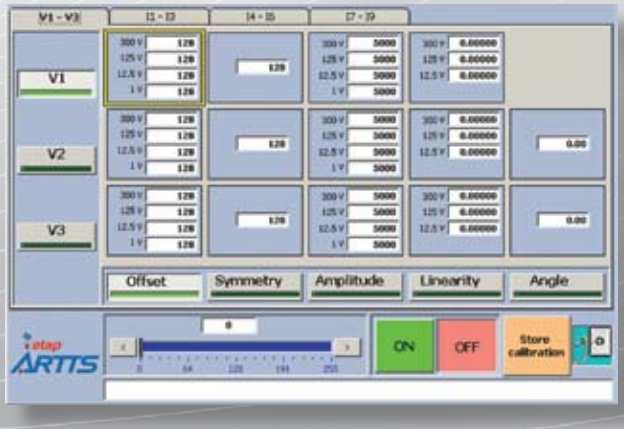
- Six independent current sources with a common neutral
- Independent adjustment of current outputs
- Continuous duty cycle
- 28 bit waveform resolution
- Capable of stepping or ramping the current
- Programmable rate of change (± 0.001 A/s to ± 999 A/s)
- Current accuracy: ± 0.1% of the value, ± 0.02%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

RANGE		CONNECTION	CURRENT A	POWER VA	ZMAX Ohm	RESOLUTION
1	6 X	DIRECT	0-15	80	0.35	230 µA
2	6 X	DIRECT	0-1.5		0.35	23 µA
3	6 X	DIRECT	0-0.15		0.35	2 µA
4	3 X	DIRECT	0-15	100	0.44	230 µA
5	3 X	DIRECT	0-1.5		0.44	23 µA
6	3 X	DIRECT	0-0.15		0.44	2 µA
7	3 X	2 IN PARALLEL	0-30		0.18	460 µA
8	3 X	2 IN PARALLEL	0-3	160	0.18	46 µA
9	3 X	2 IN PARALLEL	0-0.3		0.18	5 µA
10	3 X	2 IN SERIES	0-15		0.71	230 µA
11	2 X	3 IN PARALLEL	0-45	160	0.12	690 µA
12	1 X	6 IN PARALLEL	0-90	240	0.06	1.38 mA
13	1 X	2 SERIES OF +2 IN PARALLEL	0-30	480	0.35	460 µA

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

RANGE		CONNECTION	VOLTAGE V	POWER VA	ZMAX Ohm	RESOLUTION
1	4 X	DIRECT	0-125	80	195	1.9 mV
2	3 X	DIRECT	0-12.5		195	190 µV
3	3 X	DIRECT	0-1		195	19 µV
4	1 X	2 IN SERIES	0-250	160	390	3.8 mV
5	1 X	2 IN PARALLEL	0-125	160	97	1.9 mV
		OPTIONAL 300 V OUTPUT				
1	4 X	DIRECT	0-300	80	1125	4.6 mV
2	3 X	DIRECT	0-125	80	195	1.9 µV
3	3 X	DIRECT	0-12.5		195	190 µV
4	1 X	2 IN SERIES	0-600	160	390	9.2 mV
5	1 X	2 IN PARALLEL	0-300	160	97	4.6 mV



Voltage and Current I/O Configuration

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)