

Multilin™ C70

CAPACITOR BANK PROTECTION SYSTEM

Capacitor Banks Protection & Control



KEY BENEFITS

- Protect capacitor banks of a variety of configurations with sensitive current and voltage balance protection functions
- Complete IEC 61850 Process Bus solution providing resource optimization and minimizing total P&C lifecycle costs
- Adaptive compensation techniques truly compensation for the inherent bank unbalance providing sensitive protection
- Robust network security enabling Critical Infrastructure Protection through user command logging, and dual permission access control
- Custom programmable logics for advanced shunt capacitor bank controls
- Flexible Automatic voltage regulation of shunt capacitor banks along with control supervision
- Embedded IEC61850 Protocol
- Reduced relay to relay wiring and associated installation costs through high-speed inter-relay communications
- Ambient temperature monitoring with alarming when outside temperature exceeds upper thresholds

APPLICATIONS

- Protection, Control, Monitoring and Automation of shunt capacitor banks of different voltage levels
- Suitable for protecting multiple capacitor banks
- Sensitive protection for grounded, ungrounded single and parallel capacitor banks and banks with taps, for a variety of capacitor bank configurations
- Capacitor banks based AVR and Capacitor control supervision

FEATURES

Protection and Control

- Voltage differential protection
- Compensated Bank Neutral Voltage Unbalance
- Phase Current Unbalance and Neutral Current Unbalance protection, , phase, ground and neutral overcurrent. Thermal overload, phase and negative sequence directional overcurrent; and broken conductor.
- Bank phase overvoltage
- Negative sequence over voltage
- User programmable logics for custom schemes
- Automatic Voltage Regulator (AVR) for switching capacitor banks based on voltage, power factor and reactive power
- Time and Date function allowing capacitor bank switching based on time of day, week and seasons.
- Capacitor control supervision block for processing commands from SCADA, remote communication and local control through front panel HMI

EnerVista™ Software

- Graphical Logic Designer and Logic Monitor to simplify designing and testing procedures
- Document and software archiving toolset to ensure reference material and device utilities are up-to-date
- EnerVista™ Integrator providing easy integration of data in the C70 into new or existing monitoring and control systems

IEC 61850 Process Bus Interface

- Robust communications with up to 8 HardFiber Bricks
- Seamless integration with existing C70 functions
- Redundant architecture for dependability and security

Monitoring and Metering

- Metering - current, voltage, power, energy, frequency
- Oscillography – analog and digital parameters at 64 samples/cycle
- Event Recorder - 1024 time tagged events with 0.5ms scan of digital inputs
- Data Logger - 16 channels with sampling rate up to 1 sample / cycle
- Advanced relay health diagnostics
- Setting Security Audit Trail for tracking changes to C70 configuration

Communications

- Networking interfaces – 100Mbit Fiber Optic Ethernet, RS485, RS232, RS422, G.703, C37.94
- Multiple Protocols - IEC61850, DNP 3.0 Level 2, Modbus RTU, Modbus TCP/IP, IEC60870-5-104, Ethernet Global Data (EGD)
- Direct I/O – secure, high-speed exchange of data between URs for Direct Transfer Trip and I/O Extension applications
- Embedded Managed Ethernet Switch with 4 - 100 Mbit Fiber optic ports and 2 copper ports



Digital Energy

Introduction

The C70 is an integrated protection, control, and monitoring device for shunt capacitor banks based on the well established and proven UR relay platform of GE Multilin. The C70 provides both the bank and system protection schemes for shunt capacitor bank protection. The current and voltage-based protection functions are designed to provide sensitive protection for grounded, ungrounded single, and parallel capacitor banks and banks with taps, for a variety of capacitor bank configurations. The sophisticated built-in control functions can be used to automate capacitor switching with ease and flexibility for automatic voltage regulation of the system. Part of the universal relay family, C70 comes with a variety of versatile features truly integrating protection, monitoring, metering, communication and control in one easy-to-use device. Universal relay family offers higher degree of modularity in its design and functionality providing superior performance in protection and control meeting the toughest requirements of the marketplace. The unparalleled software toolsets from Enervista with its user-friendly interfaces helps managing the relay and the power system in the easiest way.

