

Multilin™ Capacitor Bank Controller

DGCC



KEY BENEFITS

- Increases grid efficiency through optimized voltage regulation, improving Power Factor & VARs
- Through deployment of a Volt/VAR system, the Multilin DGCC:
 - Enables up to a 6% reduction in energy demand
 - Improves load management and power quality
- Enhances and optimizes capacitor bank utilization
- Common hardware, firmware, software platform with other Multilin Distribution Automation (DA) controllers
- Performs real-time control from remote or local locations
- Lowers operational costs through improved system & operational efficiency
- Integrates with industry leading Capacitor Bank Switch manufacturers
- Rugged construction designed for outdoor use in harsh environments (-40°C to +60°C)
- Reduces time associated with setup and commissioning with easy-to-use, industry leading, software tools and quick setup keys on front panel
- Local Open/Close control through large pushbuttons on front panel
- Advanced logic engine using FlexLogic™ for creating customized control schemes

APPLICATIONS

- Controller for pole-top or pad mounted Capacitor Banks for Distribution feeders
- Integrated into centralized or decentralized Volt/VAR systems
- Ideal for medium and small size Distribution Capacitor Banks

FEATURES

Capacitor Bank Control

- Auto/Manual or Local/Remote control
- Automatic control based on Time, Temperature, Voltage and VAR
- Control override based on Temperature and voltage
- Over/Under Voltage settings
- Perpetual calendar with time zones and day light savings
- Options for multiple seasons
- Close operations counters

Protection, Automation & Control

- Star Neutral Overcurrent (Blown Fuse Indication)
- Customized automation schemes using FlexLogic™
- Expandable inputs and outputs for advanced applications

Metering & Monitoring

- Metering - current, voltage, power, frequency, PF, Harmonics
- Event Recorder - Up to 256 time tagged events
- Temperature via RTD inputs
- Enhanced system diagnostics & reporting

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
 - 19 System status LED's
 - 4 quick setting keys

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.

Volt/VAR Control

Utilities face a difficult challenge having to dynamically balance the load scenario between customer demands and available generation capacity. Adding to the challenge is the ever changing consumption patterns due to factors such as day of the week, time of day, season, temperature and Power Factor from connected loads. Maintaining an efficient and reliable distribution network is critical to a utility's operation. Meeting this challenge requires voltage regulator controller and capacitor bank controllers working in unison. These devices can operate as part of an integrated Volt/VAR Control (IVVC) scheme or as a Centralized Volt/VAR control (CVVC) system.

The IVVC or CVVC system works to achieve two key objectives:

- 1) Optimize Voltage - through 'Conservation of Voltage' that leads to reduced demand, that may result in decreased generation up to 6%.
- 2) Increased efficiency - through improved power factor and reduced VAR which helps to reduce power line losses.

Overview

The Multilin DGCC Capacitor Bank Controller enables a utility to optimize operational planning and asset tracking through 3-Phase power quality monitoring, and to reduce system downtime. The Multilin DGCC is a 3-Phase Capacitor Bank Controller that is compatible with most Capacitor Bank Switches, including Cooper, Joslyn, and Trinetics.

The Multilin DGCC Capacitor Bank Controller, is part of GE's advanced Distribution Automation controller platform which also includes a Voltage Regulator Controller, a Switch Controller, and a Field RTU/Monitor Controller.

Capacitor Bank Control

Robust Design

Based on GE's proven controller platform with tens of thousands of units installed globally, the Multilin DGCC underwent 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 DGCC 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).

