


# 750/760

## FEEDER PROTECTION SYSTEM

### Comprehensive, draw out distribution feeder protection and management



## KEY BENEFITS

- Easy to use Feeder Protection System supported by industry leading suite of software tools
- Accurate built-in metering functions - Eliminates auxiliary metering devices and reduces cost
- Improve uptime of auxiliary equipment - I/O monitoring
- Reduce troubleshooting time and maintenance costs - IRIG-B time synchronization, event reports, waveform capture, data logger
- Minimize replacement time - Draw-out construction
- Simplify testing - Built in simulation features
- Cost effective access to information. Supports industry protocols such as DNP & Modbus. Includes an optional 10MB Ethernet port for system integration
- Complete asset monitoring - Analog I/O, Full metering including demand & energy
- Leading edge technology - Flash memory for product field upgrade
- Extended life - Optional conformal coating for chemically corrosive and humid environments
- Globally accepted - Member of the most renowned product family in the market, SR.

## APPLICATIONS

- Primary protection and control for distribution feeders on solidly grounded, high impedance grounded or resonant (Peterson Coil) grounded systems
- Bus blocking/Interlocking schemes
- High-speed fault detection for arc flash mitigation
- Throw over schemes (bus transfer scheme applications)
- Load shedding schemes based on voltage and frequency elements
- Back-up protection for transmission lines, feeders and transformers
- Distributed Generation (DG) interconnect protection

## FEATURES

### Protection and Control

- Directional time, instantaneous phase overcurrent protection
- Directional time, instantaneous ground overcurrent protection
- Directional sensitive ground and Restricted Earth Fault protection
- Negative sequence overcurrent protection
- Bus and line undervoltage
- Overvoltage
- Neutral overvoltage
- Underfrequency/Frequency decay
- Reverse power protection
- Synchro Check
- Automatic bus transfer
- Manual control
- Cold load pickup control
- Power factor control
- 4 shot recloser (760 only)
- Power factor control
- Syncrocheck - V, f, Hz, & dead-source

### Communications

- Networking interfaces - 10Mbps Ethernet, RS232, RS485 and RS422 ports
- Ethernet port, 10Mbps
- Multiple protocols - ModBus™ RTU, ModBus™ RTU, TCP/IP, DNP 3.0 Level 2

### Monitoring & Metering

- Metering - current,voltage, sequence components, power, energy, voltage
- Breaker operation & trip failure
- Event recording - 128 time tagged events
- Total breaker arcing current
- Ambient temperature /analog transducer input
- Analog transducer input
- Oscillography & Data Logger - 10 records up to 32 power cycles
- Simulation mode and playback capability.

### EnerVista™ Software

- State of the art software for configuration and commissioning GE Multilin products
- 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 750/760 into new or existing monitoring and control systems

Digital Energy
Multilin

## Protection and Control

The 750/760 Feeder Protection System is a digital relay intended for the management and primary protection and control of distribution feeders. This easy to use relay provides comprehensive protection functions for feeders and back up protection for bus, transformers and transmission lines at a reduced product life cycle cost.

### Time & Instantaneous Overcurrent

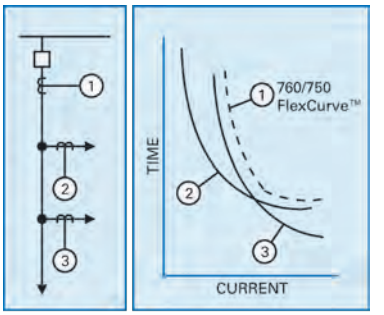
The 750/760 has two phase TOC elements with level detectors for each phase. The 750/760 also has two overcurrent elements most commonly used for primary and back up protection. Each TOC element has the following programmable characteristics:

- Pickup current level for trip, alarm, or control
- Choice of 15 curve shapes (including FlexCurves) and curve multipliers
- Instantaneous or linear reset time characteristic
- Voltage restraint

| | |
|---|---|
| **ANSI** | Extremely Inverse |
| | Very Inverse |
| | Normally Inverse |
| | Moderately Inverse |
| | Definite Time |
| **IEC** | Curve A (BS142) |
| | Curve B (BS142) |
| | Curve C (BS142) |
| | Short Inverse |
| **IAC** | Extreme Inverse |
| | Very Inverse |
| | Inverse |
| | Short Inverse |
| **Custom** | FlexCurve™ A |
| | FlexCurve™ B |

*Standard and Flex Curves*

The 750/760 has two phase IOC elements with level detectors for each phase. Each IOC element has a programmable pickup current, a time delay during which current must exceed the pickup for operation, and the minimum number of phases required for operation.




