**KEY BENEFITS**

- Backup protection functions along with powerful programmable automation controller with math engine eliminates the need for separate substation programmable logic controller
- Highly reliable and dependable controller with its deterministic real-time operating system ensuring the execution of automation logic regardless of the number of equations configured
- Local HMI providing real-time bay control with configurable single line diagrams with control of up to six breakers
- High-end load shedding blocks with multiple stages of under frequency, rate-of-change-of-frequency and undervoltage elements
- Customizable annunciator panel capable of handling up to 288 alarms using a pallet of 16 colors eliminates the need for a separate panel
- High-end fault and disturbance recording, including internal relay operating signals eliminates the need for digital fault recorders and disturbance recorders
- Easy to use and set up software reducing installation, maintenance, and operation costs
- Phasor Measurement Unit - Synchronized phasor information according to IEEE C37.118 standard for detection of system instability
- Intuitive large front panel color screen with pre-configured and customizable display of metering, fault records, event records and equipment status

**APPLICATIONS**

- Custom protection and bay interlocking schemes
- Bay controller for common bus-bar arrangements
- Substation alarm concentrator, annunciator, and controller
- Control for up to 6 breakers and 30 disconnect switches
- Custom bus transfer schemes
- Standalone fail & reclosing
- Controller for custom applications in utility and industrial plants

**FEATURES**

**Bay Protection & Control**

- Dedicated automation controller with 4000 lines of logic at a deterministic 50 mSec execution rate
- Powerful math, control and boolean operators
- 10 stages under/over frequency protection for load shedding
- 4 stages of rate-of-change-of-frequency for load shedding
- 6 stages of under-voltage elements for load shedding
- Dedicated protection logic at 1 mSec execution rate
- Dedicated HMI for breaker and disconnect control
- Synchrocheck and line check function for multi-breaker
- Single/three pole autoreclosing
- Dual breaker failure protection
- Direct and tele-protection elements are available using the Inter-relay communication card

**Communications**

- IEC61850, DNP3, Modbus RTU, Modbus TCP/IP, IEC 60870-5-104
- Three independently configurable IP’s with fail-over features
- Inter-relay communication card to enable implementation of pilot-schemes based on standard communication protocols
- Front USB for maintenance & downloading records and events

**Ease of Use and Security**

- Graphical protection and automation logic programming
- Real time Logic Monitoring to simplify commissioning and troubleshooting
- Document and software archiving toolset to ensure reference material and device utilities are up-to-date
- EnerVista™ Integrator providing easy integration of data (SCADA or DCS) into new or existing systems

**Monitoring and Metering**

- CT and VT monitoring
- Metering - current, voltage, frequency, power, energy and phasors as per IEEE C37.118
- Fault recorder - 256 samples/cycle, 30 sec of storage capacity
- Disturbance recorder – 1 sample/cycle, 5 min of storage capacity
- Event recorder - 8000 time tagged events, with 0.5 ms scan of digital inputs
- Comprehensive display of metering, phasors, maintenance and fault information in the front panel.
C90Plus Controller

Digital Alarm Annunciator
- 288 customizable alarms in multiple pages using a pallet of 16 colors
- Eliminates the need for separate annunciator
- Descriptive self-test messages

Intuitive HMI
- User configurable single line diagrams using IEC/ANSI library symbols
- Local control and status indication of breakers & disconnect switches, 20 user programmable push buttons
- Local/Remote control
- Fault, event, disturbance and transient reports

Bay Protection
- Overcurrent, over/under voltage, over/under frequency
- Breaker failure, autoreclose, synch check
- 512 lines of Protection FlexLogic™ @ 1 msec execution

Advanced Automation Controller
- Built-in industry hardened logic controller
- 4096 lines of independent user programmable logic, 50 msec execution rate
- Advanced Math, Boolean and Control operations

Advanced Communication Capabilities
- Up to three independent Ethernet ports with redundant fast-over
- IEC61850, DNP3, MODBUS TCP/IP, IEC60870-5-104 protocols
- Front USB port for high speed data transfer

Advanced Recorders
- Eliminates the need for stand-alone disturbance recorders
- Configurable and up to 256 samples/cycle, 1 min duration recorder
- Dedicated disturbance recorder for recording long term events
- Synchrophasors over Ethernet

Advanced disturbance recorder eliminates stand-alone DFR and Phasor Measurement Unit

Real time phasor information of fundamental and sequence components

Digital fault recorder summary with the latest information on the events, faults, transients and disturbances.
C90Plus – Controller

The C90Plus is a powerful logic controller and protection product designed for the requirements of industrial and utility power systems. Its unparalleled list of features make the C90Plus one of the most agile and advanced products allowing it to perform several functions and be used in many scenarios based on the needs of each customer. Its unparalleled list of features make the C90Plus one of the most agile and advanced products allowing it to perform several functions and be used in many scenarios based on the need of each customer. The C90Plus provides unmatched logic processing ability combined with a powerful math engine with deterministic execution of logic equations regardless of the configuration of the number of lines of logic.