Mode of Operation

To provide optimal application flexibility, the Multilin DGCC offers two modes or methods of operation in which the device can be implemented to control the Capacitor Bank:

- a) Manual Mode (Local Control or Remote Control)
- b) Automatic Mode

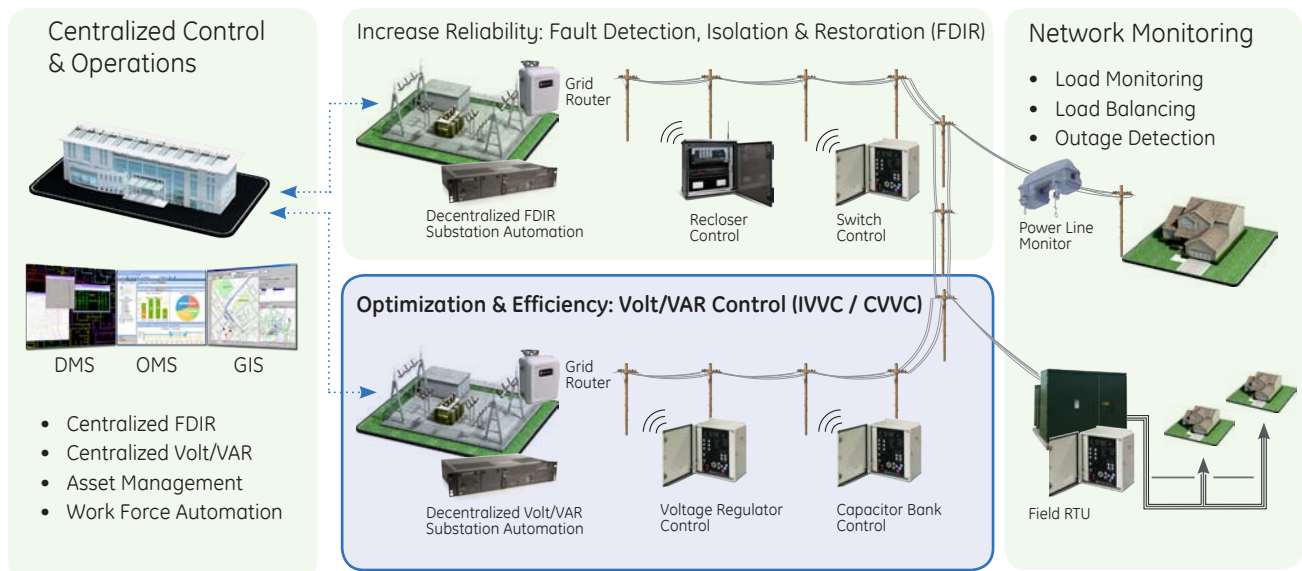
Manual Mode -Local Control

In this mode, it is possible to Open or Close the Capacitor Bank, locally, from the large pushbuttons located on the front panel of the Multilin DGCC. For increased operational reliability and operator safety, inhibit functions configured in the unit will continue to operate as defined.

Manual Mode -Remote Control

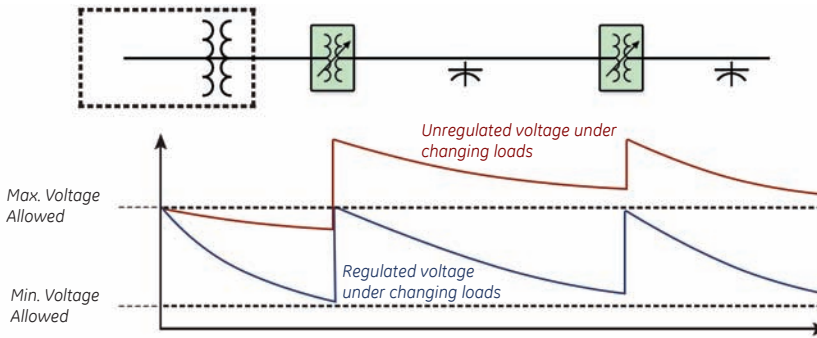
In this mode, the commands for Open or Close of the Capacitor Bank are received via communication channels from the SCADA or a Volt/VAR control system. This communication channel can be provided via optional radio or cellular communications.