*Typical application of FlexCurves™*

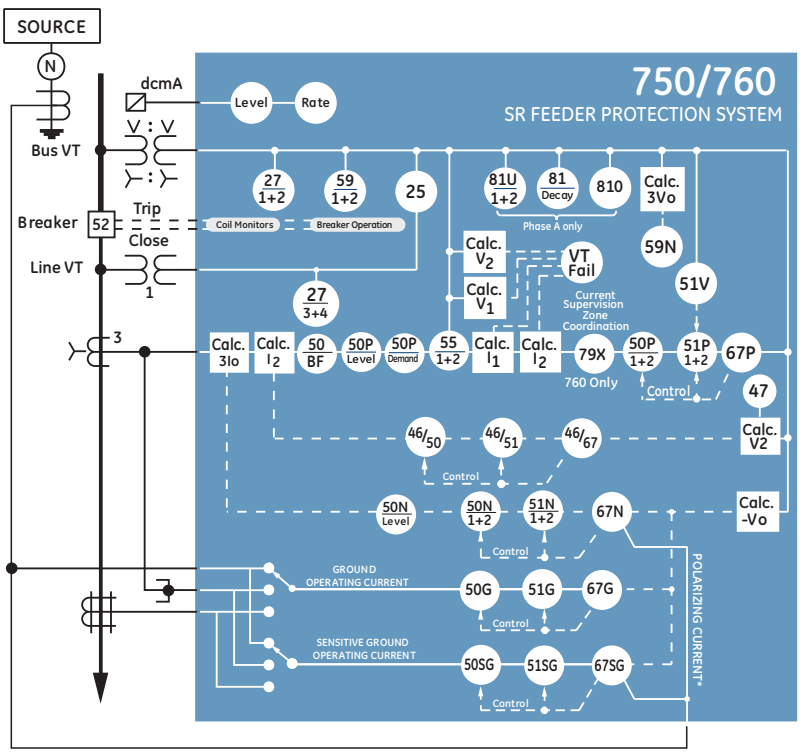
### Ground overcurrent protection

Solidly grounded and low impedance grounded distribution systems requiring fast clearing of ground faults to limit equipment damage. The following functions are incorporated in the 750/760 to provide ground fault protection

- Neutral IOC and TOC
- Ground IOC and TOC

750/760 allows directional elements to be used to supervise the ground overcurrent protection elements. This means the 750/760 can be used to provide sensitive tripping for faults in one direction. Typical

## Functional Block Diagram




* POLARIZING CURRENT AND GND CURRENT ARE MUTUALLY EXCLUSIVE SINCE BOTH USE THE SAME RELAY CT INPUT TERMINALS

ANSI Device Numbers & Functions

| Device Number | Function |
|---|---|
| 25 | Synchronism Check |
| 27 | Bus/Line Undervoltage |
| 32 | Reverse Power |
| 46/50 | Negative Sequence Instantaneous Overcurrent |
| 46/51 | Negative Sequence Timed Overcurrent |
| 46/67 | Negative Sequence Directional Overcurrent |
| 50 | Breaker Failure |
| 50N | Neutral Instantaneous Overcurrent |
| 50P | Phase Instantaneous Overcurrent |
| 50G | Ground Instantaneous Overcurrent |
| 50SG | Sensitive Ground Instantaneous Overcurrent |
| 51N | Neutral Time Overcurrent |
| 51P | Phase Time Overcurrent |
| 51G | Ground Time Overcurrent |
| 51SG | Sensitive Ground Time Overcurrent |
| 55 | Power Factor |
| 59 | Overvoltage |
| 59N | Neutral Overvoltage |
| 59P | Phase Overvoltage |
| 67N | Neutral Directional Overcurrent |
| 67P | Phase Directional Overcurrent |
| 67G | Ground Directional Overcurrent |
| 67SG | Sensitive Ground Directional Overcurrent |
| 81U/O | Under/Over Frequency |
| 81 | Frequency Decay |

applications for directional overcurrent include:

- Isolation of the faulted feeder in ring bus or parallel feeder arrangements.
- Prevention of back-feeding utility source fault from industrial plant generators
- Sensitive hi-speed ground protection of transformers

### Sensitive ground and Restricted Earth Fault (REF) protection

Sensitive ground and RGF protection features provide sensitive detection of ground faults. Sensitive ground fault protection includes:

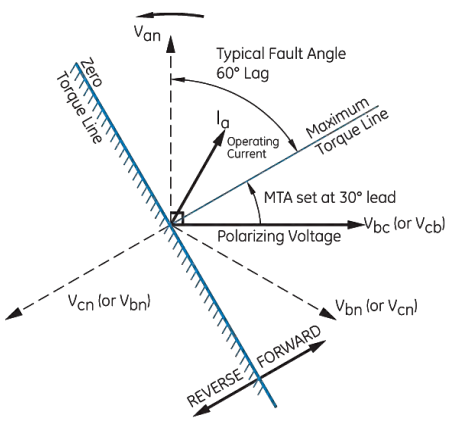
- Instantaneous (50N) & Tim (51N) - 2 levels
- Directional supervision allows to discriminate between forward and reverse faults.
- Dual polarization (current & voltage) provides max security and reliability

750/ 760 employed to provide transformer back up protection (grounded wye windings and autotransformers) using the RGF feature.

### Voltage Protection

Overvoltage/Undervoltage protection features can cause a trip or generate an alarm when the voltage exceeds a specified voltage setting for a specified time. Voltage protection includes a negative sequence voltage element to detect abnormal system unbalance conditions, and a neutral displacement voltage element using the calculated zero sequence voltage (3V0) to detect ground faults

| Protection/Control | FEEDER Capacitor | FEEDER Radial | FEEDER Two-ended | BUS Backup | BUS Transfer | TRANSFORMER Backup | LINE Backup |
|---|---|---|---|---|---|---|---|
| Bus/Line Undervoltage | ● | ● | ● | ● | ● | | ● |
| Negative Sequence Voltage | ● | ● | ● | ● | | ● | ● |
| Phase/Neutral/Gnd/Neg Seq/Sens Gnd IOC | ● | ● | ● | | | ● | ● |
| Phase/Neutral/Gnd/Neg Seq/Sens Gnd TOC | ● | ● | ● | ● | ● | ● | ● |
| Bus Overvoltage/Neutral Displacement | ● | ● | ● | ● | | ● | ● |
| Phase/Neutral/Neg Seq/Sens Gnd/Gnd Directional Control | | | ● | ● | | ● | ● |
| Bus Underfrequency/Rate of Change | | | | ● | | ● | ● |
| Undervoltage Automatic Restoration | ● | ● | ● | ● | | ● | |
| Underfrequency Automatic Restoration | ● | ● | ● | ● | | ● | |
| Breaker Failure with Current Superv. | ● | ● | ● | ● | ● | ● | ● |
| Bus Transfer | | | | | ● | | |
| Programmable Logic Inputs | ● | ● | ● | ● | ● | ● | ● |
| Multiple Setpoint Groups | ● | ● | ● | ● | ● | ● | ● |
| **Monitoring/Control** | | | | | | | |
| Synchronism Check | | | ● | | ● | | ● |
| Phase/Neutral Current Level | ● | ● | ● | ● | ● | ● | ● |
| Power Factor | ● | ● | | | | | |
| Autoreclose (760 only) | | ● | ● | | | | ● |
| Overfrequency | | | | | | | ● |
| Breaker Open/Close | ● | ● | ● | ● | ● | ● | ● |
| Manual Close Feature Blocking | ● | ● | ● | | ● | ● | |
| Cold Load Pickup Feature Blocking | | ● | ● | ● | | ● | |
| Breaker Operation Failure | ● | ● | ● | ● | ● | ● | ● |
| Trip/Close Circuit Failure | ● | ● | ● | ● | ● | ● | ● |
| Total Breaker Arcing Current | ● | ● | ● | ● | ● | ● | ● |
| VT Failure | ● | ● | ● | | | | ● |
| Demand (A, MW, Mvar, MVA) | ● | ● | ● | ● | ● | ● | ● |
| Analog Input | ● | ● | ● | ● | ● | ● | ● |
| Event Recording | ● | ● | ● | ● | ● | ● | ● |
| Analog Output | ● | ● | ● | | | | ● |
| Fault Locator | | ● | ● | | | | ● |
| Trip Counter | ● | ● | ● | ● | ● | ● | ● |




*Phase directional (for phase A).*

### Frequency Protection

750/760 provides functionality to improve network (grid) stability using voltage or frequency based techniques. Also allows to provide back up protection and trip breakers directly when protecting generators and other frequency sensitive power equipment.

- 2 Under-frequency elements (81U)
- 2 Over-frequency elements (81O)
- Frequency decay: 4 df/dt elements (59/81)
- 2 Undervoltage elements

### Reverse power detection

750/760 relay allows to trip or alarm when power flows against the intended direction. In systems having in-plant generation parallel to the utility supply, detection of power flow toward the utility is necessary. For such applications, 750/760 eliminates requirement for separate device to detect power flow direction and reduces overall cost. This feature can also be used to detect motoring power into the generator.

