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COOPER POWER
SERIES

iST source transfer relays

Highlights

- Add functions and features using the IDEA Workbench™ feature
- Virtual Test Set™ (VST) event record simulator
- Relay-Replay™: The "what-if" analysis tool
- Interactive oscillography
- Instantaneous, Demand and Energy Metering
- Harmonics and THD metering
- Sequence of Events Recording
- Eight setting groups
- DNP 3.0 and Modbus protocols

Protective functions

- Programmable source transfer for two sources
- Parallel or non-parallel restoration
- Manual or automatic restoration
- Sync-check (25) function for parallel restoration
- Source health parameters include two levels of undervoltage (27), positive sequence undervoltage (27P), underfrequency (81U), and over frequency (81O)
- Source restoration parameters include voltage (59), positive sequence voltage (59P), and over / underfrequency (81O / 81U)
- Phase instantaneous /definite time, and inverse time overcurrent (50/51) for single load
- Ground instantaneous / definite time, and inverse time overcurrent (50N/51N) for single load
- Fault block to prevent source transfer during an overcurrent event

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General

The iST family of source transfer relays for two sources is a member of Eaton's Cooper Power series Edison™ Idea™ line of protective relays. The iST relay family consists of the iST-621 for single feeder applications, and iST-921 and iST-901 for two feeder applications. The iST relay family also provides advanced metering, control, and communications, and event analysis tools.

iST relays use ProView™ application software for PCs running the Microsoft® Windows® operating system. The IDEA Workbench™ feature of the ProView application permits the user to add additional functionality.

Applications

iST relays are designed for applications with single or two feeders.

- The iST-621 is the source transfer relay for configurations with two sources and a single feeder. Phase and ground overcurrent protection for the feeder is included.

- The iST-921 and iST-901 relays are designed for configurations with two feeders.

  - The iST-921 is the source transfer relay for two sources and includes phase and ground overcurrent protection for the first feeder.

  - iST-901 relays provide phase and ground overcurrent protection for the second feeder.

To address the needs of automation, Energy Management Systems (EMS), and SCADA systems, iST relays provide advanced power quality, load (tap) metering, control, and communications capabilities.

Transfer logic

The comprehensive transfer logic includes the following features:

Five source preference selections:

- Source 1 preferred; Normal restoration
- Source 1 preferred; Hold on alternate
- Source 2 preferred; Normal restoration
- Source 2 preferred; Hold on alternate
- No Source Preference

Normal restorations can be either Non-parallel with an adjustable time delay, or Parallel with sync-check.

The Parallel with Sync check Restoration Mode supervises source closing for both automatic and manual operations. The Sync Check function compares the phase rotation, voltage magnitude, phase angle, and frequency of both sources. Paralleling of the sources is permitted only when all parameters are within the customer-configurable thresholds. In automatic mode, it permits closing the preferred source prior to opening the alternate source to achieve a "blinkless" transfer.

In manual mode, the Sync Check function prevents accidental paralleling of non-synchronous sources. If parallel restoration is not enabled, the two source switches cannot both be closed manually.

The alternate source can be either a utility line or a generator. Settings for generator startup time, standby time, and shutdown time are included.

There are seven independent parameters for Source Health. Each has a settable threshold and time delay.

Any combination can be enabled to declare an unhealthy source:

- Two levels of phase-ground undervoltage (27)
- Positive sequence undervoltage (27P)
- Two levels of underfrequency (81U)
- Two levels of overfrequency (81O)

Four independent parameters declare Source Restoration. Any combination can be enabled to declare a restored source:

- Minimum phase-ground voltage (59)
- Minimum positive sequence voltage (59P)
- Minimum frequency (81U)
- Maximum frequency (81O)

Overcurrent protection

For single feeder applications, the iST-621 relay offers overcurrent protection of the single load, and separate inverse curves for phase and residual CLPU overcurrent elements to minimize nuisance trips. The TCC selection includes industry standard IEEE® and IEC curves, industry standard recloser curves, Kyle 106 through 165, plus five commonly used fuse curves.

For dual feeder applications, the iST-921 relay offers independent inverse time phase and residual overcurrent protection for feeder 1 and the iST-901 relay offers independent inverse time phase and residual overcurrent protection for feeder 2.

A Fault-block function is included to enable or disable automatic transfer during an overcurrent (OC) event.