Typical Application of Distribution Automation solutions (Volt/VAR control (VVC) & Fault Detection, Isolation & Restoration (FDIR))

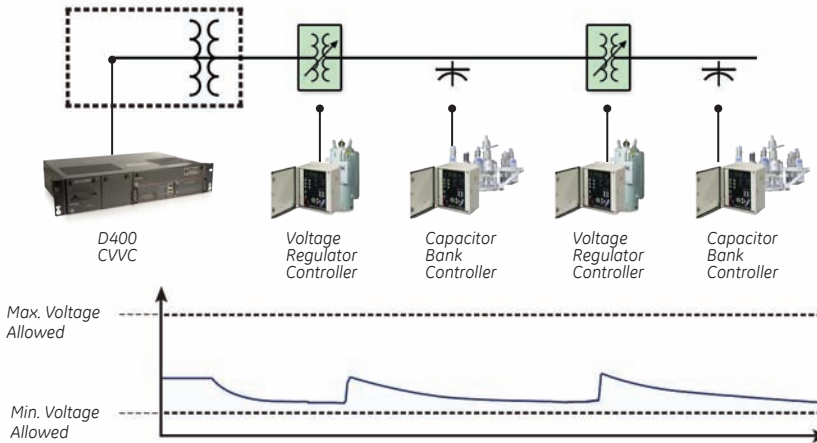


Above depicts a simplified distribution network and two key distribution automation solutions driving grid optimization, efficiency, and reliability

Unregulated voltage supply vs. Regulated supply using Distribution Automation controllers



- Unregulated end-of-line voltage will fluctuate with changes in load demand and often may drift outside allowable limits, potentially causing damage to connected loads.
- Regulated end-of-line voltage through the use of voltage regulators and capacitor bank controllers ensure voltage supply is kept within allowable limits. Equating to a safe and healthy end-of-line voltage to consumers.



When integrated with an IVVC or CVVC system, Vol/VAR controllers provide regulated voltage levels with minimal fluctuations along the feeder segment, they ensure voltage is maintained within allowable limits, and they improve power factor which reduces line losses (VAR reduced).

Each day of the week can be independently programmed with one close time (when capacitor bank is switched on) and one open time.

Temperature control

The Temperature control function enables the Multilin DGCC to control the capacitor bank based on the measurement of the ambient temperature taken from an external temperature sensor. When the ambient temperature deviates from the set temperature range, the Multilin DGCC issues a Close command to put the Capacitor Bank in service. When the temperature falls within the limits, the Multilin DGCC issues an Open command to put the Capacitor Bank out of service.

Voltage control

The Voltage control function in the Multilin DGCC is based on the measurement of the line voltage. The capacitor bank is Closed when the voltage is lower than the minimum threshold voltage programmed. The capacitor bank is Opened when the line voltage reaches the Hi voltage threshold. If required, the Multilin DGCC offers an override function for this feature. Voltage control is programmed via several key parameters including: Delta V. Average & Min. Delta Volts. The Delta V. Average function defines the change in voltage expected during an insertion of the capacitor bank into the system. If the delta voltage measured by the Multilin DGCC is lower than the expected average voltage, the Multilin DGCC will issue an alarm.

The Min Delta Volts function specifies the minimum variation of voltage expected when the capacitor bank is switched on and inserted in to the grip. The minimum voltage is calculated as a percent of the Delta voltage average set point.

VAR Control (Min Delta KVAR)

The VAR control function specifies the minimum variation of KVAR expected when the capacitor bank is switched on and inserted in to the grid. The minimum KVAR is calculated as a percent of the three phase bank size set point. In situations where reverse current is detected, the Delta KVARs functionality can be blocked.

Automatic Mode

In automatic mode, the Multilin DGCC issues commands to Open or Close the Capacitor Bank. In this mode, the Capacitor Bank is controlled based on the following key parameters:

- Time Schedule
- Temperature
- Voltage
- VAR

Four Season Configuration

Enabling application flexibility, the Multilin DGCC offers configurable controls to account for the changing seasons. Each season is programmed by indicating the starting and ending date, with each group having its own independent control parameters.