### Synchronism Check

Breaker closing can be supervised by ΔV, Δf and ΔHz setpoints. Dead-source alternatives are provided.

### Cold Load Pickup Control

This function allows automatic or manual blocking or raising of trip settings for a period after the breaker is closed. Built-in scheme available to perform main-tie-main transfer using a set of three relays, two on incoming and one on a normally open bus tie breaker. This scheme uses " open before close " sequence for safe operation.

### Manual Close Control

After the breaker is closed manually, the relay can block any IOC element or raise the pickup value of any TOC element, each for a programmable time delay, after which normal operation is restored.

### Bus Transfer Scheme

A set of three relays, two on incoming and one on a normally open bus tie breaker can perform transfer on loss-of-source.

### Recloser (760 Only)

Autoreclosing can be initiated externally or from an overcurrent protection. Up to four reclose operations are possible, each with a programmable dead time. For each reclose shot, the relay can be programmed to block any IOC element, and to adjust the curve characteristics of any TOC element. The number of shots can be reduced by high currents.

### Equipment Management

The following comprehensive features in the relay allows to manage the primary breaker:

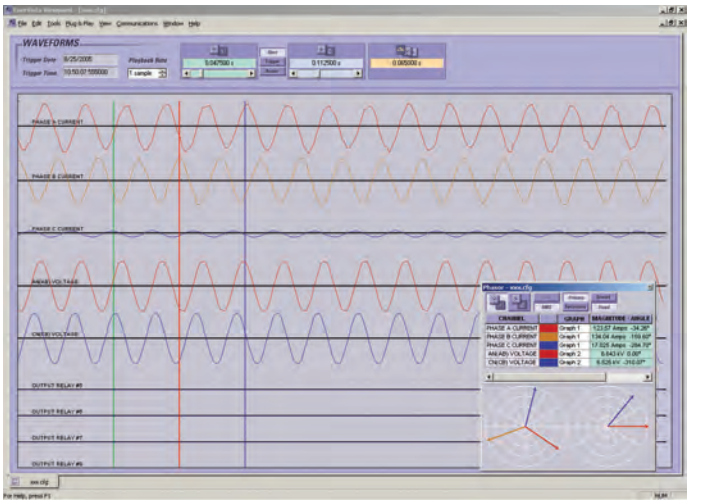
- Trip counter to keep track of number of operations
- Per-phase breaker contact wear calculations for maintenance
- Breaker failure detection
- Trip coil monitoring

## Monitoring and Metering

The 750/760 features advanced monitoring and metering functions which include:

### Fault Locator

The relay uses captured data to calculate the type, distance to and the impedance of the fault. Records of the last 10 faults are stored.




*The 750/760 saves up to 256 power frequency cycles of waveform data*

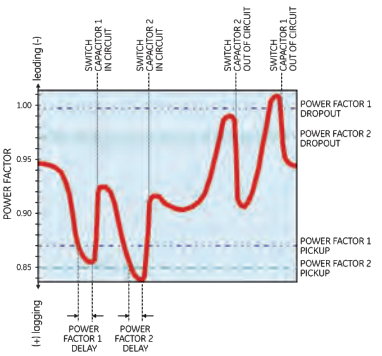
### Breaker Conditions

The relay calculates the per-phase wear on the breaker contacts to establish a threshold. When the breaker maintenance threshold is exceeded the relay can trigger an alarm. An alarm is also generated if the relay detects that the supervisory trickle current is not present. A failure to respond to an open or close signal in a programmed time can be used to generate an alarm.

### VT Failure

The VT failure feature monitors each phase of input voltage, generating an alarm and sending the programmed output signals when a failure is detected.

### Power Factor




*By monitoring the power factor the 750/760 can help minimize both costs and voltage excursions.*

Two independent elements monitor power factor, each with programmable pickup, dropout and time delay.

### Analog Input

Any external quantity may be monitored via an auxiliary current input. Two analog input level monitoring elements and two rate-of-change elements are available. When the measured quantity exceeds the pickup level, the relay can trigger an alarm or signal an output.

### Event Recording

The relay captures and stores the last 256 events, recording the time, date, cause, and system parameters. Events may be recorded selectively by category, so that only events of interest are recorded.

### Oscillography

A block of configurable volatile memory can be used for recording samples of the AC input voltages and current, and the status of logic inputs and output relays. This memory can be configured between the ranges of two to 16 blocks with 16 to 256 power frequency cycles of data respectively. The amount of pre-event data recorded is set by the user. Trace memory recording can be triggered by operation of selected features or logic inputs.