The C90Plus provides the tools and functionality necessary for creating customized automation and control schemes that include:

- Advanced bay control and interlocking
- Breaker monitoring and control
- Automatic Bus Transfer schemes
- Load shedding and load restoration schemes
- Ultra Fast Load shedding in industrial plants

Automation Logic

The C90Plus incorporates advanced automation features including powerful FlexLogic™ (user programmable logic) independent for protection and automation schemes. Combined with the communication capabilities, C90Plus automation features far surpass what is found in average relays with programmable logic. The C90Plus integrates seamlessly with UR and URPlus relays for complete system protection including interlocking and special protection schemes.

FlexLogic™

FlexLogic™ is the powerful user programmable logic engine that provides the ability to create customized protection and control schemes thereby minimizing the need, and the associated costs, of auxiliary components and wiring. The independent automation FlexLogic™ features math, Boolean and control functions which can be used for advanced load shedding, load restoration and dynamic volt/var control schemes. More than 4000 lines of logic is provided with a deterministic execution rate of 50 msec irrespective of the number of lines of logic. Automation FlexLogic™ operators include:

- Math: EXP, ACOS, ATAN2, ATAN, ASIN, FLOOR, CEIL, LOG, LOG10, POW, SIN, COS, TAN, NEG, ABS, SQRT, ADD, SUB, MUL, DIV, CONSTANT
- Boolean: AND, NAND, NOR, NOT, OR, XOR

- Control: =, <, <=, >, >=, >, Latch, Positive/ Negative/Dual one shot, Timers, Counters

Deterministic Automation

A power system is a real-time system in which time and accuracy of every control should be considered critical. C90Plus operating system ensures that every action and control is scheduled properly and beforehand to guarantee that nothing is missed nor delayed. This intelligence inside the C90Plus handles both protection trip commands as well as any other logic written for execution as per its programmed timeline. No more delays or missed timelines when it comes to control because processor is ‘busy’ or otherwise.

Protection & Control

A new protection element called the small signal oscillation detection is added to the product. Modern power systems are becoming increasingly interconnected to each other for the benefits of increased reliability, reduced operation cost, improved power quality and reduced necessary spinning reserve. With the increasingly large interconnected power systems some technical challenges also URPlus revision 1.80 release notes 6 become apparent. One of these challenges is the inter-area low frequency oscillations that is a major threat to reliable operations of large-scale power systems. Inter-area oscillations not only limit the amount

Functional Block Diagram

ANSI Device Numbers & Functions

<table>
<thead>
<tr>
<th>Device Number</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Synchronism Check</td>
</tr>
<tr>
<td>27</td>
<td>Auxiliary Undervoltage</td>
</tr>
<tr>
<td>50BF</td>
<td>Breaker Failure</td>
</tr>
<tr>
<td>50DD</td>
<td>Ground Instantaneous Overcurrent</td>
</tr>
<tr>
<td>50N</td>
<td>Neutral Instantaneous Overcurrent</td>
</tr>
<tr>
<td>50P</td>
<td>Phase Instantaneous Overcurrent</td>
</tr>
<tr>
<td>50G</td>
<td>Phase Directional Overcurrent</td>
</tr>
<tr>
<td>51N</td>
<td>Neutral Overvoltage</td>
</tr>
<tr>
<td>55P</td>
<td>Phase Overvoltage</td>
</tr>
<tr>
<td>55K</td>
<td>Auxiliary Overvoltage</td>
</tr>
<tr>
<td>59_2</td>
<td>Negative Sequence Overvoltage</td>
</tr>
<tr>
<td>67N</td>
<td>Neutral Directional Overcurrent</td>
</tr>
<tr>
<td>67P</td>
<td>Phase Directional Overcurrent</td>
</tr>
<tr>
<td>67_2</td>
<td>Negative Sequence Directional Overcurrent</td>
</tr>
<tr>
<td>79</td>
<td>Automatic Recloser</td>
</tr>
<tr>
<td>81</td>
<td>Under and over frequency</td>
</tr>
</tbody>
</table>
of power transfer, but also threaten the system security and equilibrium, as they may lead to system instability and cascading outages. Therefore, it is essential to identify the characteristics of the inter-area oscillations, including oscillation frequency and damping ratio, so that proper actions can be taken based on the results. This is required to improve the system damping and maintain stability in the power system. The C90Plus can detect these inter-area oscillations and provide an alarm or even a trip signal to prevent a large-scale system disturbance.

**Overcurrent function**

The C90Plus provides multiple stages of overcurrent functions for phase, neutral and ground. Overcurrent functions include:
- Instantaneous and timed overcurrent elements for phase, neutral, ground and negative sequence protection
- Directional supervision is available for phase neutral and negative sequence elements
- Time O/C elements can individually be set to use IEEE, IEC or custom FlexCurves™

**Over and under voltage protection**

Long lines under lightly loaded conditions or no-load or sudden loss of power may experience voltages exceeding the rated per unit voltage level of the line. Use the phase overvoltage element of the C90Plus to initiate a local trip as well as a remote trip using direct transfer trip. The C90Plus also provides additional voltage functions including neutral overvoltage, negative sequence overvoltage and phase undervoltage. The phase undervoltage can be programmed as definite time or inverse time.