Time Schedule Control

The Time Schedule Control enables the Multilin DGCC to open or close the Capacitor Bank according to a calendar/timetable schedule programmed by the user.

Inhibit Controls

The Multilin DGCC includes configurable, inhibit controls to protect critical assets (the Capacitor Bank & the Capacitor Bank Switch), maximize asset life, and work to minimize grid anomalies. There are four key functions that provide this inhibit control; Minimum Voltage Inhibit, Max Close / Day, Max Close Total, and Circuit Breaker Switch Fail Block.

The Minimum Voltage Inhibit function prevents the Multilin DGCC from issuing a Close command if the voltage falls below the utility specified limit to ensure there is no significant increase in reactive power in the system.

The Max Close / Day function in the Multilin DGCC determines the maximum number of closing operations allowed during one day. If this maximum number is reached, the automatic close commands are inhibited until the next calendar day.

The Multilin DGCC's Max Close Total function inhibits all further close commands if the maximum number of total closing operations has been reached. The automatic close commands are inhibited until the counter is cleared.

Finally, the Circuit Breaker Switch Fail Block function checks for switch discrepancy. Upon detection of a discrepancy between the 52a and 52b contacts of the capacitor bank switch, the Multilin DGCC will block both the Open & Close commands.

Protection

Reverse Power Detection

The Multilin DGCC includes a Reverse Power Detection function, which defines the minimum pickup required to detect reverse power conditions. Such a condition will be detected if the active power measured by the Multilin DGCC is maintained higher than the set value for a predetermined period of time.

Neutral Overcurrent Protection (Blown Fuse Condition)

Short circuits across bushings or other capacitor units may cause the internal fuse(s) to blow. This blown fuse(s) may occur on one or two phases, causing the phase to be disconnected from the

system. In addition, a breaker contact failure will also cause one or two phases to be disconnected from the system. The resulting disconnection of one or two phases causes a neutral overcurrent current to flow through the wye connection point of the capacitor bank. A disconnection of one or two phases will cause an overvoltage across the other phase(s) and can result in damage to the capacitor bank, if action is not taken. The Multilin DGCC monitors and is capable of detecting the neutral current and if an overcurrent situation arises, the Multilin DGCC automatically issues a trip command, and issues an alarm (through SCADA system, if connected) protecting this critical asset from damage. In situations where the capacitor bank

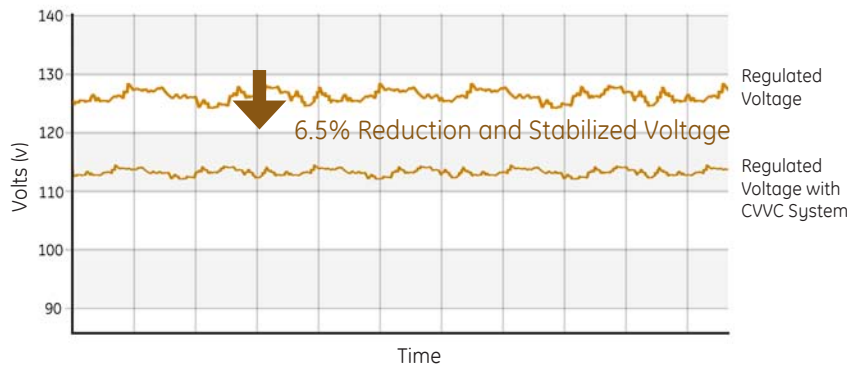
has been tripped due to a neutral current unbalance situation, the Multilin DGCC will execute a reclose action to validate the state of the fault, ensuring that the fault was not transient in nature. This automatic reclose action ensures maximizes system reliability. If a neutral fault persists, a neutral lockout trip is activated to protect the integrity of the grid and the capacitor bank.

