

Multilin™ Switch Controller

DGCS



KEY BENEFITS

- 20+ years of field proven auto-sectionalizing algorithm
- 5 shot auto-sectionalizing enables more switches per section
- 3 setting groups enable different setting selections based on switched conditions
- Advanced logic engine and multiple IOs for creating customized control schemes
- Improve performance and reliability by integrating remote feeders into DMS/OMS/SCADA
- Real time monitoring of energy to track non-technical losses
- Improves asset monitoring and maintenance schedules based on measured energy discharge
- Compatible with low energy analog (0-10V or 0-1V) voltage sensors
- Enhanced troubleshooting tools including sequence of event records and data logger
- Reduces time setup and commissioning time with easy-to-use software tools and quick setup keys on front panel
- Common hardware, firmware and software platform with other Multilin Distribution Automation (DA) controllers
- Rugged construction designed for outdoor use in harsh environment (-40° C to + 60° C)

APPLICATIONS

- Automatic control of load break and no-load switches (LBS/ NLS) for fault detection and isolation
- Automatic control of pad mounted switch gear
- Interfacing with FDIR/FLISR for auto-sectionalizing and auto-restoration

FEATURES

Fault / Level Detections

- AC parameters level detections
 - Phase Over current
 - Neutral Over current
- Over voltage
- Under voltage
- Voltage unbalance
- Reverse power detection
- Power loss
- 5 shots to lockout
- 3 setting groups for different detection applications

Communications

- Networking Interface - two wire RS485
 - Multiple protocols (Modbus®, DNP3.0)
 - Optional wireless communications (radio or cellular)
- User Interface
 - Front panel USB port
 - 4 line HMI display
 - 20 system status LED's

Automation & Control

- Auto-sectionalizing
- CLP Cold load pickup
- Auto/Manual, Local/Remote control
- Customized automation schemes using FlexLogic™

Metering & Monitoring

- Metering - current, voltage, power, energy, frequency and PF
- Event Recorder - Up to 256 time tagged events with 1ms res
- Enhanced system diagnostics and reporting

Security & EnerVista™ Software

- 4-Level device security to maintain authorized access only
- Simplified device configuration software tool and industry leading suite of software tools to manage and maintain Multilin devices

Hardware

- 3: CT supports traditional as well as line post sensors
- 6: VT supports traditional as well as LEA inputs
- Expandable inputs and outputs for advanced applications

Reliability in Networks

A key driver and measurement of utility effectiveness is in the reliability of power to its customers. As many faults on overhead distribution lines are transient in nature, reclosing at the substation and installation of mid-line reclosers./switches can improve a utilities SAIDI reliability index by up to 24%.

When permanent faults occur on overhead lines, having feeders with increasing degrees of automation can greatly enhance distribution grid reliability and reduce restoration of unfaulted segments from several hours to a few seconds or minutes. A key component of these automation schemes is intelligent controllers that can integrate with FDIR systems through sharing local information and accepting control commands.

Fault Isolation and Restoration

With adequate deployment of Reclosers and switches, faults on distribution networks can often be isolated allowing unaffected parts of the system to be restored. Two main modes of operation of isolation and restoration commonly deployed are:

- A, **Manual:** Fault Isolation & restoration is done manually by the crew visiting the site.
- B. **Automatic:** Intelligence at the switching locations detect faults and based on the level of automation available, the following three options are possible.

1. **Localized Control:** Local intelligence for detecting and isolating a faulted section of the feeder allowing for automatic reclosing and restoration to unfaulted upstream sections of the feeder.
2. **Operator Control:** Operator Control requires a DMS application like GE's PowerOn or GeNe solutions running in the control center. This is a combination of local intelligence communicating to the control center with an Operator executing switching plans to isolate the fault and restore service to non-faulted sections.
3. **Automated Control:** Automated Control requires a DMS application like GE's PowerOn or GeNe running in the control center or a decentralize

system running in the substation like GE's D400-FDIR. FDIR algorithms determines fault location and automatically reconfigure the feeder to isolate the fault & restoring power to non-faulted sections.

Overview

The Multilin DGCS is an advanced Switch Controller for detection of faults and controlling overhead and pad mounted switches. The DGCS is compatible with most switches and provides a great degree of flexibility in integrating with FDIR systems.