Protection

C70 provides Sensitive protection functions designed specifically to protect the shunt capacitor banks effectively. The C70 provides current based protection functions, which include phase, ground, and neutral instantaneous and time overcurrent elements for standard overcurrent protection of the bank. Two elements per configured CT bank are available.

The standard current based protection functions include:

- Phase instantaneous overcurrent (50P)
- Phase time overcurrent (51P)
- Phase directional (67P)
- Thermal overload (49)
- Ground instantaneous overcurrent (50G)
- Ground time overcurrent (51G)
- Neutral instantaneous overcurrent (50N)
- Neutral time overcurrent (51N)

- Negative sequence instantaneous overcurrent (50_2)
- Negative sequence time overcurrent (51_2)
- Negative sequence directional overcurrent (67_2)

The C70 also provides breaker failure protections and standard voltage based protection functions which include:

- Phase overvoltage (59P)
- Phase undervoltage (27P)
- Auxiliary overvoltage (59X)
- Neutral overvoltage (59N)
- Negative sequence undervoltage (27N)

Apart from the standard current and voltage based functions the C70 comes with protection functions specifically designed to provide sensitive protection for capacitor banks in a single box. Typical configurations with their associated model numbers are shown.

Voltage Differential

- Applicable for both grounded and ungrounded banks. In the ungrounded case, the algorithm uses the neutral point voltage to provide sensitive protection.
- Based on a simple voltage divider principle, which compares the bus voltage with the tap voltage of the bank.
- Three-phase element with four independent stages for alarming and control. Each stage has independent per phase settings and a common time delay.
- Provision to set the per phase voltage divider factors manually, or by selecting the auto-setting feature. The voltage divider factor can be calculated automatically under user supervision either locally or remotely.
- One voltage differential element provided per VT bank up to a maximum of three.

Compensated Bank Neutral Voltage Unbalance

- Applicable to ungrounded banks
- Truly compensates for both the system unbalance and the bank unbalance.

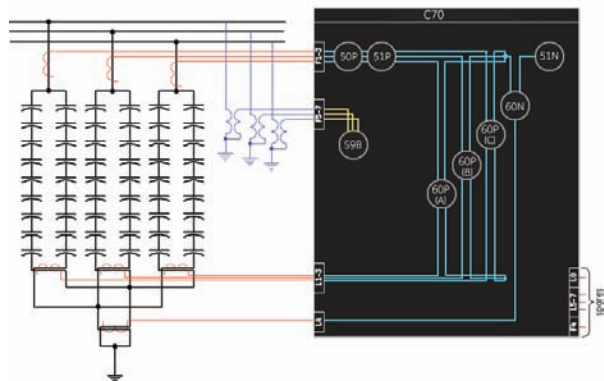
- Each element has four independent stages; each stage has an independent threshold, restraint slope, and time delay.
- Provisions to set the inherent bank unbalance factors manually, or by selecting the auto-setting feature. The bank unbalance factor can be calculated automatically under user supervision either locally or remotely.

Bank Phase Overvoltage

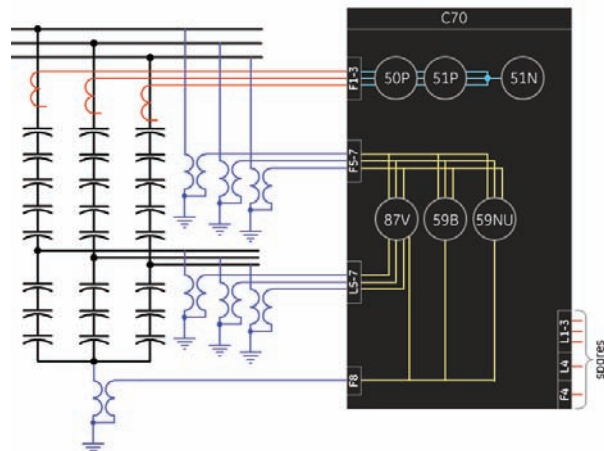
- Applicable for both grounded and ungrounded banks. In the later case the relay takes the neutral point voltage in order to derive the voltage drop across the capacitor strings.
- Three phase element with three definite time stages and one inverse time stage; each definite time stage has an independent threshold and time delay, the inverse time stage has an independent threshold, curve time multiplier and customizable curve shape. Each stage can be independently configured for alarming or tripping.
- One bank overvoltage element provided per VT bank up to a maximum of three.