**Over and under frequency Protection**

The multiple stages of under- and over-frequency elements can be used to initiate load shedding or remedial actions schemes or frequency-based load restoration schemes during lack of generation in the network or due to sudden load drops. Combined with the advanced automation capabilities of the C90Plus flexible, special protection schemes, advanced load shedding and load restoration schemes can be built. The C90Plus supports the most popular industry standard protocols enabling easy, direct integration into DCS and SCADA systems including:
- IEC 61850
- DNP3
- Ethernet Global Data (EGD)
- IEC60870-5-104
- Modbus RTU, Modbus TCP/IP

**Interoperability with Embedded IEC 61850**

Use the C90Plus with integrated IEC 61850 to lower costs associated with protection, control and automation. GE Multilin’s leadership in IEC 61850 comes from thousands of installed devices and follows on many years of development and operational experience with IEC 2.0.

- Replace expensive copper wiring between devices with direct transfer of data using GOOSE messaging
- Configure systems based on IEC 61850 and also monitor and troubleshoot them in real-time with EnerVista™ Viewpoint Engineer

**Custom Programmable Logic Designer**

The C90Plus supports an advanced automation logic engine that supports Boolean operators, analog comparisons, and advanced mathematical operations.

- Integrate GE Multilin IEDs and generic IEC 61850-compliant devices seamlessly in EnerVista™ Viewpoint Monitoring

**Extreme Communication**

- High reliable communication card with automatic failover and extremely fast redundant schemes
- Inter-relay communication card to enable implementation of pilot-schemes that are based on standard communication protocols, and both “Direct” and “Tele-Protection” inputs and output elements are available

**Ease of Use and Security**

Ease-of-use and quick setups are considered throughout every application and configuration parameter requiring virtually no training for those working in the power industry. The EnerVista™ Suite is an industry-leading set of software programs that simplifies every aspect of using the C90Plus 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 C90Plus into DCS or...
SCADA monitoring systems. Convenient COMTRADE and Sequence of Events viewers are an integral part of the URPlus Setup software included with every URPlus relay, to carry out postmortem event analysis to ensure proper protection system operation.

**Security and NERC/CIP**
- Audit Trail
- Password protection and authentication
- Support for alphanumeric passwords
- Role-based access control to manage multiple personnel rights as per ANSI INCITS 359-2004

**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 of 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 you to configure and test your 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

**User Interface and HMI**
The C90Plus provides extensive local HMI capability through two dedicated display panels. One serves as a digital annunciator and the other optional HMI is for display and control functions.

**Annunciator**
Enhanced HMI and Annunciator panels on the front of the C90Plus make it one of the most powerful human machine interfaces on local units. The C90Plus provides an embedded, configurable color LCD annunciator on the front panel of the device eliminating the need for LED labels and separate annunciators in the relay panel.
- Any contact/direct/remote input or internally generated Flexlogic™ operand can be assigned to be displayed on the annunciator.
- Up to 288 targets may be assigned. The display can be configured for 12/24/48 alarms per page to a max. of 24 pages using a 16-color for better visualization and customization.

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**Power System Troubleshooting**
The C90Plus contains tools that allow for early detection of impending breaker problems and allow for maintenance to be performed before serious damage occurs.

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**Triggering a waveform on each breaker operation can identify changes in the length of time each part or mechanism in the breaker takes to perform its function.**
Bay Configurations

The C90Plus has 12 pre-configured bay single-line diagrams and corresponding controls for each of the bay equipment. Users can also program their own single line diagrams using the ANSI/IEC library symbols provided in the EnerVista set-up program.

Multiple programmable control pushbuttons, ten pushbuttons per page with multiple levels of control.

Local/Remote Control

Sequence of event records with the ability to view time difference between two events for troubleshooting and analysis.

Pre-programmed comprehensive displays for:
- Metering
- Bay Control
- Fault Reports
- Sequence of Event Reports
- Fault Records
- Device Diagnostics
- Equipment Manager
- Real Time Phasor Displays of Voltage, Current and Sequence components

User programmable single line diagram supported by ANSI/IEC symbols. Pre-programmed single line diagrams for bay monitoring and control for common bus configurations, including ring-bus, double breaker and breaker-and-half configurations.

A separate self-test message page on the annunciator panel shows clear error messages about the device health, greatly assisting in identifying, and correcting device related issues.

For easy maintenance and asset management product information such as IP addresses and serial numbers of each module are also accessible without the need to connect to the unit.

Sequence of event records with the ability to view time difference between two events for troubleshooting and analysis.

12 to 48 user configurable alarms per page eliminates the need for a separate annunciator.

HMI

Comprehensive data visualization.

Easy to read large display of metering values.