The Multilin DGCS provides integrated fault detection, control, and Auto-Sectionalizing functionality that senses downstream faults and isolates faulted sections based on the set auto-sectionalized shots or elapsed time. features, the Multilin DGCS can greatly improve distribution reliability whether it is being used working independently or in tandem with an FDIR scheme.

The Multilin DGCS is capable of monitoring 3 currents and up to 6 voltages allowing for 3-phase voltage measurement on each side of the switch. The Multilin DGCS support traditional CTs and PTs sensors as well as line post sensors such as (Lindsey, Fisher Pierce).

With this measurement capability, Multilin's DGCS can measure and communicate critical information including voltage and

current magnitudes to SCADA and DMS systems. The Multilin DGCS calculates power factor, phase angle, power flow direction, power and energy. Multilin's DGCS performs real time tracking of recloser operations, parameters and the recloser wear thereby enabling the utility to manage their assets effectively and efficiently

Robust Design

Based on GE's proven Switch Controller platform with tens of thousands of units installed globally, the Multilin DGCS undergoes extensive Accelerated Life Testing (ALT) and Highly Accelerated Life Testing (HALT) to validate accurate functionality under specified conditions and to ensure accurate performance in extreme operating conditions and harsh environments.

As a complete package, the Multilin DGCS is offered in a NEMA-4 certified cabinet that is suitable for operation of harsh environments with an operating range of -40°C to +60°C (-40°F to +140°F).

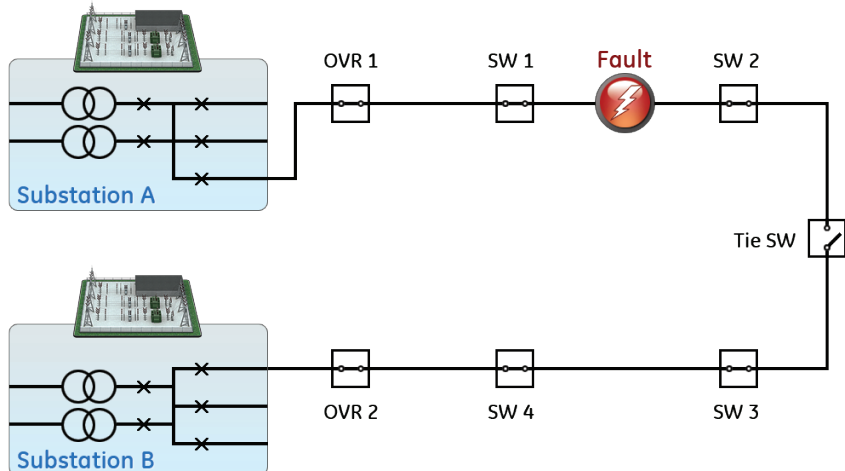
Modes of Operation

The Multilin DGCS Switch Controller provides two modes of operation:

- Remote mode
- Local mode

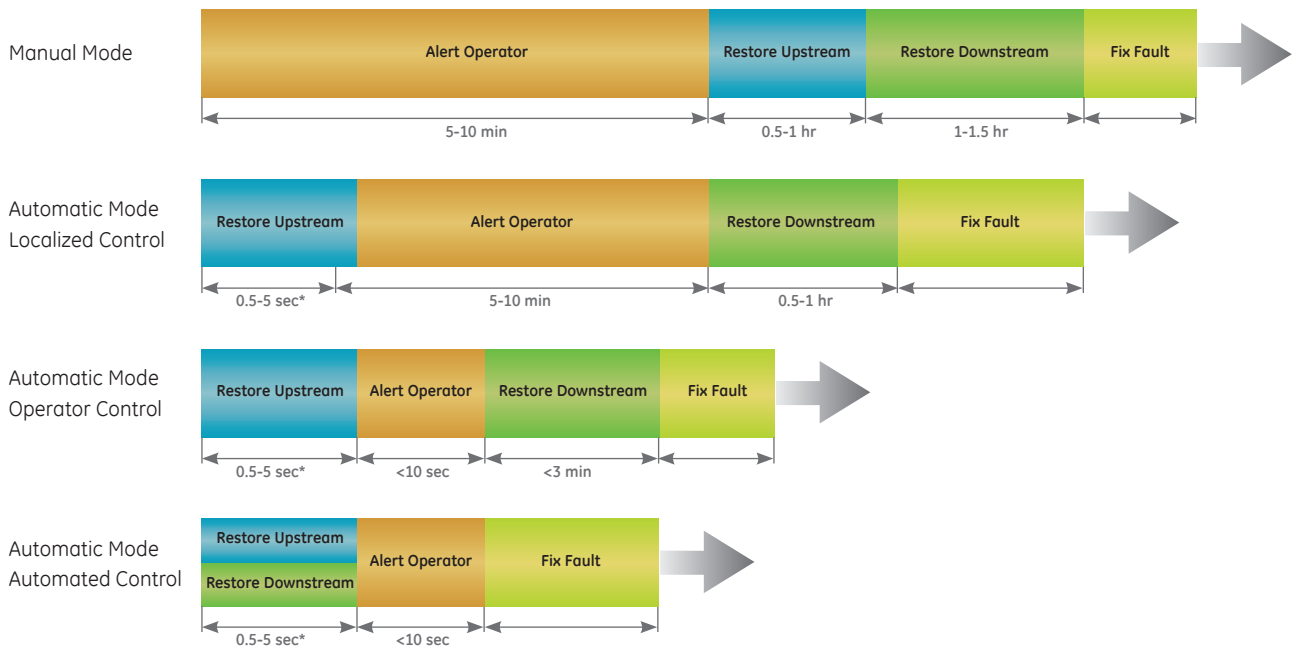
The Multilin DGCS Switch Controller measures three phase voltages and currents, and based on the measurements, manages Auto-Sectionalizing functionality.