When enabled in the iST-621 relay single feeder application, fault block prevents an automatic transfer while the OC element is picked up. When an OC trip occurs, the iST-621 relay is switched to manual mode to prevent automatic operations until the relay is reset.

When enabled in the iST-921 / iST-901 relay two feeder application, fault block prevents an automatic transfer while either OC element is picked up. When the OC element drops out, or after a trip, automatic operation of the source switches resumes.

Metering

The iST relay family offers extensive metering capabilities, including:

- Instantaneous voltage and frequency of each source, and load current
- Current, Watts, VARS, and power factor of each load
- Demand metering (current and four quadrant power) of each load
- Energy metering (four quadrant) of the load
- Harmonics metering through the 15th harmonic including THD for all voltage and all current channels

iST relays use the voltage inputs from the connected source for all power, energy, and other voltage-related metering.

Use the IDEA Workbench feature to customize iST relays

The iST is a fully functional family of relays, ready to use right out of the box. However, there are applications where custom control logic, or custom functions need to be added to the relay. The IDEA Workbench feature is a revolutionary graphical software programming environment which permits the user to customize iST relays.

- Add new features or protective functions by means of IDEA Workbench Custom Modules. These operate in the same fashion as the plug-ins for popular internet browsers. Your investment in the relay is protected as future needs and developments may be addressed through new Custom Modules.
- Create custom control and protection logic using over 400 programming signals and tools, all selectable from drag-off Toolboxes. Logic created using these tools can then be saved as Custom Modules to be reused or shared with associates.
- Monitor and control practically every aspect of the relay's operation
- Create custom metering and measurement quantities
- Create custom sequence of event records
- Configure communication protocols to match existing SCADA system mappings

The IDEA Workbench offers the user the ability to rapidly and accurately create customizations by working the way the engineer thinks, by using logic diagram and flowchart construction methods. No equation-based or command-based logic programming is required. See Figure 2.
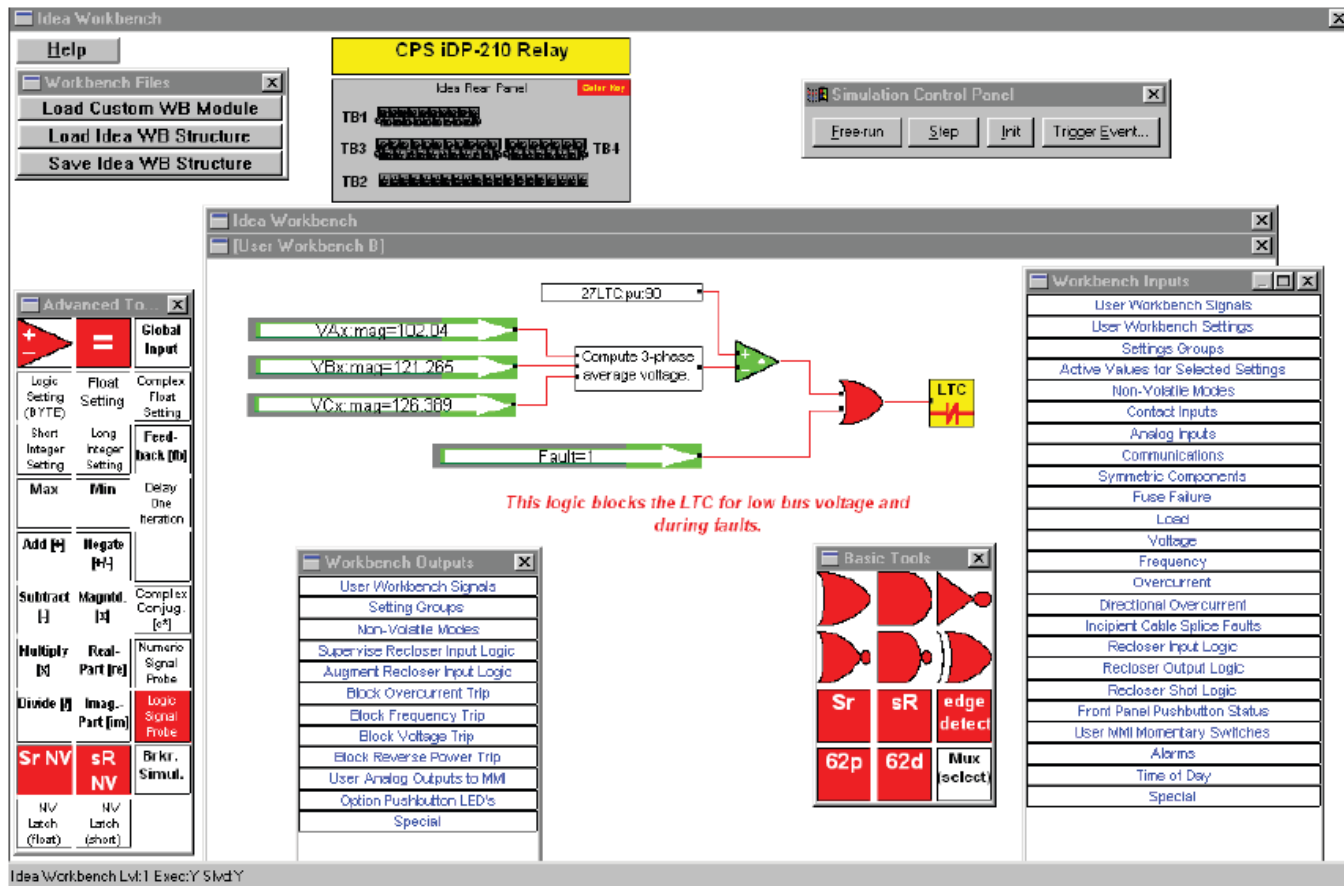
Figure 2. The Idea Workbench graphical customization environment.

