**Guideform Specifications**

**GE F650 Feeder Protection Relay and Bay Controller**

Protection, monitoring and metering shall be supplied in one integrated digital relay package for applications suitable for incorporation into an integrated station control system.

F650 Feeder and Bay Controller unit provides protection, control, monitoring, metering, and register functionality for a substation bay. A minimum parts count ensures maximum field reliability. A redundant power supply is optionally available for each unit. Unit architecture is modular, allowing flexible analog and digital I/O by the addition of single card modules. Extended I/O capability will be available through distributed I/O modules using fiber optic CAN bus.

The relay shall be equipped with the following protection monitoring, control, automation, and reporting functions. If supporting functions are not available within the relay suitable external devices shall be provided to meet the specification requirements.

## Protection

* The relay can execute protection related algorithms up to 10 times per power system cycle.
* The Relay provides the following current based protection functions:
  + Phase/neutral/ground/isolated ground instantaneous overcurrent (50P/N/G/IG)
  + Sensitive ground instantaneous overcurrent (50SG)
  + Phase/neutral/ground time overcurrent (51P/N/G)
  + Sensitive ground time overcurrent (51SG)
  + Negative sequence instantaneous overcurrent (50\_2)
  + Negative sequence Timed overcurrent (51\_2)
  + Phase/neutral directional overcurrent (67P/N)
  + Sensitive Ground directional overcurrent (67SG)
  + Sensitive ground directional overcurrent (67SG)
  + Negative sequence directional overcurrent (67\_2)
  + Restricted Ground Fault (87REF)
  + Breaker Failure (50BF)
  + Thermal Model (49)
  + Cold Load Pickup (CLP)
* The phase over current can be selected to operate either on RMS or Fundamental value.
* The Relay provides the following voltage based functions:
  + Phase Over and Under Voltage (59P, 27P)
  + Auxiliary Over and Under Voltage (59x, 27x)
  + Neutral Over Voltage (59N)
  + Negative Sequence Over Voltage (59\_2)
  + Directional Power (32)
  + Forward Power (32FP)
  + Wattmetric ground fault (32G)
  + Voltage restrained phase time overcurrent (51V)
* The Relay provides the following control functions:
  + 4 Shot Auto Reclose (79)
  + VT Fuse failure (VTFF)
  + Over/Under Frequency (81O/81U)
  + Rate of change of Frequency (81df/dt )
  + Synchrocheck (25)
  + Breaker Failure (50BF)
  + Locked Rotor (48)
  + Maximum number of starts (66)
  + Load Encroachment
* Up to 24 user configurable commands with programmable operate, interlocks, fail and success conditions and operation timers.
* Configurable one line diagram for the substation bay.
* The relay has 3 switchable setting groups for dynamic reconfiguration of the protection elements due to changed conditions such as system configuration changes, or seasonal requirements.

## Programmable LOGIC

* Relay supports user defined logic to build control schemes supporting logic gates, timers, nonvolatile latches.
* The programmable logic in the relay is executed up to 10 times per power system cycle.
* The Relay configuration tool has an embedded graphical user interface to build programmable logic.

## Communications/Integration

* The Relay supports the following communication protocols; Modbus RTU, Modbus TCP/IP, IEC 61850 GOOSE, IEC 61850 Ed 2, DNP 3.0, IEC 60870-5-104, IEC 60870-5-103 and PROCOME.
* The 61850 settings can be configured by any third party system configuration tools.
* The Relay supports up to five IEC61850 concurrent client connections.
* The Relay supports multiple time synchronization sources such as IRIG-B, IEEE 1588 and SNTP with the ability to configure priority for the time sources and dynamically switch based on availability of each sources.
* The Relay supports networks for IEC62439/PRP (Parallel Redundancy Protocol) and HSR (High-availability Seamless Redundancy)
* The Relay has an option for RSTP (Rapid Spanning Tree Protocol - IEEE 802.1 d)
* The Relay provides two fiber optic or cable Ethernet ports with the following modes of operation: independent mode, LLA (Link Loss) operation, PRP, HSR, RSTP and Daisy Chain.
* A front panel USB port that provides connectivity to configure settings.
* The Relay provides a User Definable Memory Map that allows reading 256 non-consecutive data records (settings and statuses).

## Front-Panel Visualization

* The front panel includes user-programmable LEDs and pushbuttons and navigation keys.
* Local alphanumeric 4 lines x 20 characters LCD as the basic option.
* Optional graphical LCD (128x240 pixels or 16 lines x 40 characters) for bay information that includes user programmable screens for:
  + One line diagram displaying
  + Switchgear operation
  + Access to metering information
  + Alarm panel display
  + I/O status display.
  + Relay settings

## METERING & DIGITAL FAULT RECORDING

* The current metering accuracy is +/-0.5% of the reading +/-10 mA from 0.05 to 10 A (for phases and ground) and +/-1.5% of the reading +/-1 mA from 0.005 to 5 A (for sensitive ground).

±1.5% of the reading for higher values

* The voltage metering accuracy is +/-1% of reading from 10 to 208 V.
* The frequency metering accuracy is +/- 30 mill Hertz.
* The Relay features Breaker Health Monitoring including Breaker close and breaker open times, Trip/Close circuit monitoring.
* The Relay provides up to 16 digital channels and 9 analog channels of oscillography with programmable sampling rate (maximum of 64 samples per cycle) and depth.
* The Relay provides Event Recording - with a record of the last 479 events, time tagged with a resolution of 1ms.
* The Relay stores all its recorded data in nonvolatile memory.
* The Relay provides a separate data logger function which can record a maximum of 16 Analog channels with a settable sampling rate of 1 s, 5 min., 10 min., 15 min., 20 min., 30 min. or 1 hour.
* The Relay provides a Fault Location feature with programmable trigger. The fault locator provides the fault type (three-phase, phase-to-phase, phase-to-ground), the distance to the fault and the fault resistance.
* Pulse counting for energy metering also available

## Hardware

* The relay has optional conformal coated electronic board assemblies for harsh environment deployment.
* The Relay has a draw-out construction to facilitate testing, maintenance and interchange flexibility
* The power supply module is field upgradable.
* The Relay Operating temperature range is –10° to + 60°C.
* The Relay supports up to 16 Digital Outputs.
* The Relay can provide up to 64 Digital Inputs.
* The Digital Inputs accept DC input signals. Threshold is software selectable from 10V to 230V.

## Service and Support

* Warranty: The device includes a ten-year for all material and workmanship defects.