Phase Current Unbalance

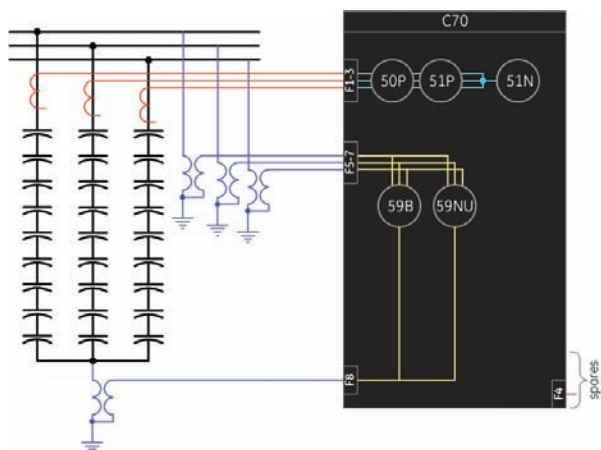
- Based on the balance between phase currents of two parallel banks and is applicable to both grounded and ungrounded banks.
- Compensates for bank unbalances to provide better sensitivity.
- Three-phase element with four independent stages for a protection and alarming. Each stage has independent per phase settings and a common time delay.
- Provision to set the current divider factor individually per phase manually, or by selecting the auto-setting feature. The current divider factor can be calculated automatically under user supervision either locally or remotely.
- Immune to system transients, providing secure operation without resorting to any excessive filtering.
- One phase current unbalance element is provided per CT/VT module up to a maximum of three.



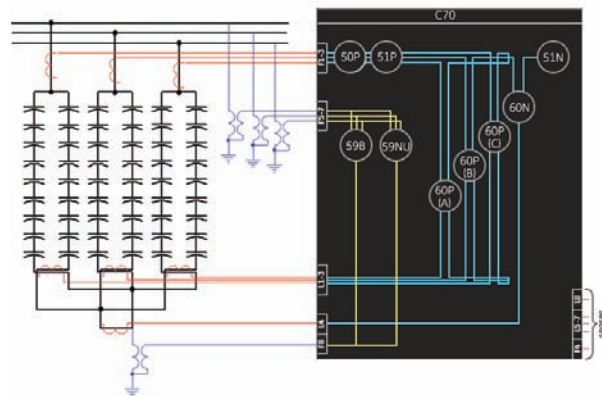
Typical Application: Grounded, parallel banks
 Typical Model No: C70-N03-HPH-F8L-H6P-M8N-PXX-UXX-WXX



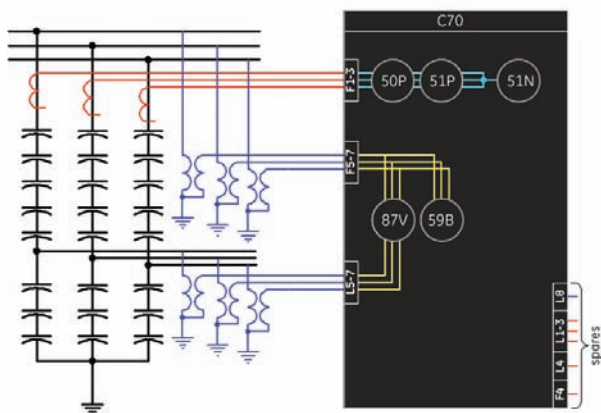
Typical Application: Ungrounded wye banks with taps
 Typical Model No: C70-N03-HPH-F8L-H6P-M8L-PXX-UXX-WXX