The IDEA Workbench also addresses some of the more difficult questions associated with custom relay programming, namely:

Clarity: Compared to that offered by equation and command based programming techniques, graphical programming results in customizations whose operation is intuitive.

Testing: ProView software provides a Virtual Test Set (VTS), which can be used to test the developed logic with realistic fault signals. During test, the logic diagrams become "live" showing the state of all variables, logic gates, contacts, counters, etc. To avoid any question of how the custom logic interacts with the relay itself, the VTS environment models the entire relay in addition to the custom programming. Unlike other programming environments, the IDEA Workbench does not require the user to have an actual relay or relay test set on hand to verify the proper operation of the programmed logic.

Documentation: Notes regarding how the custom logic operates may be embedded within the IDEA Workbench feature. This improves the ability of others to quickly understand how the logic is designed to work. Links to external files may also be embedded in the IDEA Workbench feature, providing fast access to larger documents stored on company's network servers.

Portability: If the original data files are lost, the entire IDEA Workbench feature may be uploaded from the relay, complete with logic diagrams, embedded notes and external reference links.

Event records and analysis tools

The iST family of relays share the same event records and analysis tools as all Edison Idea relays. The Edison Idea relay allows for the display of event records in a variety of formats including waveforms (oscillography), magnitude plots, phasor diagrams, symmetrical component diagrams and more. ProView, the software for the Edison Idea relay, also provides a unique Application Diagram View that provides a one-screen view of everything that is going on in the relay. Many of these event views are also available in On-Line View mode, where it is possible to monitor the status of the relay in real-time, including phasor diagrams and the Sync Scope, which is ideal for verifying iST relay CT phasing during commissioning.
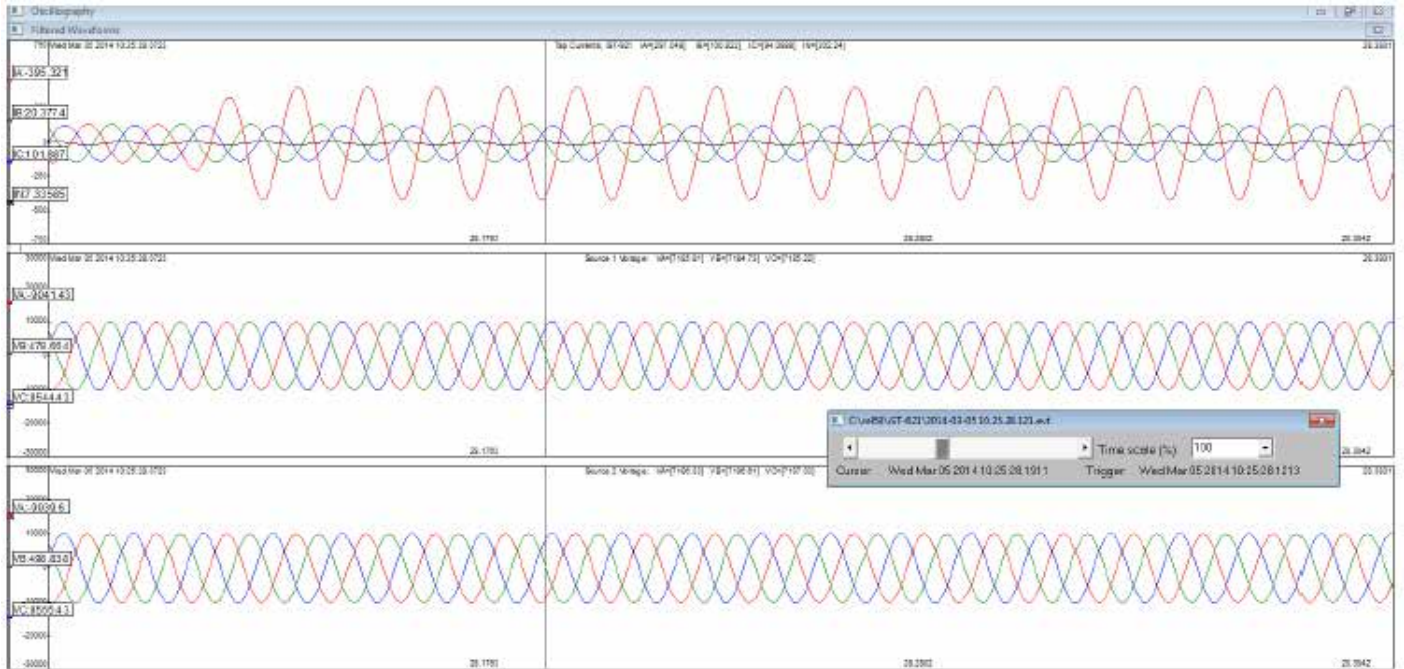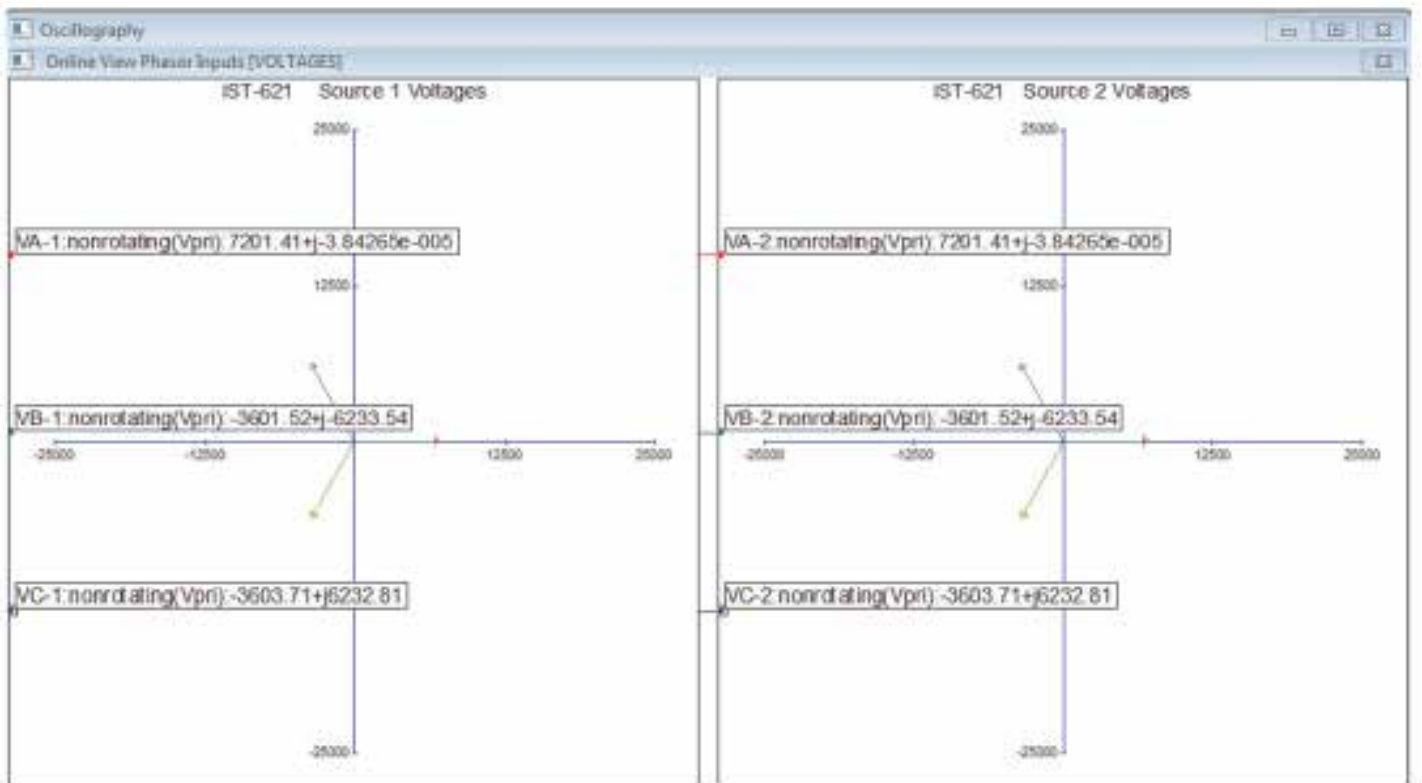
Figure 3. Current and voltage waveforms.