Single Bus Configuration

Front Panel USB

The front panel of the C90Plus provides a USB 2.0 host for field laptop connections for high-speed data transfer and making downloading and uploading faster than a conventional RS232 connection.
**Technical Specifications**

**APPLICATION**
- **Modelling**: single-pole and three-pole
- **Input voltage**: 50.0 to 220.0
- **Input current**: 20.0 to 60.0

**ALARMING & DETECTION**
- **Alarm levels**:
  - **Current**: 0.00 to 0.10pu in steps of 0.001
  - **Voltage**: 100.0 to 0.1pu in steps of 0.001
- **Alarm priority**:
  - **Current**: 0.00 to 0.10pu in steps of 0.001
  - **Voltage**: 100.0 to 0.1pu in steps of 0.001
- **Reset levels**:
  - **Current**: 0.10 to 0.20pu in steps of 0.001
  - **Voltage**: 0.20 to 0.60pu in steps of 0.001
- **Switching**:
  - **Delay**: 0.00 to 0.60sec in steps of 0.01
  - **Trip time**: 0.00 to 0.65sec in steps of 0.001

**BREAKER FAILURE**
- **Current threshold**:
  - **Minimum**: 50.0 to 0.1pu in steps of 0.001
  - **Maximum**: 60.0 to 0.1pu in steps of 0.001
- **Reset delay**:
  - **Minimum**: 0.00 to 0.10sec in steps of 0.01
  - **Maximum**: 0.00 to 0.65sec in steps of 0.001

**BREAKER FLASHBACK**
- **Current threshold**:
  - **Minimum**: 50.0 to 0.1pu in steps of 0.001
  - **Maximum**: 60.0 to 0.1pu in steps of 0.001
- **Reset delay**:
  - **Minimum**: 0.00 to 0.10sec in steps of 0.01
  - **Maximum**: 0.00 to 0.65sec in steps of 0.001

**CHARACTERISTICS**
- **Type**:
  - **Current**: 0.00 to 0.10pu in steps of 0.001
  - **Voltage**: 100.0 to 0.1pu in steps of 0.001
- **Range**:
  - **Current**: 0.00 to 0.04pu (twice the current cut-off level threshold)
  - **Voltage**: 0.00 to 0.04pu (twice the voltage cut-off level threshold)

**INVERSE CURVES**
- **Number**: 4 (A through D)
- **Reset points**:
  - **A**: 0.01 times the pickup
  - **B**: 0.01 times the pickup
  - **C**: 0.01 times the pickup
  - **D**: 0.01 times the pickup
- **Time delay**:
  - **A**: 0 to 65.35ms in steps of 1
  - **B**: 0 to 65.35ms in steps of 1
  - **C**: 0 to 65.35ms in steps of 1
  - **D**: 0 to 65.35ms in steps of 1

**SELECTION**
- **Elements**: 8
- **Operating signal**: any analog actual value, or two values in differential mode
- **Operating signal mode**:
  - **Level**: over, under
  - **Delta**:
    - **Hysteresis**: 0 to 50.0 in steps of 0.1
    - **Delta time**: 20 to 60ms
- **pickup**:
  - **Operation time**: 0.00 to 65.35sec in steps of 0.001
  - **Delay**: 0.00 to 65.35sec in steps of 0.001
PHASE DIRECTIONAL OVERCURRENT
Realty connection: phase A (VABC), phase B (VBC), phase C (CAB) for A/B/C phase sequence.
Quadrature voltage: phase A (VABC), phase B (VBC), phase C (CAB) for A/B/C phase sequence.
Polarizing voltage threshold: 0.005 pu.
Current sensitivity threshold: ±5%.
Characteristics angle: ±35° in steps of 1.
Trip operation: <12 ms, typically/Inverse load, forward fault.
Blocking time: >8 ms, typically/Forward load, reverse fault.

PHASE INSTANTANEOUS OVERCURRENT
Pickup level: 0.000 to 30.000 pu in steps of 0.001.
Level accuracy at 0.1 to 2.0 CT: ±5% of pickup.
Level accuracy at >2.0 CT: ±1.5% of pickup.
Overreach: <2%.
Pickup delay: 0.00 to 600.000 seconds in steps of 0.01.
Reset delay: 0.00 to 600.000 seconds in steps of 0.01.
Time accuracy for operation at 1.5 x pickup: ±3% of 4 ms (whichever is greater).

VOLTAGE
Voltage: phasor only.
Pickup level: 0.000 to 30.000 pu in steps of 0.001.
Dropout level: <89% of pickup.
Level accuracy at 0.1 to 2.0 CT: ±5% of pickup.
Level accuracy at >2.0 CT: ±15% of pickup.
Curve shapes: IEEE Moderately Inverse, IEEE Very Inverse, IEEE Extremely Inverse, IEC IBS A, IEC IBS B, IEC IBS C, IEC Short Inverse, IAC Inverse, IAC Short Inverse, IAC Extremely Inverse, IEC FlexCurves™ (programmable), definite time 0.01 second base curve.
Curve multiplier: 0.01 to 600.000 seconds in steps of 0.01.
Reset type: instantaneous/limited (per IEC).
Timing accuracy for operation at 1.03 to 20.000 x pickup: ±3.5% of 5 ms (whichever is greater).

PROTECTION VOLTAGE
Pickup level: 0.000 to 1.100 pu in steps of 0.001.
Level accuracy at 0.1% of pickup: ±100% of pickup.
Level accuracy at 10 to 200 V: ±5% of pickup.
Curve shapes: GE IA/V; IEEE Definite Time 0.01 second base curve.
Curve multiplier: 0.01 to 600.000 seconds in steps of 0.01.
Timing accuracy for operation at >2.0 CT: ±3.5% of 5 ms (whichever is greater).