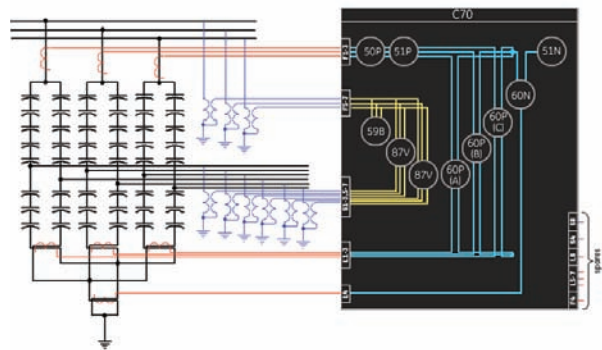
Typical Application: Ungrounded wye banks
 Typical Model No: C70-N03-HPH-F8L-H6P-MXX-PXX-UXX-WXX



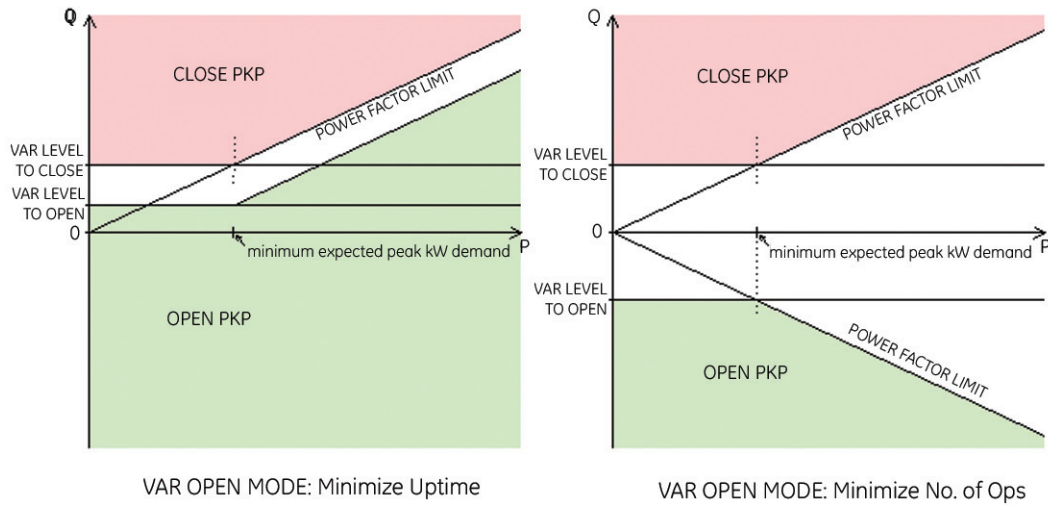
Typical Application: Ungrounded, parallel banks
 Typical Model No: C70-N03-HPH-F8N-H6P-M8L-PXX-UXX-WXX



Typical Application: Grounded wye banks with taps
 Typical Model No: C70-N03-HPH-F8L-H6P-M8V-PXX-UXX-WXX



Typical Application: Grounded, parallel banks with taps
 Typical Model No: C70-N03-HPH-F8N-H6P-M8L-PXX-U8V-WXX



Neutral Current Unbalance

- Based on the balance between interconnected neutral current of two parallel banks and is applicable to both grounded and ungrounded banks.
- Grounded banks require a window CT.
- Each element has four independent stages; each stage has independent threshold and time delay settings.
- Provision to set the bank unbalance factors manually, or by selecting the auto-setting feature. The bank unbalance factor can be calculated automatically under user supervision either locally or remotely.
- One neutral current unbalance element provided per CT/VT module, up to a maximum of three.

Control

The C70 is provided with built-in control functions to help end users build capacitor bank control schemes of their choice with ease and flexibility.

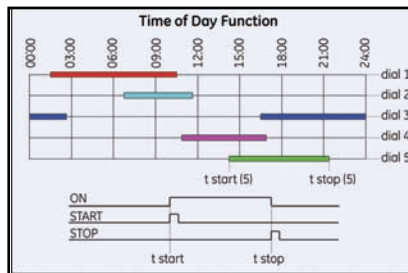
Automatic Voltage Regulator

The AVR is a capacitor bank controller responding to either voltage, reactive power, or power factor. One AVR element is provided per CT/VT module, up to a maximum of three. The AVRs can operate independently, each on their own section of the bank, or only the one set for present conditions/time-of-day, as determined by FlexLogic (user programmable logic). For the voltage control path, a provision is made to operate from any phase-phase voltage (VAB, VBC, VCA), average voltage (VAVER), positive-sequence voltage (V1)

or the single phase auxiliary voltage. Two applications using the reactive power/power factor path are shown below.