Typical Loop Feeder Arrangement



The DGCS can play an important part of FDIR/FLISR solutions for improving distribution grid reliability.

Automating the reconfiguration of faulted distribution circuits reduce customer outage time on unfaulted sections of the network from hours to seconds



Switch Controller

Comparison of time taken for different fault isolation and restoration options.

- Detects Fault** – Dispatch crew on receipt of fault information
- Restore Upstream** – Restore power back from S/S A to first switching device (SW1). Crew travel time, Isolate fault (Open SW1)
- Restore Downstream**– Restore power to segment between SW2 and Tie SW. Crew travel time, Isolate fault (Open SW2) & reroute power (Close tie SW)
- Fix Fault** – Rectify the fault & revert back to normal

* Actual restoration time varies based on the circuit configuration.

NETWORK RECONFIGURATION IMPROVING RELIABILITY

Efficient fault detection, isolation and restoration greatly enhances distribution grid reliability, reducing restoration time drastically from several hours to a few seconds or minutes. Distribution reliability performances are greatly enhanced, as are the indexes of CAIDI, SAIFI and SAIDI, which are commonly used as a reliability indicator by electric power utilities.

SAIDI:

The System Average Interruption Duration Index is the average outage duration for each customer served.

SAIFI:

The System Average Interruption Frequency Index is the average number of interruptions that a customer would experience.

CAIDI:

The Customer Average Interruption Duration Index is $SAIDI \div SAIFI$. CAIDI gives the average outage duration that any given customer would experience. CAIDI can also be viewed as the average restoration time.

Fault / Level Detections

The Multilin DGCS provides early warning for downstream over current and earth faults. The Multilin DGCS can be programmed to isolate a faulted segment either independently or from the remote. Effective fault isolation is a key feature for grid reliability. The DGCS also offers control, monitoring and diagnostics in one integrated efficient design.

Cold Load pickup

The Multilin DGCS can be programmed to block the instantaneous over-current elements, and raise the pickup level of the time over-current elements, when a cold load condition is detected. The cold load condition is detected during closing of the breaker on a feeder that has been de-energized for a long time. The feeder inrush current and the motor accelerating current during breaker closing maybe above some over-current protection settings.

Phase IOC

The Multilin DGCS has one instantaneous overcurrent detection function Phase IOC. It consists of three separate instantaneous overcurrent elements; one per phase, with identical settings.

Phase TOC

The TOC in the Multilin DGCS comes with the following user selectable curves: Extremely/Very/Moderately/Normally Inverse, Definite Time, IEC Curve A/B/C and Short Inverse, IAC Extremely / Very / Inverse / Short, User Curve, FlexCurve A, FlexCurve B.

The TOC settings are applied to each of the three phases to produce pickup and alarm conditions per phase

Neutral current detection

The Multilin DGCS has one Neutral Overcurrent detection function. The settings of this function are applied to the calculated neutral current for pickup and trip flags.

Overvoltage detection

The phase OV protection protects voltage sensitive feeder loads and circuits against sustained overvoltage conditions. The phase OV protection generates alarms

when the voltage exceeds the selected voltage level for the specified time delay.