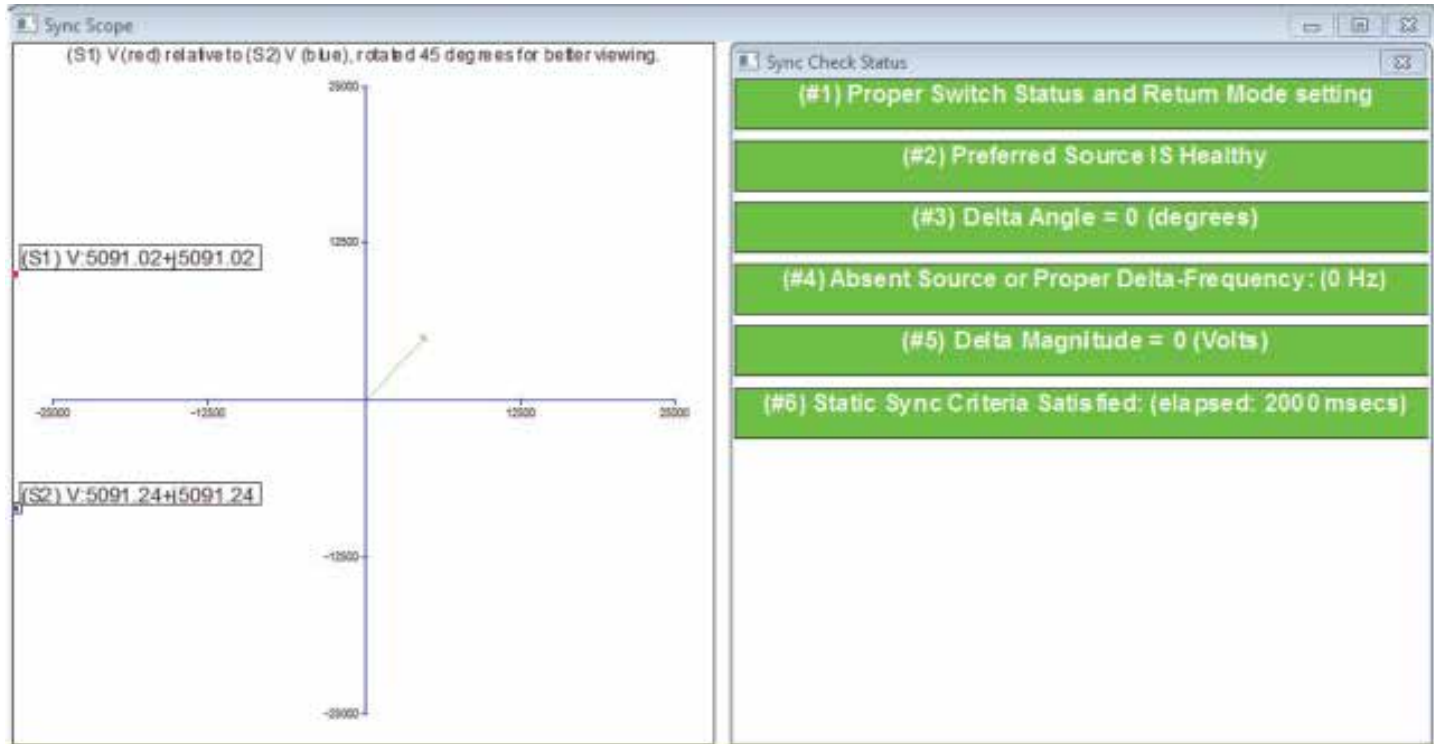**Figure 4. Source 1 and Source 2 phase diagrams.**