Automation

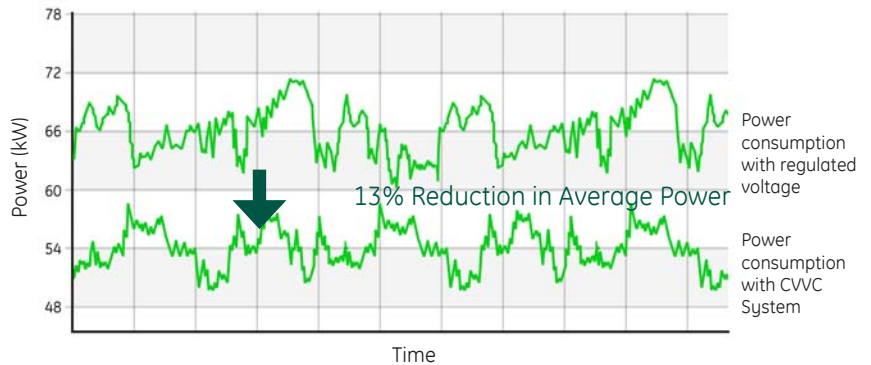
The Multilin DGCC offers powerful I/O and programmable FlexLogic™ options for advanced automation control, reducing the need for additional programmable controllers or discrete control relays.

Benefits of implementing a CVVC System with GE's Multilin DA Controllers

Typical End-of-Line Voltage Profile



Typical End-of-Line Power Profile



A 6.5% voltage reduction translates to an approximate 13% reduction in Power consumption, under certain load conditions

Virtual Inputs and Outputs

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

Command Setting

The Multilin DGCC has the ability to force commands from the menu structure accessible through the Multilin EnerVista setup software that runs on a PC. This simulation ensures that the raise & lower commands can be safely issued from a distance without using the front panel.

Alarm Reset

The Reset function on the Multilin DGCC provides the ability to reset the active alarms. The Reset command can be sent to the Multilin DGCC from the front HMI, from SCADA or through the front panel USB port.

FlexLogic™

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

Metering & Monitoring

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

- Phase-Ground Voltage (kV)
- Phase-to-Phase Voltage (kV)
- Line Voltage (kV)
- A, B, and C Phase Currents (A)
- Line Current (A)
- Ground Current (A)
- 3-Phase Active Power (kW)
- 3-Phase Reactive Power (kVAR)
- 3-Phase Apparent Power
- Delta Reactive Power (KVAR)

- Power Factor (Lag or Lead)
- 2nd to 8th harmonic upto 20% – for current
- 2nd to 8th harmonic upto 20% – for voltage
- THD in 20% – for current
- THD in 20% – for voltage
- Temperature [°C]

These data points can be easily integrated into a customer's database for seamless viewing through a SCADA or DMS system.

The Multilin DGCC has the ability to monitor the following setpoints / conditions and issue an alarm if measured values fall outside of specified limits:

- Minimum voltage limit
- Bank switch failed
- Switching alarm (Reverse Power)
- Total close counter reached
- Max Daily operation counter reached
- Minimum VAR Delta (variation)
- Minimum Volt. Delta (variation)
- Neutral overcurrent

Event recorder

To significantly reduce time and enable more effective disturbance, post fault analysis and troubleshooting, the Multilin DGCC 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 and Diagnostics

The Multilin DGCC 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. In addition, Statistics & Counters are utilized to keep a record on the number of operations as well as the various dependable parameters.

Statistics & Counters

The Multilin DGCC provides counters which records key operational parameters to aid in enabling preventative maintenance programs. The Multilin DGCC includes many counters & statistical values including the following:

- Max / Min Values of Temperature per day (in the season)
- Daily close operation
- Total Close Operation

Advanced Device Health Diagnostics

Comprehensive device health diagnostic tests are performed by the Multilin DGCC 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 DGCC 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. Providing continuous monitoring and early detection of possible issues enables preventative and predictive maintenance programs, thus improving system availability and reliability.