### Trip Counter

The number of breaker trip operations is recorded, and can be displayed for statistical purposes (useful for units without operation counters).

### Metering

The 750/760 performs accurate measurement of the following:

- Actual V, A, Hz, W, Wh, var, varh, VA-PF
- Watthour cost
- Phasor presentation of V and I
- Symmetrical components of V and I

- Line (synchronous) voltage: RMS voltage, frequency, and differentials
- Percent of load-to-trip
- Analog input
- Running and maximum demand: A, MW, MVAR, MVA

Setpoints allow the user to simulate three common electrical utility demand measuring techniques.

### Data Logging

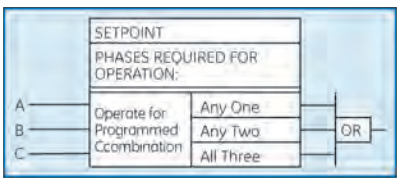
A configurable memory block can record eight channels of any measured or calculated parameter. In continuous mode, this feature can be programmed to capture from 136 seconds of data per cycle to 48 weeks of data per hour.

### Simulation

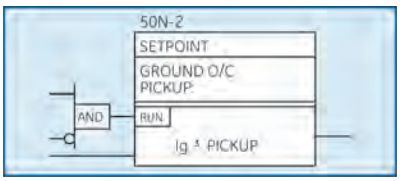
The relay provides a powerful simulation feature for testing the functionality of the relay in response to programmed conditions. System parameters are entered as setpoints. Pre-fault, fault, and post-fault conditions can be simulated to exercise relay features.

### Logic Inputs

The relay has 14 contact and 20 serial inputs which can be programmed to perform any of 60 predefined functions, including remote tripping, resetting, feature blocking, and more.




*Setpoints block diagram.*




*Level detectors block diagram.*

## Inputs and Outputs

The 750/760 features user-configurable inputs and outputs:

### Outputs

The 750/760 has eight electromechanical relay outputs.

- Two are factory programmed for breaker control
- Five can be configured to operate as either failsafe or non-failsafe, and either latching, self-resetting, or pulsed; these relays can be programmed to be operated by any feature
- One of the relays is factory programmed as a fail safe internal failure alarm relay

The 750/760 has one high-speed SCR solid state output.

The 750/760 has eight analog output channels. Any of 31 measured parameters can be selected to drive these outputs.

### IRIG-B Input

An IRIG-B input allows time synchronization using a satellite signal.

## Communications

The 750/760 is equipped with three standard serial communications ports, one RS232 located in the front panel, and two RS485/RS422 in the rear of the relay. A rear Ethernet port is also available as an optional feature. The front panel port allows easy local computer access. The rear ports provide remote communications or connection to a DCS, SCADA, or PLC. The baud rate of all the serial ports is variable from 300 to 19,200 bps. The optional Ethernet port can be used to connect the 750/760 to 10 Mbps Ethernet networks. The 750/760 supports ModBus® RTU, DNP3.0 Level 2, and ModBus® RTU TCP/IP protocols.

The three serial ports support ModBus® RTU protocol, while any one of the two rear ports but not both can be configured to support DNP 3.0 Level 2. The optional Ethernet port supports ModBus® RTU via TCP/IP protocol. The communication system of the 750/760 is designed to allow simultaneous communication via all ports.

Using Ethernet as the physical media to integrate the 750/760 to Local or Wide Area Networks, replaces a multidrop-wired network (e.g., serial Modbus®), and eliminates expensive leased or dial-up connections, reducing monthly operating costs.

### Access Security

The 750/760 can be protected against unauthorized setpoint changes. A key switch may be installed on the rear terminals to allow setpoint changes from the front panel. An optional passcode restricts setpoint changes from both the front panel and ports.

## EnerVista™ Software

The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the 750/760 relay. The EnerVista™ suite provides all the tools to monitor the status of your protected asset, maintain the relay, and integrate information measured by the 750 into DCS or SCADA monitoring systems. Convenient COMTRADE and Sequence of Events viewers are an integral part of the 750 Setup software included with every 750 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 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 Monitoring

Viewpoint Monitoring is a simple-to-use and full-featured monitoring and data recording software package for small systems. Viewpoint Monitoring provides a complete HMI package with the following functionality:

- Plug-&-Play Device Monitoring
- System Single-Line Monitoring & Control
- Annunciator Alarm Screens
- Trending Reports
- Automatic Event Retrieval
- Automatic Waveform Retrieval