Figure 5. Sync scope.

Relay-Replay™

To evaluate the effect different settings would have on the relay, the Relay-Replay™ feature of the Edison Idea software allows the user to make any number of setting changes and replay an existing event using these new settings without the need for an actual relay or expensive test equipment. The operation of every aspect of the relay's performance, from which elements pick-up, the response time of those elements that do and the operation of any custom programming made via the IDEA Workbench feature can be observed. This tool provides unprecedented "what-if" analysis capabilities.

Virtual Test Set (VTS)

To evaluate settings against any arbitrary fault, the Edison Idea relay ProView software permits the user to create a virtual event record through use of the Virtual Test Set (VTS) feature. The VTS feature allows complete control over:

• Pre-fault and post-fault voltage and current level

• Selection of phase-ground, phase-phase, phase-phase-ground and three phase fault types

• Selection of DC time constant

• Control over fault dynamics

• Control of frequency change, rate of change and acceleration during faults

• Control over simulated breaker open and close times

Communications

Both Modbus RTU and DNP 3.0 communication protocols are included with the iST relay family. A Communications Workbench™ function provides the user the ability to customize communication maps, add or delete information, add control points, and even create new signals to be brought out through communications. The iST relay family features two RS-232 auto-baud (57600 kbps max) communication ports and an optional port with either RS-485, serial fiber optic, or various Ethernet options (RJ-45, multi-mode fiber, single-mode fiber). Contact your Eaton's Cooper Power series product representative for availability of other communication protocols.
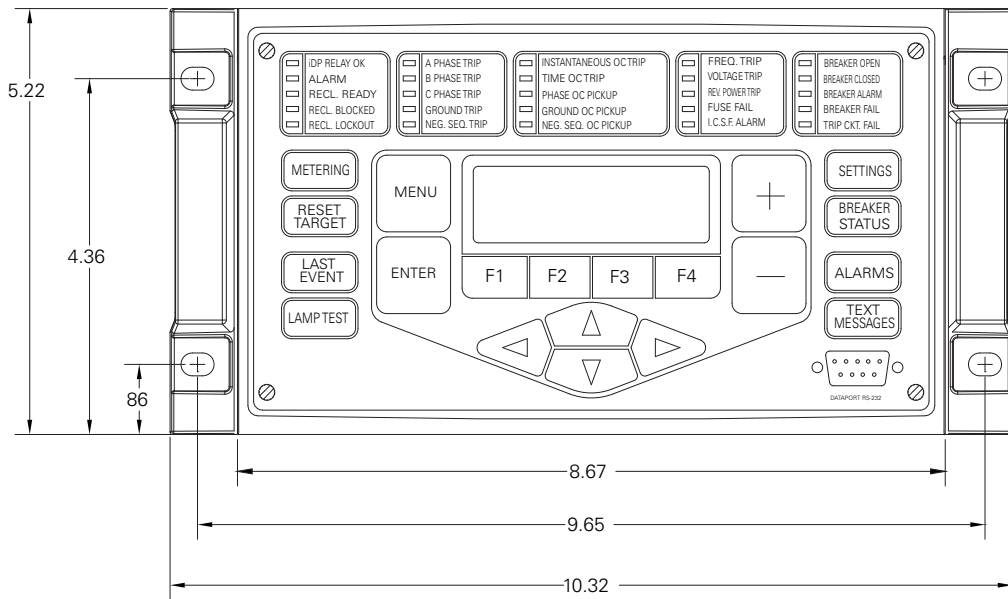
FRONT VIEW