PROGRAMMING
Programming: Reverse Polish Notation with graphical programming (��®).
Lines of code: 512.
Supported operations: NOT, OR, OR (0 to 16 inputs), AND (0 to 16 inputs), XOR (0 to 16 inputs), NAND (0 to 16 inputs), N NOR (0 to 16 inputs), & reset/initialize.
Inputs: any logical variable, contact, or virtual input.
Number of timers: 32.
Number of memories: 32.
Pickup delay: 0 to 60000 ms, seconds, or minutes in steps of 1.
Dropout delay: 0 to 60000 ms, seconds, or minutes in steps of 1.

PROTECTION VIRTUAL INPUTS
Input points: self-reset or latched.

PROTECTION VIRTUAL OUTPUTS
Output points: output of a protection FlexLogic™ equation in protection or output to an automation Logic equation.

REMOTE INPUTS (IEC 61850 GSEE/GOOSE)
Input points: 64.
Remote devices: 12.

DEFAULT STATE OF DEVICE
Remote double-16 points status inputs:

REMOTE OUTPUTS IEC 61850 GSEE/GOOSE
Standard output points: 32.
User output points: 32.

SENSITIVE EXTENSION POWER
Measured power: three-phase, true RMS.
Stages: Characteristic angle: 0 to 359° in steps of 1.
Minimum power: –2.200 to 2.200 pu.
Maximum power: ±0.01 pu (whichever is greater).
Pickup level: 0.00 to 600.000 seconds in steps of 0.01.
Time accuracy: ±3% or ±4 ms (whichever is greater).

SMALL SIGNAL OSCILLOSCOPE DETECTOR
Measured value: any analog value.
Elements: 2.
Inputs: 6.
Minimum pickup level: 0.02 to 10.000 pu in steps of 0.01 for alarm.
0.05 to 10.00 pu in steps of 0.01 for trip.
Pickup level: ±5% or ±0.1 pu whichever is greater.
Pickup delay: definite time, 0.000 to 600.000 seconds in steps of 0.01.
Time accuracy: ±3% or ±0.2 ms (whichever is greater).
Operate time: 1 1/4 times to 1 1/2 times, where fs is the signal frequency.

IF SLOW FAULT SUPPRESSION
Automation
Elements: 1 per source.
Monitored parameters: V1.2, V1.1, L1.
Number of blocks: 4096.
Logic type: cyclical.
Language: standard.
Variable types: Boolean, IEEE floating point.
Booleans operations: NOT, OR, OR, NAND, NOR, AND, XOR, any contact input, any direct input, any teleprotection input, any remote input, any virtual input, any automation logic operand or, add, subtract, multiply, divide, absolute value, square root, exponent, logarithm, sine, cosine, tangent, arc sine, arc cosine, arc tangent, natural logarithm, base 10 logarithm, modulo, ceiling, floor, logical, timer, comparator, absolute time.
Control operations: any contact input, direct input, teleprotection input, remote input, virtual input, automation logic operand and.
Analysis operations: any FlexAnalog™ quantity.
Virtual inputs: 128.
Virtual outputs: 255.
Remote inputs: 64.
Remote outputs: 64.
Remote devices: 12.

AUTOMATION VIRTUAL INPUTS
Input points: 128.
Programmability: self-reset or latched.

AUTOMATION VIRTUAL OUTPUTS
Output points: 255.
Programmability: output of an automation logic equation or input to an automation logic equation.

BREAKER CLOSING
Mode: single-pole, three-pole.
Control: open/close, local/SCADA.
Control seal-in: 0 to 2000 ms in steps of 1.

BREAKER FLEXLOGIC
Mode: single-pole, three-pole.
Control: open/close, local/SCADA.
Control seal-in: 0 to 2000 ms in steps of 1.

DISCONNECT CONTROLS
Mode: single-pole, three-pole.
Control: open/close, local/SCADA.
Control seal-in: 0 to 2000 ms in steps of 1.

DISCONNECT INTERLOCKING
Interlocking points: 6.

FAST CIRCUIT BREAKER DELAY
Elements: 1.
Algorithm: adaptive (using priorities) or static (using trip mask).
Static mode: scenarios up to 12.
Adaptive mode: priorities up to 128.
Total of infed, loads, or aggregators monitored per C90Plus: up to 64 via communications plus 6 local infeds or loads.
Infeeds: up to 32.
Loads per end device: up to 6 per GOOSE data message.
Load per C90Plus: up to 70 to 64 from end device, plus up to 6 from local contact input/output cards.
Load groups: up to 32.
Operate time: 1/8 power system cycle exclusive of communications and end device delays.
Power measurement updating: 250 ms.

RECOVERY RATE OF CHANGE LOAD SHEDDING
Elements: Minimum voltage: 0.10 to 1.25 pu in steps of 0.01.
Pickup level: 0.10 to 150.0 Hz/s in steps of 0.001.
Dropout level: 0.00 to 99.999 seconds in steps of 0.001.
Level accuracy: ±3% or ±0.1 pu whichever is greater.
Time accuracy: ±3% or ±0.1 ms (whichever is greater).
95% settling time for d/dt: +24 cycles.
Operate time: 6 cycles at +2 x pickup; 5 cycles at 3 x pickup; 4 cycles at 5 x pickup.