Communications

The Multilin DGCC 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 DGCC can also communicate to Volt/VAR or 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 DGCC 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 DGCC 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.

Software & Configuration

Quick Keys

The Multilin DGCC includes a group of “Quick Settings” buttons available on the front panel to enable users to set required application settings without having to go through the front HMI. Operators and setup & commissioning engineers have access to the following operational settings: Temperature control, Voltage control, VAR control, and Override control.

EnerVista™ Software

The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the Multilin DGCC the EnerVista™ suite provides all the tools to monitor the status of the protected asset, maintain the controller, and integrate information measured by the Multilin DGCC 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.

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

Set up with EnerVista™ Software

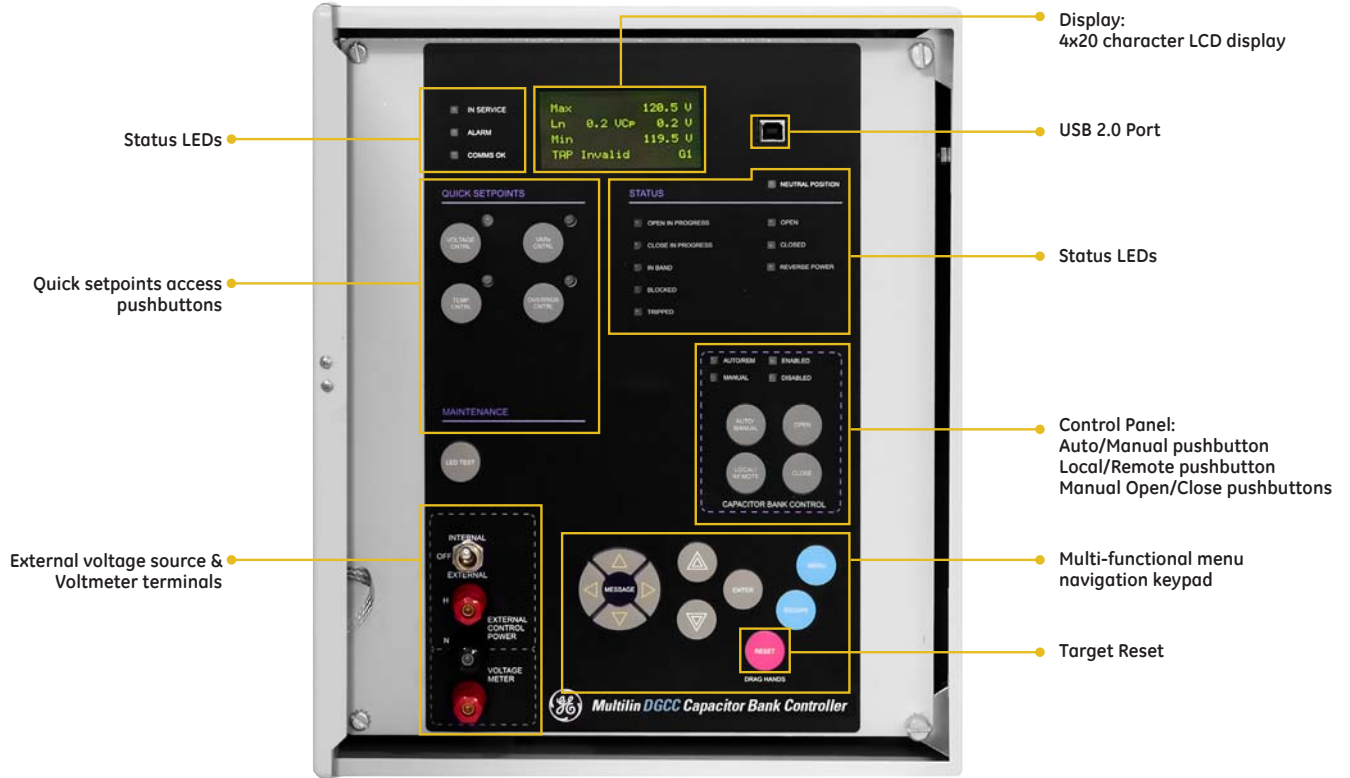
SETTING	PARAMETER
Override Control High OV Pickup	120 V
Override Control High OV Dropout	115 V
Override Control Low OV Pickup	105 V
Override Control Low OV Dropout	110 V
Override Control Voltage Time Delay	30 s
Override Control Close Over Temperature Pickup	30 °C
Override Control Close Over Temperature Dropout	20 °C
Override Control Open Over Temperature Pickup	-1 °C
Override Control Open Over Temperature Dropout	5 °C
Override Control Temperature Time Delay	30 s