Figure 6. Idea relay, side view (inches) for dimensional purposes only.
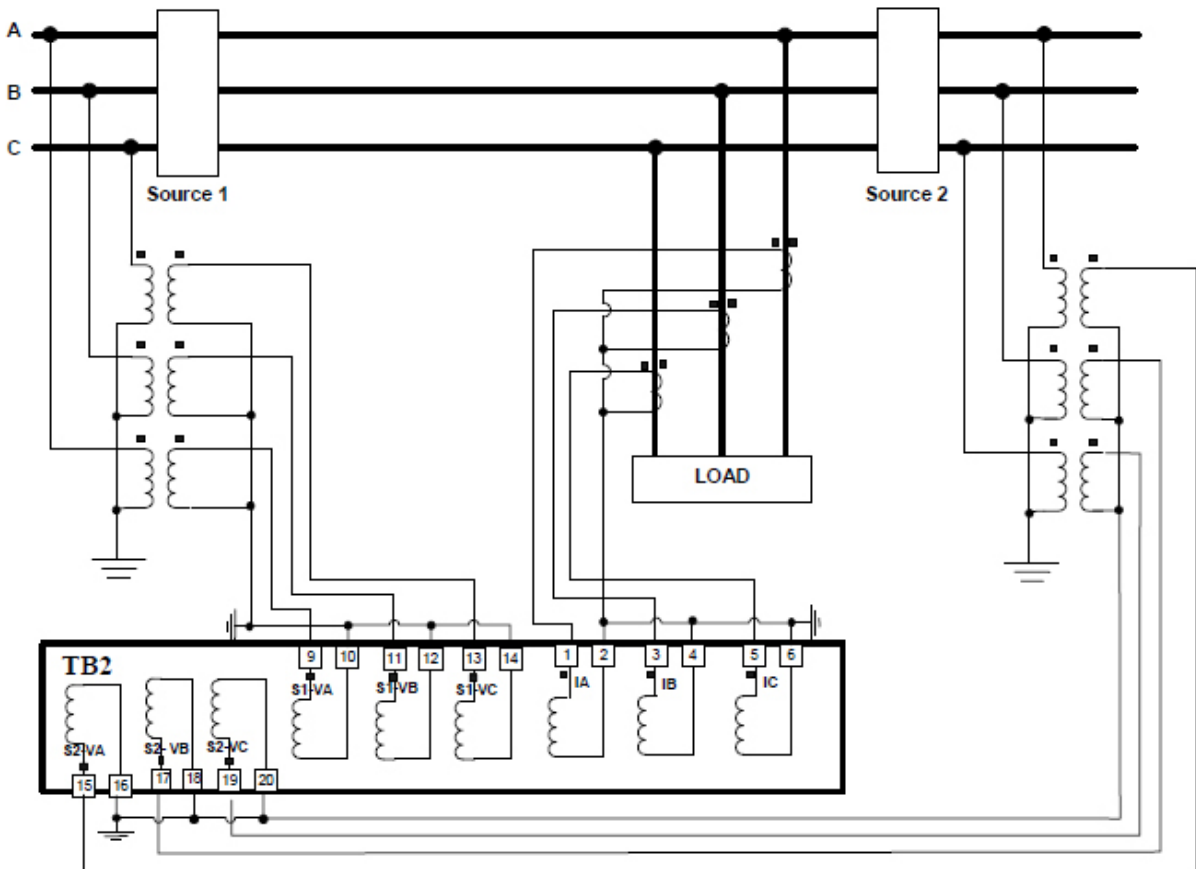
AC wiring diagram

Figure 7. Typical iST relay AC wiring diagram (gndY/GndY PTs).