Phase Under voltage detection

The phase UV protection protects voltage sensitive feeder loads and circuits against sustained under voltage conditions. The phase UV protection generates alarms when the voltage drops below the selected voltage level for the specified time delay.

Voltage Unbalance detection

The Voltage Unbalance feature in the Multilin DGCS detects voltage unbalances on a feeder. Voltage unbalance is defined as the ratio of negative-sequence to positive-sequence voltage. On unbalance an alarm is issued so the master station can take action to isolate and repair the damaged section. This could provide an indication to the system operator of a broken conductor causing a high impedance fault.

Power Loss

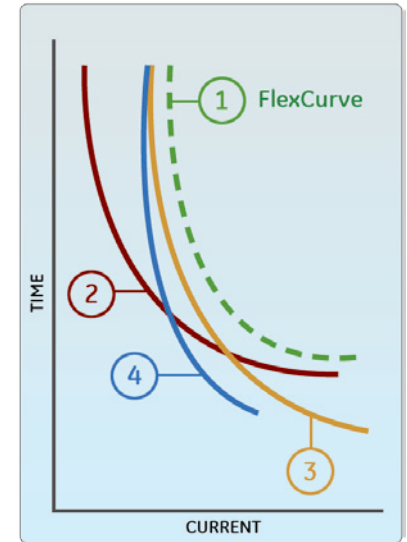
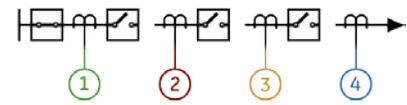
The Multilin DGCS can detect a power loss condition in each phase of the power distribution line. Open/ Close commands are blocked unless currents and voltages of each phase fall below minimum set values.

When the switch is closed, the power loss detection of the source side is used to control the opening commands execution.

When the switch is closed, the power loss detection of the source side is used to control the opening commands execution.

Reverse Power Detection

On detection of Reverse Power, the Multilin DGCS prevents the Switch Open command from being executed during the Auto Sectionalizing sequence.



Custom FlexCurves can be constructed to coordinate with other Up/down stream protection devices on a lateral

Auto Sectionalizing

The Auto sectionalizing element provides a mechanism to localize a fault by coordinating this function with the reclosing operations of the feeder breaker within a timing schedule.

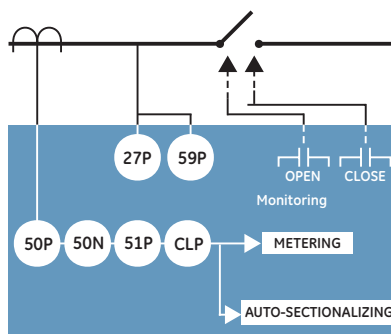
The logic implemented in this element provides a way to detect several reclosing actions from the main circuit breaker and accordingly open the local switch, in periods when the voltage is absent.

The logic uses the information of the overcurrent condition followed by a loss of voltage, loss of current, power flow direction and voltage detection functions to execute the transition into internal states.

Automation & Control

The Multilin DGCS offers powerful I/O and programmable logic (FlexLogic™) options for advanced automation and control, reducing the need and costs associated with additional programmable controllers or discrete control devices.

Functional Block Diagram



ANSI Device Numbers & Functions

Device Number	Function
50P	Phase Instantaneous Overcurrent
50N	Neutral Instantaneous Overcurrent
51P	Phase Time Overcurrent
CLP	Cold Load Pick Up
27P	Phase Time Overcurrent
59P	Over Voltage

Remote Control

For both operational efficiency and reliability reasons, the Multilin DGCS provides remote control for operating over-head recloser as well as Pad mounted switchgear. The Multilin DGCS has the capability to lock remote control operations locally to prevent remote control functionality. The Multilin DGCS is capable of providing both local and manual control of the switchgear.

The compact size of the Multilin DGCS enables it to fit in existing out door Distribution Substations without the need for additional space.

Set Point Group Control

The Multilin DGCS has three identical set point groups. The activation of the group can be done either from the HMI or via a digital input.

Virtual Inputs and Outputs

The Multilin DGCS provides 32 virtual inputs and 32 virtual outputs that provide users with the ability to send commands to the device. The Multilin DGCS can accept commands from SCADA, through the front HMI, or front USB port to issue commands such as close or open.