SETTING	PARAMETER
Temperature Control High Temperature Close	30 °C
Temperature Control High Temperature Open	20 °C
Temperature Control Low Temperature Close	-1 °C
Temperature Control Low Temperature Open	5 °C
Temperature Control Time Delay	30 s
Temperature Control Override Control	Disabled

SETTING	PARAMETER
VAR Control 3 Phase Switch In	500 kvar
VAR Control 3 Phase Switch Out	-500 kvar
VAR Control Time Delay	30 s
VAR Control Override Control	Disabled

SETTING	PARAMETER
Voltage Control High Voltage Trip	120 V
Voltage Control Low Voltage Close	80 V
Voltage Control Time Delay	30 s
Voltage Control Override Control	Disabled

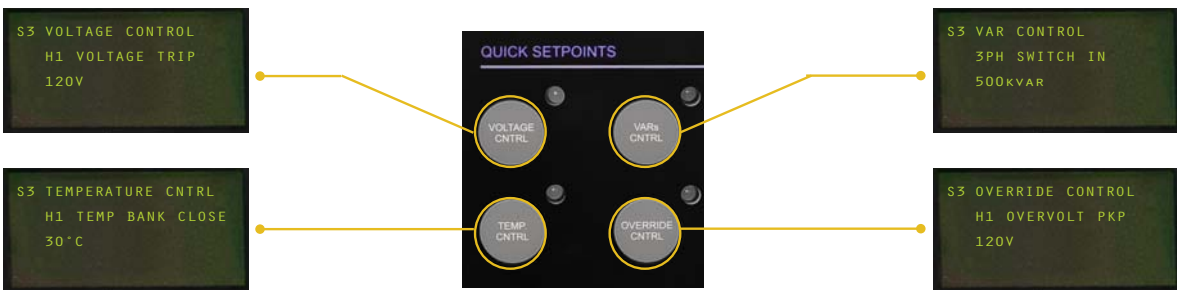
Front panel



Distribution Automation Controller

HMI Quick Setting Displays

Front panel quick keys provides direct access to key individual setting parameters



Technical Specifications

POWER SUPPLY (HIGH)

Nominal: 120 to 240 V AC , 125 to 250 V DC
Range: 60 to 300 V AC (50 and 60 Hz) , 84 to 250 V DC

Ride-Through

POWER SUPPLY (LOW)
Nominal: 24 to 48 V DC
Range: 20 to 60 V DC
Ride-Through: 35ms

ALL RANGES

Voltage Withstand: 2 x highest nominal voltage for 10 ms
Power Consumption: 16 W typical, 25 W maximum

AC CURRENT (OPTION A)

Range: 0.2 to 2.5 x CT
Input type: combined 1 A / 5 A
Frequency: 50 or 60 Hz
CT Connection: IA,IB,IC
Accuracy: ±0.5% of 0.2 to 1.5xCT

AC CURRENT (OPTION H)

Range: 0.05 to 0.5 x CT
Input type: 0.2 A
Frequency: 50 or 60 Hz
Accuracy: ±0.5% of Nominal