HIGH FREQUENCY CLOSING
Elements: Minimum voltage: 0.00 to 1.25 pu in steps of 0.01.
Minimum voltage pickup: 0.00 to 150.0 Hz/s in steps of 0.001.
Maximum negative-sequence voltage pickup: 0.00 to 150.0 Hz/s in steps of 0.001.
Maximum negative-sequence voltage dropout: 0.00 to 150.0 Hz/s in steps of 0.001.
SELECTION SWITCH
Upper position: 1 to 7 steps in 1.
Selection mode: step-up and time-out.
Time-out timer: 3.0 to 60.0 seconds in steps of 0.1.
Power-up mode: restore from non-volatile memory or synchronize to a three-bit control input/output or synchronize/restore mode.

SYNCH CHECK
Parameters: Elements: 2.
Maximum voltage difference: 0 to 10000 volts in steps of 1.
Maximum angle difference: 0 to 100° in steps of 1.
Maximum frequency difference: ±0.2 Hz in steps of 0.01.
Maximum frequency difference: ±0.01Hz in steps of 0.01.
Hysteresis for maximum frequency difference: ±0.01 Hz in steps of 0.01.
Dead source: none, LV1 & DV2, LV2 & DV1, or DV2 & DV1 or DV1 & DV2 (L = live, 0 = dead).

REFERENCES & LINKS
Elements: 18.
Pickup level: 45.00 to 65.00 Hz in steps of 0.01.
Dropout level: 45.00 to 65.00 Hz in steps of 0.01.
Dropout level: 0 to 99.999 seconds in steps of 0.01.
Dropout level: 0 to 99.999 seconds in steps of 0.01.
Level accuracy: ±3% or ±4 ms (whichever is greater).
Time accuracy: ±3% or ±4 ms (whichever is greater).
Change: ±0.5 Hz/s change.

**Equipment Manager**

**BATTERY MONITOR**
- Principle: monitors battery voltage and auxiliary alarms
- Hysteresis: 5%
- Timing accuracy: 1 cycle

**BREAKER ARCING CURRENT**
- Elements: 1 per breaker (to a maximum of 3)
- Principle: measures fault magnitude and duration
- Auxiliary contact compensation: 0 to 50000 kA2-cycle in steps of 1
- Fault duration accuracy: 0.25 of power cycle

**Metering**

**CURRENT METERING**
- Type: phase and ground RMS current
- Accuracy at 0.1 to 2.0 CT: ±0.25% of reading or ±0.1% of rated (whichever is greater)
- 50/60 Hz nominal frequency
- Accuracy at >2.0 CT: ±1.0% of reading, at 50/60 Hz nominal frequency

**FLASHER METER**
- Channels: 1 to 16
- Parameters: any FlexAnalog value
- Statistics: maximum and minimum of maximum, minimum and time of minimum, average
- Alarms: high, high-high, low, low-low

**ENERGY METERING**
- Type: positive and negative watt-hours and var-hours
- Accuracy: ±0.2% of reading
- Range: ±2.0 to 199.9 ± 100 MNW ± MVarh
- Parameters: three-phase only
- Update rate: 50 ms

**PROTECTIVE METERING**
- Accuracy at V x I = 0.001 Hz when voltage signal is used for frequency measurement
- Accuracy at I = ±0.25% of current signal
- Accuracy at I > 0.25 pu (50/60 Hz)
- Accuracy at 0.25 pu (50/60 Hz)
- Accuracy at 0.25 pu (50/60 Hz)
- Accuracy at 0.25 pu (50/60 Hz)

**IDEAL MEASUREMENTS**
- Output format: per IEC 61850-9-1
- Channels: 14 synchrophasors, 8 analogs, 16 digitals
- TVE (Total vector error): as indicated in appropriate specifications sections
- Triggering: frequency, voltage, current, power, rate of change of frequency, user-defined
- Reporting rate: 1, 2, 5, 10, 12, 15, 20, 25, 30, 50, or 60 times per second
- Number of clients: One over TCP/IP port, two over UDP/IP ports
- AC ranges: as indicated in appropriate specifications sections
- Network reporting format: 16-bit integer or 32-bit IEE floating point numbers
- Network reporting style: rectangular real and imaginary or polar (magnitude and angle) coordinates
- Post-filtering: none, 3-point, 5-point, 7-point
- Calibration: as indicated in appropriate specifications sections

**POWER METERING**
- Real power accuracy: ±0.1% of reading at -1.0 PF to 0.8 and 0.8 to 0.0 PF
- Reactive power accuracy: ±0.1% of reading at -0.2 PF to ±0.2 PF
- Apparent power accuracy: ±0.1% of reading

**VOLTAGE METERING**
- Accuracy: ±0.5% of reading from 30 to 208 volts at 50/60 Hz nominal frequency

**Digital fault recorder**

**DISTURBANCE RECORDER**
- Storage capacity: one record with all available channels at 30 samples per second for 40 seconds
- Maximum records: 1
- Sampling rate: 10 samples per cycle
- Analog channels: 64
- Analogue channels: any FlexAnalog™ quantity
- Digital channels: 32
- Digital channel data: any contact input, direct input, remote input, virtual input, automation logic operand, or FlexLog™ operand
- Triggers: any digital change of state (user-programmable), undervoltage, overvoltage, undervoltage, overcurrent, underfrequency, overfrequency, rate of change of frequency, 1 user-programmable trigger, 1 lock
- Storage modes:
  - Triggering modes: automatic overwrite, protected time window from rising edge of trigger, continuous recording as long as trigger is active
  - Pre-trigger window: 0 to 100% of non-volatile memory