Command Setting

The Multilin DGCS has the ability to force commands from the menu structure. This can also be achieved via the EnerVista™ software that runs on a PC. This simulation ensures that the close and open commands can be safely issued from a distance without using the HMI.

FlexLogic™

FlexLogic in the Multilin DGCS provides the ability to create customized control schemes. This minimizes the need and costs associated with auxiliary components and wiring. Schemes can be configured with FlexLogic specifying what actions need be taken based on the status of fault detections or control elements, as well as inputs driven by connected sensors and equipment.

Battery Management System

The Multilin DGCS is capable of controlling the Feeder Switch in different conditions including power loss. The power loss can

occur if the Line Recloser opens up or there is a distribution grid blackout. During all power loss conditions, the Multilin DGCS is supplied from a backup battery.

The battery is a 24V Sealed Valve Regulated Lead Acid (SVRLA) battery. It is sized to keep the Multilin DGCS running for 8 hours.

During normal running conditions, the battery is connected to the charger. Switching to different modes of operation is controlled by the DGCS.

The battery management system has the following modes of operations.

- Run
- Backup
- Battery test
- Fuse test

A battery alarm LED is provided for alarms, and the event will be logged into the event recorder.

Metering & Monitoring

The DGCS switch controller is able to monitor the switch state based on the auxiliary input 52a / 52b provided by the feeder switch. It can also be configured for several external inputs for monitoring possible errors provided by the switch.

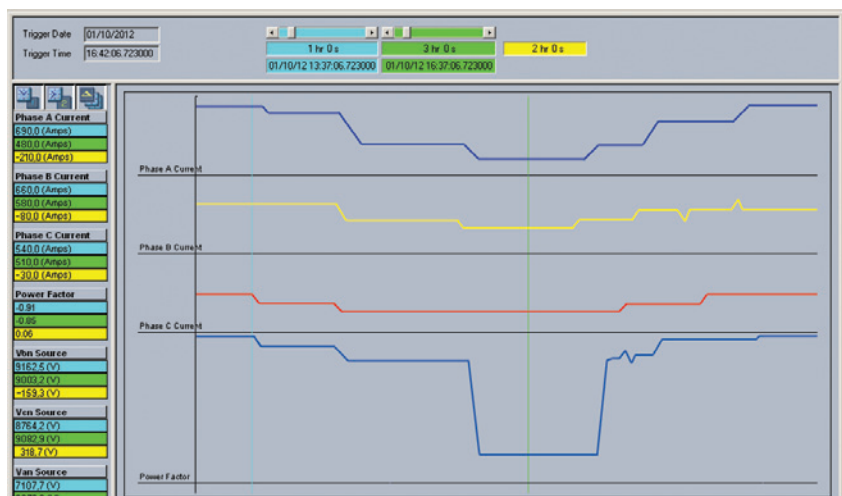
- Low Charge Limit Switch (LCL)
- Spring Charge Limit (SCL)
- Disconnect Closed & Latched (DCL)
- Open Visual Disconnect Contact

These inputs can be used to inhibit any possible local and remote closing and opening commands to the feeder switch.

The Multilin DGCS is able to monitor other external states such as low battery conditions, ambient temperature.

Event	Date	Time	Cause of Event
53	02/03/2012	16:22:44.103	TOC pickup
52	02/03/2012	16:22:44.220	Loss of Power
51	02/03/2012	16:22:45.115	TOC drop off
50	02/03/2012	16:22:45.175	AS first shot
49	02/03/2012	16:22:47.680	TOC pickup
48	02/03/2012	16:22:47.710	Loss of Power
47	02/03/2012	16:22:48.132	TOC drop off
46	02/03/2012	16:22:48.192	AS second shot
45	02/03/2012	16:22:48.412	Switch Open

Event record enables to analyze the sequence of events after each recloser action. Each event is stored with event number, date, time, and analog data of interest



Data logger helps in better understanding the analogue channel behavior. Sampling at a selectable time interval rate of 1 min to 60 minutes

Power Quality Measurements

The Multilin DGCS provides high accuracy metering and recording of all AC signals, measuring the following key parameters:

- Phase-Ground Voltages (kV)
- Phase to Phase Voltages (kV)
- Positive, Negative, Zero Sequence Voltage
- Phase A, B, and C Currents (A)
- Positive, Negative, Zero Sequence Current
- Ground Current (A)
- 3-Phase Active Power (KW)
- 3-Phase Reactive Power (KVar)
- 3-Phase Apparent Power (KVA)
- Power Factor (Lag or Lead)
- Pos. & Neg. (Import & Export) Real Energy (kWh)
- Pos. & Neg. (Import & Export) Reactive Energy (kVarh)
- 2nd to 8th Harmonic up to 20% – for Current
- 2nd to 8th Harmonic up to 20% – for Voltage

- THD in 20% – for Current
- THD in 20% – for Voltage

These data points can be easily integrated into a customer’s database for seamless viewing through a SCADA or DMS system like GE’s PowerOn or GeNe.