Time and Date Function

- Provides the user with ability to program certain actions based on time.
- 5 time of day timers
- User accessible time/date information for more sophisticated custom schemes, that respond to weekdays, weekends, summer or winter



Capacitor Control Supervision

This feature supervises the capacitor bank open and close commands from the command sources including the Relay front panel HMI (push buttons), AVR and SCADA/HMI.

Advanced Automation

The C70 incorporates advanced automation features including powerful FlexLogic™ programmable logic, communication, and SCADA capabilities that far surpass what is found in the average capacitor bank relay. The C70 integrates seamlessly with other UR relays for complete system protection.

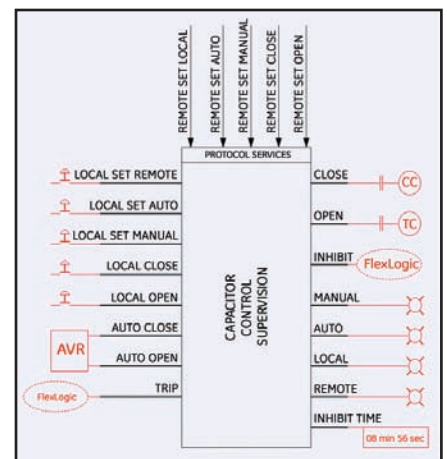
FlexLogic™

FlexLogic™ is the powerful UR-platform programming logic engine that provides the ability of creating customized protection and control schemes thereby minimizing the need, and the associated costs, of auxiliary components and wiring. Using FlexLogic™, the C70 can be programmed to provide required tripping logic along with custom scheme logic for dynamic setting group changes.

Scalable Hardware

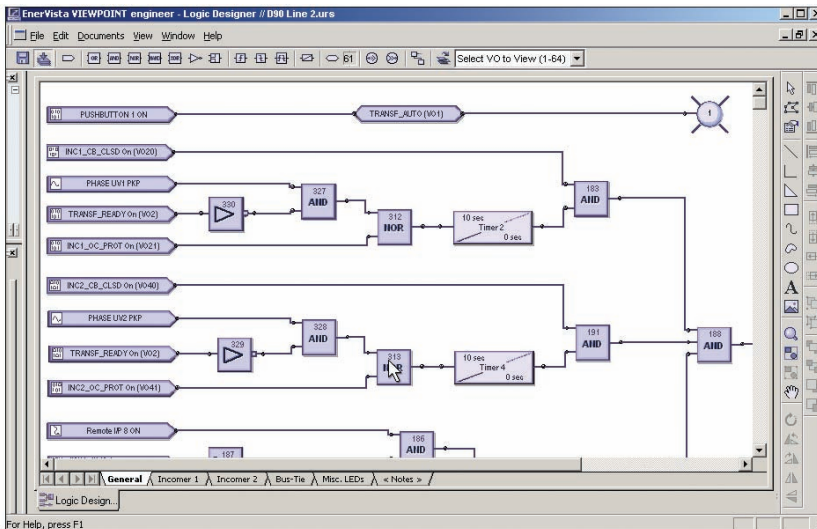
The C70 is available with a multitude of I/O configurations to suit the most demanding application needs. The expandable modular design allows for easy configuration and future upgrades.

- Multiple CT/VT configurations allow for implementation of many different schemes
- Flexible, modular I/O covering a broad range of input signals and tripping schemes



Capacitor control supervision block

FlexLogic™ Designer



Flexlogic™ allows for customizing the C70 outputs for capacitor bank protection schemes and applications.