**FAULT RECORDER**
- Storage capacity: 8192 events
- Time tag:
  - Pre-trigger: 1 to 3 ms
  - Post-trigger: 0 to 100% of non-volatile memory
- Data storage:
  - Fault records:
    - Records: 5
    - Data: station and circuit ID, date and time of trip, fault type, active setting group at time of trigger, pre-fault current and voltage phasors (2 cycles before 500 provides associated with fault report source), fault current and voltage phasors (1 cycle after trigger), protection elements operated at time of trigger, firmware revision user-selected operand, non-volatile memory
  - Fault reports:
    - Method: single-ended
    - Accuracy: ±2% of line length
    - Units: miles or kilometers
    - Trigger: from fault report
    - Data storage: non-volatile memory

**FAST LOAD SHED REPORT**
- Records:
  - Data: FLSC relay name, firmware revision, contingency date/time and duration, steady-state power flows, infleets lost, scenarios encountered, load groups shed, shedding last change date
- Triggers:
  - Fault reports:
    - Data storage: non-volatile memory
  - Fault reports:
    - Data storage: non-volatile memory

**TRANSPARENT RECORDER**
- Storage capacity: one record with all available channels at 32 samples per second for 1 minute
- Number of records: 1 to 64
- Sampling rate: 16 to 256 samples per power cycle
- Analog channels: up to 16-bit, unprocessed, 16 input channels
- Analogue channels: any FlexAnalog™ quantity
- Digital channels:
  - Data:
    - Digital channel data: up to 128
    - Sampled channel data: any contact input, direct input, remote input, virtual input, automation logic operand, or FlexLog™ operand
  - Sampling rate: up to 4
  - Triggering modes: any digital channel change of state, undervoltage, overvoltage, undervoltage, overcurrent, underfrequency, overfrequency, rate of change of frequency, 1 user-programmable, one block
  - Storage modes:
    - Triggering modes: automatic overwrite, protected time window from rising edge of trigger, continuous recording as long as trigger is active
    - Pre-trigger window: 0 to 100% of non-volatile memory

**Front panel interface**

**ANNUNCIATION**
- Inputs:
  - 288
- Pages:
  - 12 to 48
- Sequence:
  - Manual reset, locking
- Flashing indication:
  - Alarm active and not acknowledged, alarm inactive and not acknowledged
- On indication:
  - Alarm active and acknowledged, alarm inactive and not reset
- Priority:
  - By active window and page number

**CONTROL DISPLAY**
- Devices: status and control of up to 8 power system devices
- Pushbuttons: 30 dedicated user-programmable pushbuttons
- Functionality:
  - Supports select-before-operate functionality

**DIGITAL FAULT RECORDER**
- Sequence of events:
  - Fault reports:
    - Displays the stored sequence of events record
  - Transient records:
    - Displays the stored sequence of transient event record
  - Disturbance records:
    - Displays the stored sequence of disturbance event record
  - Fast load shedding record:
    - Displays the stored sequence of fast load shedding event record

**COMPANY MANAGER DISPLAY**
- Battery monitoring:
  - Displays the current battery voltage and alarm status

**METEERING DISPLAY**
- Input and output:
  - Displays the current status of all input and output components

**Hardware**

**AC CURRENT**
- CT rated primary: 1 to 5000 A
- CT rated secondary: 1 A or 5 A
- Nominal frequency: 50 or 60 Hz
- Relay burden: <0.2 VA secondary
- Conversion range: 0.02 to 64 × CT rating RMS or symmetrical
- Current withstand: 20 ms at 250 A, 1 second at 100 A, resettable, continuous 3 × rated

**AC VOLTAGE**
- VT rated secondary: 50.0 to 240.0 V
- VT ratio: 1.0 to 2400:0.0
- Nominal frequency: 50 or 60 Hz
- Relay burden: <0.25 VA at 120 V
- Conversion range: 1 to 275 V
- Voltage withstand: continuous at 260 V to neutral, 1 minute per hour at 420 V neutral