Table 1. Specifications

Frequency	50/60 Hz
Voltage Inputs	Six voltage input channels
	50 – 250 Vac continuous (phase-to-neutral)
	Burden < 0.1 VA at 120 V
	Primary DC Resistance 1,454Ω
	Error % < 0.3% over operating temperature
Current Inputs	Four current input channels
	$I_{Nominal}$ = 5 A, $I_{continuous}$ = 15 A, $I_{3 sec}$ = 150 A, $I_{1 sec}$ = 300 A
	Range of overcurrents settings 0.1 A to 90 A
	Burden < 0.2 VA at 5 A
	Primary DC Resistance 3.4 mΩ
	Error % < 0.3% over operating temperature
	$I_{Nominal}$ = 1A, $I_{continuous}$ = 3.2A, I_{3sec} = 30 A, I_{1sec} = 100 A
	Range of overcurrents settings 0.02 A to 18 A
	Burden < 0.2 VA at 1 A
	Primary DC Resistance 52.1 mΩ
	Error % < 0.3% over operating temperature
Digital Inputs (Optically Isolated)	9 – 150 Vdc [24 Vdc power supply]
	36 – 150 Vdc [48 Vdc power supply]
	90 – 300 Vdc [120 Vac / 125 Vdc power supply]
	165 – 300 Vdc [240 Vac / 250 Vdc power supply]
	Nominal current draw of 2.5 mA, minimum operating time of 15 msec
Relay Outputs	240 Vac / 250 Vdc. Make: 30 A for 0.2 seconds; Carry: 6 A continuous. Break: 0.2 A (L/R = 40 ms)
	Pickup time: <8 ms; Dropout time: <5 ms
Solid-State Outputs	240 Vac / 250 Vdc; Make: 30 A for 0.2 seconds; Carry: 8 A continuous. Break: 10 A (L/R = 40 ms)
	Pickup time: <1 ms; Dropout time: <15 ms
Power Supply	24 Vdc ± 20%
	48 Vdc ± 20%
	120 Vac / 125 Vdc ± 30%
	240 Vac / 250 Vdc ± 20%
	Burden: 14 W
Local/Remote Communications	EIA-RS-232C: 1 ea. located on front and rear panel
	Baud Rates: Auto baud rate up to 115,200 bps
	IRIG-B: 1 located on rear panel
	Optional Communications Daughterboards:
	RS-485 (DC isolated) Modbus 57,600 bps; DNP 38,400 bps
	Serial Fiber Optic (ST)
	Ethernet, Multi-Mode, Fiber Optic (MTRJ/MTRJ)
	Ethernet, Multi-Mode, Fiber Optic / Wire (MTRJ/RJ45)
	Ethernet, Multi-Mode, Wire (RJ45/RJ45)
	Ethernet, Single-Mode, Fiber Optic (LC/LC)
Front Panel Targets	23 Programmable LEDs
Front Panel Display	20 x 4 character LCD
Front Panel Keypad	8 fixed-function keys, 4 multi-function "soft" keys
	8 programmable "Hot-keys"

Table 1. Specifications (continued)

Dimensions	Idea relay: 3 U high by 8.5" wide; 19" rack mount adapter plates and side by side mounting kits available
Relay Weight	10 lbs
Mounting	Horizontal
Operating Temperature	-40 °F to 158 °F (-40°C to 70 °C) continuous
Bump & Shock Test	IEC 60255-21-2 (1988) Class 1
Cold Temperature Test	IEC 60068-2-1 (2005) 16 hours at –40 °C
Electrostatic Discharge	EN 61000-4-2 (2008 Ed. 2.0) Levels 1, 2, 3, and 4
High Temperature Test	IEC 60068-2-2 (2005) 16 hours at 70 °C
Humidity Test	IEC 60068-2-30 (1999) 25 °C to 55 °C, 95% Humidity, 2 cycles
Impulse/Dielectric Withstand	IEC 60255-5 (2000)
	Impulse Test: 5 kV, 1.2 µs rise time, half wave 50 µs. Applied 3 impulses at each polarity
	Dielectric: 3150 Vdc for 1 minute.
	Insulation Resistance: Greater than 10 Gigaohms.
Radio Frequency Interference	Radiated:
	EN 61000-4-3 (2006)
	80 MHz – 2.7 Ghz, Idea 35 V/m.
	IEEE Std C37.90.2™-1995 standard
	Conducted:
	IEC 61000-4-6 (2003 with A1: 2004, A2 2006))
	150 kHz – 80 MHz, 10 Vrms
Surge Withstand	IEEE Std C37.90.1™-2012 standard 2.5 kV oscillatory, ‡ 4 kV fast transient
Vibration Test	IEC 60255-21-1 (1988) Class 1
Contact Rating	IEEE Std C37.90™-1989 standard, Section 6.7, 30 A for 0.2 seconds, 2000 operations, at 125 Vdc, 250 Vdc, and 240 Vac

Specifications subject to change without notice.

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