Statistics & Counters

- Open Counter
- Close Counter
- KI²T Phase A Counter
- KI²T Phase B Counter
- KI²T Phase C Counter
- Total Close/Open Operation

Maintenance Elements

The maintenance elements in the Multilin DGCS provides alarms to the system based on the maximum number of closing/opening executed commands per period of time and I²t measurements per feeder.

Event Recorder

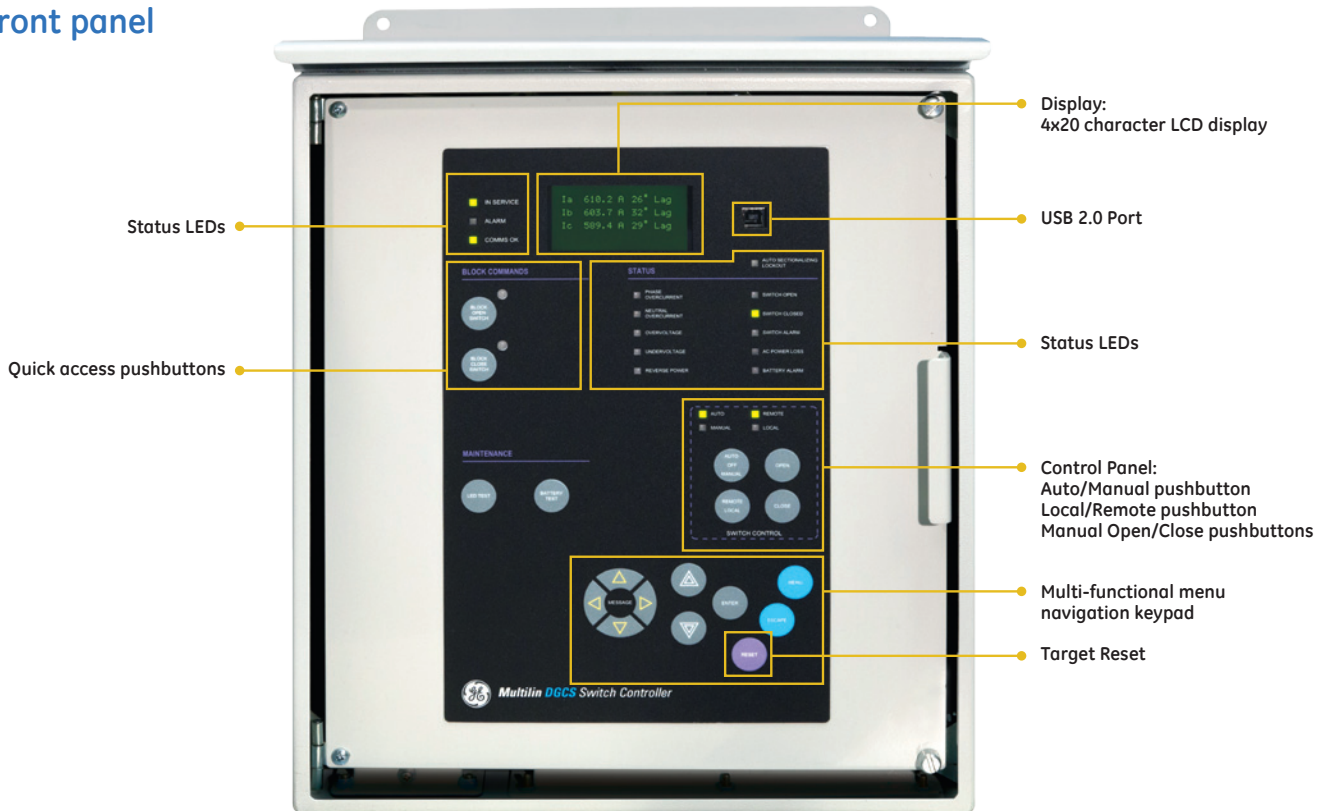
To significantly reduce time and enable more effective distribution, post fault analysis and troubleshooting, the Multilin DGCS provides an integrated event recorder and detailed diagnostic features. The sequence of events recorder offers the following features:

- Up to 256 consecutive events stored
- Enable or disable, operate and dropout events by set points
- Phase voltage/current and power metering shot is also included and stored at each event

Data Management & Diagnostics

The Multilin DGCS provides advanced disturbance diagnostic features that significantly reduce the time and costs associated with troubleshooting power system events and reconstruction. Recording functions include enhanced diagnostics with a 10 channel RMS recorder data logger.

Front panel



Advanced Device Health Diagnostics

Comprehensive device health diagnostic tests are performed by the Multilin DGCS during startup and continuously at runtime to test its own major functions and critical hardware. These diagnostic tests monitor for conditions that could impact the Multilin DGCS Controller's performance, evaluates the potential impact and criticality of this condition, and presents the device status to operators via SCADA and/or through the front panel display.

Communications

The Multilin DGCS utilizes industry standard communications technologies making it one of easiest and most flexible controllers to use and integrate into new and existing SCADA or DMS infrastructures. Supported communication protocols include:

- DNP 3.0
- Modbus RTU (RS485)

Multiple communication ports and protocols allow for remote control and easy access to device and system information.

All communication ports are capable of simultaneous communications.

The Multilin DGCS can also communicate to FDIR/FLISR/SCADA systems via wireless communications media. The supported wireless media includes:

- Wireless radio (MDS or customer specific)
- GSM/GPRS
- Pre-wired for future radio

Security

The Multilin DGCS Controller and associated software tools provide a suite of security features that ensure only approved personnel can make changes to the configuration of the system or execute commands. These functions enable a utility to meet NERC/CIP requirements.

Password Security

The Multilin DGCS offers multiple levels of password security to limit access control based on settings or command levels. There are four levels of password security provided:

- Local settings access
- Local control access
- Remote settings access
- Remote control access

Local access refers to users making changes using the front USB serial port and the HMI. Remote access refers to users making changes using the rear RS485 port one 24 hour day period.

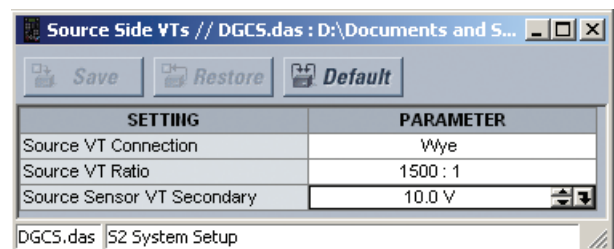
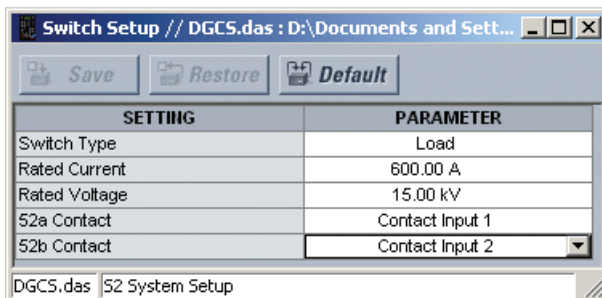
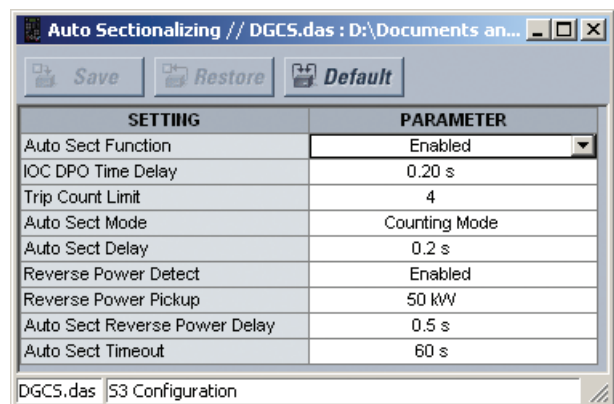
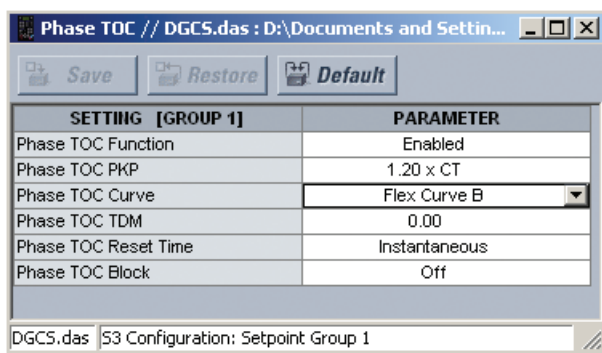
Software & configuration

The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the Multilin DGCS.