- RTDs and DCmA inputs are available to monitor equipment parameters such as temperature & pressure

IEC 61850 Process Bus

The IEC 61850 Process Bus module is designed to interface with the GE Multilin HardFiber System, allowing bi-directional IEC 61850 fiber optic communications. The HardFiber System is designed to integrate seamlessly with the existing Universal Relay applications, including protection functions, FlexLogic, metering and communications.

The GE Multilin HardFiber System offers the following benefits:

- Communicates using open standard IEC 61850 messaging
- Drastically reduces P&C design, installation and testing labor by eliminating individual copper terminations
- Integrates with existing C70's by replacing traditional CT/VT inputs with IEC 61850 Process Bus module
- Does not introduce new Cyber Security concerns

Visit the HardFiber System product page on the GE Multilin web site for more details.

Monitoring and Metering

The C70 includes high accuracy metering and recording for all AC signals. Voltage,

current, and power metering are built into the relay as a standard feature. Current and voltage parameters are available as total RMS magnitude, and as fundamental frequency magnitude and angle.

Fault and Disturbance Recording

The advanced disturbance and event recording features within the C70 can significantly reduce the time needed for postmortem analysis of power system events and creation of regulatory reports. Recording functions include:

- Sequence of Event (SOE)
 - 1024 time stamped events
- Oscillography,
 - 64 digital & up to 40 Analog channels
- Data Logger, disturbance recording – 16 channels up to 1 sample / cycle / channel
- Fault Reports
 - Powerful summary report of pre-fault and fault values

The very high sampling rate and large amount of storage space available for data recording in the C70 can eliminate the need for installing costly standalone recording equipment.

Advanced Device Health Diagnostics

The C70 performs comprehensive device health diagnostic tests during startup and continuously at runtime to

test its own major functions and critical hardware. These diagnostic tests monitor for conditions that could impact security and availability of protection, and present device status via SCADA communications and front panel display. Providing continuous monitoring and early detection of possible issues helps improve system uptime.

- Comprehensive device health diagnostic performed during startup
- Monitors the CT/VT input circuitry to validate the integrity of all signals

Communications

The C70 provides advanced communications technologies for remote data and engineering access, making it easy and flexible to use and integrate into new and existing infrastructures. Direct support for fiber optic Ethernet provides high-bandwidth communications allowing for low-latency controls and high-speed file transfers of relay fault and event record information. The available redundant Ethernet option and the embedded managed Ethernet switch provide the means of creating fault tolerant communication architectures in an easy, cost-effective manner without the need for intermediary communication hardware.

The C70 supports the most popular industry standard protocols enabling easy, direct integration into DCS and SCADA systems.

- IEC61850
- DNP 3.0
- IEC60870-5-104
- Modbus RTU, Modbus TCP/IP

Interoperability with Embedded IEC61850

Use the C70 with integrated IEC61850 to lower costs associated with capacitor bank protection, control and automation. GE Multilin's leadership in IEC61850 comes from thousands of installed devices and follows on seven years of development experience with UCA 2.0.

- Replace expensive copper wiring between devices with direct transfer of data using GOOSE messaging

- Configure systems based on IEC61850 and also monitor and troubleshoot them in real-time with EnerVista™ Viewpoint Engineer
- Integrate GE Multilin IEDs and generic IEC61850-compliant devices seamlessly in EnerVista™ Viewpoint Monitoring

Direct I/O Messaging

Direct I/O allows for sharing of high-speed digital information between multiple UR relays via direct back-to-back connections or multiplexed through a standard DS0 multiplexer channel bank. Regardless of the connection method, Direct I/O provides continuous real-time channel monitoring that supplies diagnostics information on channel health.

Direct I/O provides superior relay-to-relay communications that can be used in advanced interlocking, generation rejection and other special protection schemes.

- Communication with up to 16 UR relays in single or redundant rings rather than strictly limited to simplistic point-to-point configurations between two devices
- Connect to standard DS0 channel banks through standard RS422, G.703 or IEEE C37.94 interfaces or via direct fiber optic connections
- No external tester required to provide channel diagnostic information

EnerVista™ Software

The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the C70 relay. The EnerVista™ suite provides all the tools to monitor the status of the protected asset, maintain the relay, and integrate information measured by the C70 into DCS or SCADA monitoring systems. Convenient COMTRADE and Sequence of Events viewers are an integral part of the UR Setup software included with every UR relay, to carry out postmortem event analysis to ensure proper protection system operation.