**CONTACT INPUTS**
- Input rating:
  - Selectable: 300 V DC maximum
- Voltage thresholds: 240 to 250 V
- Maximum current: 10 mA during turn-on, 0.5 mA steady-state
- Recognition time:
  - ≤0.1 ms
- Debounce time:
  - ≤0.5 to 16.00 ms in steps of 0.25 ms
- Contact material:
  - Silver alloy
CONTACT OUTPUTS: FORM-A RELAY
Make and carry for: 30 A as per ANSI C37.90
Continuous carry: 6.00 AM
Break at L/R of: 0.250 A at 125 V DC, 0.125 A at 250 V DC
Operate time: <100 μs
Contact material: silver alloy
CONTINUOUS RELAY FAILURE
Make and carry for: 30 A as per ANSI C37.90
Carry continuous: 6.00 AM
Break at L/R of: 10 A at 250 V DC
Operate time: <100 μs
Contact material: silver alloy
CONTINUOUS POWER OUTPUT
Capacity: 100 mA DC at 48 V DC
Isolation: 2 kV
COMMUNICATIONS
DIRECT INPUTS
Input points: 96 per channel
Remote devices: 16
Default states on loss of communications: On, Off, Latest/On, Latest/Off
Ring configuration: yes, no
Data rate: 64 or 128 kbps
CRC: 32-bit
CRC alarm: responding to rate of messages failing the CRC
CRC alarm monitoring message count: 1 to 1000 in steps of 1
Unreturned messages alarm monitoring message count: 1 to 1000 in steps of 1
REMOTE INPUTS IEC 61850-5-3 GE/SSE/GOOSE
Input points: 64
Remote devices: 32
Default states on loss of communications: On, Off, Latest/On, Latest/Off
Remote double- or point status inputs: 16
REMOTE OUTPUTS IEC 61850-5-3 GE/SSE/GOOSE
Standard output points: 12A
User output points: 32
TELEGRAPHY
Input points: 16 per channel
Remote devices: 3
Default states on loss of communications: Off, On, Latest/On, Latest/Off
Ring configuration: No
Data rate: 64 or 128 kbps
CRC: 32-bit
Inter-relay communications
TYPICAL DISTANCE
RS422 interface: 1200 m (based on transmitter power; does not take into consideration the clock source provided by the user)
G.703 interface: 2.0 km (ISO/125 μm cable with ST connector, 2.9 km (62.5/125 μm cable with ST connector)
NOTE: The typical distances shown are based on the assumptions for system loss shown below. As actual losses vary from one installation to another, field distance covered by your system may vary.
LINK LOSSES (850 NM LASER, MULTIMODE MODULE)
ST connector losses: 2 dB (total of both ends)
50/125 μm fiber loss: 2.5 dB/km
62.5/125 μm fiber loss: 3.0 dB/km
Splice loss: one splice every 2 km, at 0.05 dB loss per splice
System margin: 3 dB of additional loss was added to calculations to compensate for all other losses, including age and temperature
LINK POWER BUDGET (850 NM LASER, MULTIMODE MODULE)
Maximum optical input power: -9 dBm
Minimum transmit power: -22 dBm (into 50 μm fiber), -18 dBm (into 62.5 μm fiber)
Maximum receiver sensitivity: -32 dBm
Power budget: 10 dBm (for 50 μm fiber), 14 dBm (for 62.5 μm fiber)
NOTE: These power budgets are calculated from the manufacturer’s worst-case transmitter power and worst-case receiver sensitivity.
Tests
PRODUCTION TESTS
Thermal: products go through a 12 hour burn-in process at 60°C
TYPE TESTS
Vibration: IEC 60701-4-6 / IEC60701-4-6, class 3 (10 m RMS)
Shock: IEC 60701-4-5 and IEC 60701-4-5, 1250 g force lasting up to 2 ms; 10 ms at 1 g
Humidity: IEC 60068-2-3 and IEC 60068-2-3, 10% RH to 95% RH, 50°C
Electrostatic discharge: IEC 61000-4-2 and IEC 61000-4-2, class 4, 1.5 kV (ISO/IEC 8015 1.5 kV, 2.5 kV, 4 kV)
Damped magnetic immunity: IEC 61000-4-4 (level 5, ISO 1000A/m)
Impulse voltage withstand: EN/IEC60255-5 (5 kV)
Humidity cyclic: IEC 60068-2-30, 6 days 55°C, 95%RH (variant 1)
Environmental
OPERATING TEMPERATURE
Cold: IEC 60068-2-1, 16 hours at -40°C
Dry heat: IEC 60068-2-2, 16 hours at 80°C
OTHER ENVIRONMENTAL SPECIFICATIONS
Altitude: Installation category: IIA IP rating: IP30 for front, IP10 for back
Approvals and certification
UL609 17th edition and C22.2 No 14-05. UL Listed for the USA and Canada
CE LVD 2006/95/EC
CE EMC 89/336/EEC
www.GEDigitalEnergy.com
## Ordering

<table>
<thead>
<tr>
<th>Base Unit</th>
<th>C90P</th>
<th>E</th>
<th>H</th>
<th>X</th>
<th>Description</th>
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<td>Base Unit</td>
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<td>P</td>
<td>D</td>
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<td>E</td>
<td>L</td>
<td>C</td>
<td>Basic Protection &amp; Protection FlexLogic™</td>
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<td>02</td>
<td>03</td>
<td>04</td>
<td>Modbus TCP/IP, DNP 3.0 TCP/IP, IEC 61850, &amp; IEC 60870-5-104</td>
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<td>Fault Recorder &amp; Sequence of Events</td>
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### Accessories for the C90Plus

- **Multilink Ethernet Switch**: ML2400-F-HI-HI-A2-A2-A6-G1
- **Viewpoint Engineer**: VPE-1
- **Viewpoint Maintenance**: VPM-1
- **Viewpoint Monitoring IEC61850**: VP-1-61850

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