EnerVista provides all the tools to monitor the status of the protected asset, maintain the controller and integrate information measured by the Multilin DGCS into SCADA or the DMS monitoring systems.

The ability to easily view sequence of events is an integral part of the setup software, as postmortem event analysis is critical to proper system operation.

Set up with EnerVista™ Software



EnerVista setup software can reduce device set-up and configuration time with the help of easy to use drag & drop configuration menu.

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’s 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
- Guide form specifications
- Brochures
- Wiring diagrams
- FAQs
- Service bulletins

Technical Specifications

POWER SUPPLY	
Nominal:	24 to 48 V DC
Range:	20 to 60 V DC
Power Consumption:	16 W typical, 25 W maximum
AC CURRENT (OPTION A)	
Input type:	Combined IA/SA
Frequency:	50 or 60 Hz
AC VOLTAGE: (OPTION B)	
Input type:	60 to 300 V AC
Nominal frequency:	50 or 60 Hz
AC VOLTAGE: (OPTION J)	
Input range:	0-12 V AC
Nominal frequency:	50 or 60 Hz
DIGITAL INPUTS:	
Type:	opto-isolated inputs
External switch:	wet contact
Maximum input voltage:	36 V AC
DIGITAL OUTPUTS:	
Operate time:	10 ms
Minimum contact load:	10 mA at 5 V DC
Continuous current:	10 A

Make & carry for 0.2s:	30 A per ANSI C37.90
COMMUNICATION	
SERIAL	
RS485 port:	Opto-coupled
Baud rates:	up to 115 kbps
Response time:	1 ms typical
Parity:	None, Odd, Even
Maximum distance:	1200 m (4000 ft)
Isolation:	2 kV
Protocol:	Modbus RTU, DNP 3.0
USB	
Standard specification:	Compliant with USB 2.0
Connector:	115 kbps
TESTING AND CERTIFICATION	
ISO:	Manufactured under an ISO9001 registered program
PHYSICAL SPECIFICATIONS	
Enclosure Size:	356 mm (W) x 406 mm (H) x 254 mm (D); 14.0" (W) x 16.0" (H) x 10.0" (D)
Weight (Base):	18 kg (excluding batteries)

ENVIRONMENT	
Ambient operating temperature:	-40°C to +60°C [-40°F to +140°F]
Ambient storage / shipping Temperature:	-40°C to +85°C [-40°F to +185°F]
Humidity:	up to 90% non-condensing
Pollution degree:	2
Installation category:	Class I
Overvoltage category:	Class III
IP rating:	NEMA 4/ IP65

Provides ingress protection rating of NEMA 4 (and equivalent IP rating - IP65) as defined by NEMA IEC 60529 for pole top installation.

Ordering

	DGC	S	E	L	S	S	A	*	*	E	*	*	1	*	X	X	X	Description
Application		S																Switch Controller
Language			E															English (Standard)
Power Supply				L														Low (20 to 60vdc)
Communication					S													RS485 Modbus RTU / DNP3.0 (Standard)
Options						S												Standard
I/O							A											Current Input Card (1A/5A)
								B	B									Voltage Input Card (60 - 300VAC)
								J	J									Sensor Input Card (0-12V)
										E	E							Two (2) 10 A Form-A relays and six (6) 20 to 60V DC digital Inputs (2xIO_E Standard), Max 3xIO_E
												E	E					Four (4) 10A form-C relays (Optional, Max 1 IO_D)
												D	D					3 RTD (Optional, Max 1 IO_G)
												G	G					None
Wireless Radio Option															X			None
															1			MDS TransNet
															2			MDS iNET-II
															4			Prewired for future radio with 12VDC Power Supply installed
															5			Prewired for future radio with 24VDC Power Supply installed

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- Review applications Notes and support documents
- Buy the Multilin DGCS Switch Controller online
- View/download the Multilin DGCS brochure