EnerVista™ Launchpad

EnerVista™ Launchpad is a powerful software package that provides users with all of the setup and support tools needed for configuring and maintaining GE Multilin products. The setup software within Launchpad allows configuring devices in real-time by communicating using serial, Ethernet, or modem connections, or offline by creating setting files to be sent to devices at a later time.

Included in Launchpad is a document archiving and management system that ensures critical documentation is up-to-date and available when needed. Documents made available include:

- Manuals
- Application Notes

- Guideform Specifications
- Brochures
- Wiring Diagrams
- FAQ's
- Service Bulletins

Viewpoint Engineer

Viewpoint Engineer is a set of powerful tools that will allow the configuration and testing of UR relays at a system level in an easy-to-use graphical drag-and-drop environment. Viewpoint Engineer provides the following configuration and commissioning utilities:

- Graphical Logic Designer
- Graphical System Designer
- Graphical Logic Monitor
- Graphical System Monitor

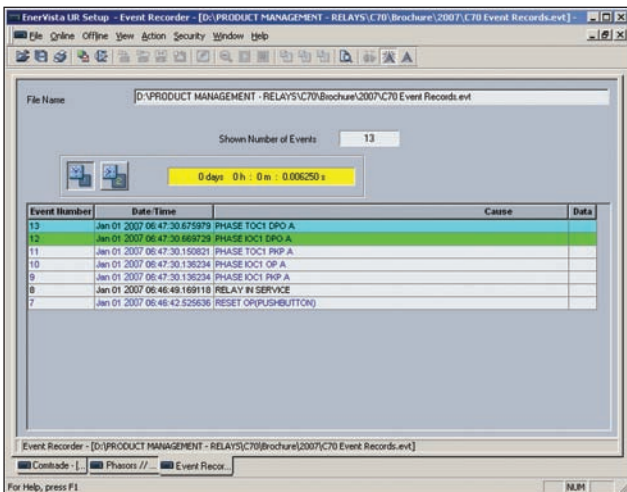
EnerVista™ Integrator

EnerVista™ Integrator is a toolkit that allows seamless integration of GE Multilin devices into new or existing automation systems. Included in EnerVista Integrator is:

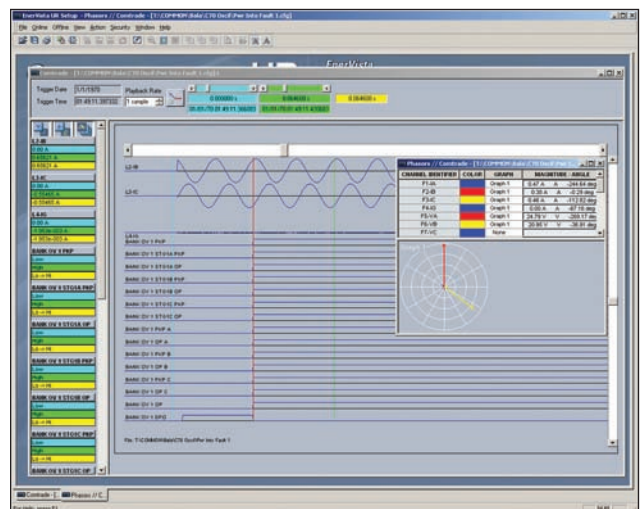
- OPC/DDE Server
- GE Multilin Drivers
- Automatic Event Retrieval
- Automatic Waveform Retrieval

Power System Troubleshooting

The C70 contains many tools and reports that simplify and reduce the amount of time required for troubleshooting power system events.



Record the operation of the internal C70 elements and external connected devices with 1ms time-stamped accuracy to identify the Sequence of Operation of station devices during capacitor bank faults and disturbances.



Analyze capacitor bank faults using both analog and digital power system quantities that are measured and recorded up to a rate of 64 samples per cycle.