AC CURRENT (OPTION S)

Input type: Line current sensor, 0-10V

AC VOLTAGE (OPTION B)

Input range: 60 to 300 V AC
Nominal frequency: 50 or 60 Hz
VT Connection: VA,VB,VC,VAB,VBC,VCA
Accuracy: ±0.5% of reading

DIGITAL INPUTS:

Type: opto-isolated inputs
External switch: wet contact
Maximum input voltage: 300 V AC
Fixed pickup: 65 V AC
Recognition time: 2 cycles
Current draw at rated voltage: 60 mA @ 120 V; 75 mA @ 240 V
Momentarily sampled every cycle
Input impedance: 1.7 kΩ

RTD INPUTS

Sensor type: 100 ohms Platinum
Sensing current: 5 mA
Accuracy: ±3°C

OUTPUTS

Operate time: 10 ms
Minimum contact load: 10 mA at 5 V DC
Maximum switching rate 300 operations per minute (no load): 30 operations per minute (load)
Mechanical life: 10 000 000 operations
Continuous current: 10 A
Make and carry for 0.2s: 30 A per ANSI C37.90
Output relay break capacity: (FORM-A RELAY)
AC resistive: 120/240 V AC 10 A
AC inductive: PF = 0.4 pilot duty 2 A
DC resistive: 30 V DC 10 A (FORM-C RELAY)
Output relay break capacity: (FORM-C RELAY)
AC resistive: 120 V AC 10 A normally-open, 5 A normally-closed
AC inductive: 240 V AC 10 A normally-open, 8 A normally-closed
DC resistive: PF = 0.4 pilot duty 2.5 A
AC resistive: 30 V DC 10 A
AC inductive: normally-closed
DC resistive: PF = 0.4 pilot duty 2.5 A
EXECUTION RATE
4 times/cycle: Main task for detection elements
1/sec – display update rate: 115 kbps

COMMUNICATION

SERIAL
RS485 port: Opto-coupled up to 115 kbps
Baud rates: 1 ms typical
Response time: None, Odd, Even
Parity: 1200 m (4000 ft)
Maximum distance: 2 kV
Isolation: Modbus RTU, DNP 3.0
Protocol: 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: 325 mm (W) x 400 mm (H) x 215 mm (D); 12.7" (W) x 15.5" (H) x 8.45" (D)
Weight (Base): 16 kg

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: IP20 (base unit), IP65 (control panel)

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

Ordering

	DGCC	E	*	S	S	*	B	*	*	*	*	*	X	X	X	X	Description
Language		E															English (Standard)
Power Supply			H														High (60-300 VAC/80-250VDC)
Communication			L		S												Low (20 to 60VDC)
Options						S											RS485 Modbus RTU / DNP3.0 (Standard)
Analogue I/O																	Standard
							A										1A/5A Current Input Card
							H										0.2A Current Input Card
							S										Sensor Inputs.
							X										Not Required
								B									Voltage Input Card
Digital I/O									C	C	C	C					Two (2) 10 A Form-A relays and six (6) 60 to 300V AC digital Inputs (Standard either IO-C or IO-E)
									E	E	E	E					Two (2) 10 A Form-A relays and six (6) 20 to 60V DC digital Inputs (Standard either IO-C or IO-E)
										D	D	D					Four (4) 10A form-C relays (optional)
										G	G	G					3 RTD
										X	X	X					Not Required
Controller packaging													1				Only Controller
													2				Controller + Front Display Panel
													3				Controller + Front Display Panel in Enclosure
Wireless Radio Option														X			Contact GE for any wireless option, including prewiring for Radio

Visit www.GEMultilin.com/DGCC to:



- Download the instruction manual
- Review applications Notes and support documents
- Buy the Multilin DGCC Capacitor Bank Controller online
- View/download the Multilin DGCC brochure