***Guideform Specifications***

***GE Multilin 859 Motor Protection Relay***

# Motor Protection Relay

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

The Digital Relay shall have a common Hardware and Firmware platform that shall support Feeder, Motor, Transformer and Generator applications. The relay shall be equipped with a single multi-core processor for protection and for communication related functions. 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 and Control

### The built-in motor Thermal model (49) shall include the following.

#### Homogenous solution for both stator and rotor thermal stress monitoring

#### Motor thermal limit curves - NEMA® standard, voltage dependent and customized motor curves

#### IEC 60255-8 thermal overload curves

#### Current unbalance biasing

#### Independent running and stopped exponential cooling curves

#### Optional RTD biasing of the thermal model to adapt to real-time temperature measurements

#### Compensation for hot/cold motor condition

#### Two speed motor thermal protection

#### Smoothing filter for cyclic loads

### The relay shall provide the following functions for motor start-up and control.

#### Autorestart

#### Undervoltage Restart

#### Reduced voltage starts

#### Residual voltage-based Backspin Detection and start Inhibit

#### Timer based Backspin Start Inhibit

#### Single Shot Restart

#### Thermal inhibit

#### Maximum starting rate

#### Time between starts and Number of starts

#### Lockout (86)

#### Lock rotor stall protection

#### Acceleration time

### The relay shall provide the following current based protection functions.

#### Short circuit protection

#### Ground fault protection

#### Undercurrent (37)

#### Mechanical jam

#### Current unbalance (46)

#### Phase/Neutral/Ground Instantaneous Overcurrent (50P/N/G)

#### Phase/Neutral/Ground Time Overcurrent (51P/N/G)

#### Negative Sequence Instantaneous Overcurrent (50\_2)

#### Phase/Neutral Directional Overcurrent (67P/N)

#### Breaker Failure (50BF)

### The phase time overcurrent can be selected to operate either on RMS or Fundamental value.

### The relay shall provide the following voltage-based functions.

#### Phase reversal protection

#### Phase Overvoltage and Phase Undervoltage (59P, 27P)

#### Auxiliary Overvoltage (59x)

#### Neutral Overvoltage (59N)

#### Negative Sequence Overvoltage (59\_2)

#### Directional Power (32)

#### Overfrequency/Underfrequency (81O/81U)

#### Voltage restrained phase time overcurrent (51V) with adjustable voltage lower limit

#### Underpower (37P)

### The relay shall support Volts/Hertz (V/Hz) with voltage mode options:

#### Phase-Ground

#### Phase-Phase

### The V/Hz shall support Definite Time, Inverse A, Inverse B, Inverse C, Flex Curve A, Flex Curve B, Flex Curve C and Flex Curve D.

### The relay shall have 4 Programmable Flexcurves with graphical manipulation of the individual points.

### The relay shall be capable of detecting Loss of Excitation (40)

### The relay shall be capable of detecting Reactive Power (40Q)

### The relay shall be capable of detecting Out of Step

### The relay shall provide support for up to 12 RTD inputs for temperature-based protection, an ability to detect open and shorted RTDs, and configurable voting using 2 or 3 RTDs. In addition, the relay shall support 100 Ohm Nickel, 120 Ohm Nickel, 100 Ohm Platinum or 10 Ohm Copper RTDs.

### The relay shall be capable of being configured for a Breaker or Contactor controlled scheme.

### The relay shall provide protection for motors driven by variable frequency drives and provide frequency tracking for the range of 3 to 72 Hz. In addition, the relay shall be capable of automatically switching between voltage-based or current-based frequency tracking.

### The relay shall be capable of setting lead/lag Power Factor (55) for the monitoring and protection of synchronous motors.

### The relay shall have ability to build trip and alarm matrices and directly assign a corresponding output relay without using programmable logic

### The relay shall have configurable options to select any protection elements to be used as a trip, alarm or latched alarm function without using programmable logic.

### The relay shall have 6 switchable setting groups for dynamic reconfiguration of the protection elements based on user-defined conditions.

### The relay shall support 8 Flex elements that can use any available/calculated analog parameters within the relay (e.g. comparator, inverter, over/under, etc.)

### The relay shall support up to 16 Digital Counters.

### It should be possible to test the Binary Inputs, Outputs and protection functions without the need for an external test kit.

### The relay shall be capable of measuring the motor speed

## Programmable Logic

### Relays shall support 1024 lines of user defined logic to build control schemes supporting logic gates, timers, and non-volatile latches.

### The programmable logic in the relay shall be executed at 8 times per power system cycle.

### The relay configuration tool shall have embedded graphical user interface to build programmable logic.

### The relay shall provide up to 96 Virtual Outputs + 64 Virtual Inputs.

### The relays shall support Logic designer and Logic Monitor – i.e. graphical logic editing tool and online monitoring of logic states in a graphical way.

## Communications/Integration

### The relay shall support the following communication protocols: Modbus RTU, Modbus TCP/IP, IEC 61850 GOOSE, IEC 61850 edition 2 MMS, DNP 3.0, IEC 60870-5-104, IEC 60870-5-103, and OPC-UA.

### The relay shall have the ability to configure both protection and IEC 61850 related settings directly from a single setting (IEC 61850-6 based XML format) file. There shall be direct uploading of single IEC 61850-6 based XML file into the relay. There shall be no further proprietary file format conversion required. All setting managements through a single IEC 61850-6 based file shall be supported.

### The relay shall support up to eight IEC61850 concurrent client connections.

### The relay shall support GOOSE Analog reception and transmission.

### The relay shall support up to 128 Virtual Outputs and Virtual Inputs over GOOSE

### The relay shall support file transfer protocol TFTP and file transfer through 61850.

### The relay shall support multiple time synchronization sources such as IEEE 1588 and SNTP (2), with the ability to configure priority for the time sources and dynamically switch based on availability of each source.

### The relays shall provide two copper Ethernet ports with two modes of operation – Fail over mode or Independent mode.

### The relays shall support networks for IEC62439/PRP (Parallel Redundancy Protocol).

### A front panel USB port shall provide connectivity to configure settings and retrieve operational records.

### The relay shall provide a User Definable Memory Map.

### The relay shall support Modbus connectivity to slave devices to gather data.

## Relay Configuration/Setting File Management

### Setting the entire relay from only a single setting file shall be supported.

### Entire relay settings (not only communication related but also protection and control functional settings) shall be part of the same single setting file.

### The relay shall be configured through the IEC 61850-6 standard based on the Configured IED Description (CID in XML) format file only.

### There shall be only a single relay setting (i.e. CID based XML format) file which can be directly uploaded into the device. This means there is no intermediate conversion of any proprietary setting file formats which requires managing multiple settings files for just one relay.

### The relay shall be able to receive single configuration/setting files from any third-party tool (not only from a vendor specific proprietary relay configuration tool).

## Front-Panel Visualization

### The user interfaces shall provide a large color LCD front panel display and navigation keys.

### The front panel shall have color LCDs to display up to 6 configurable Single Line Diagrams (SLD), 12 control objects, 15 status & 15 metering objects with a provision to control the breaker, online metering and status information.

### The front panel shall be capable of displaying measured values, calculated values, I/O status, device status, target messages, events, motor learned data, and configured relay settings.

### The front panel shall have support for breaker and switch control through the single line diagram and pushbuttons with Select-Before-Operate mechanism.

### The front panel shall have user-programmable LEDs and pushbuttons.

### The relay shall provide up to 36 configurable annunciation indicators like an annunciator panel to monitor and reset alarms through the front panel.

### The relay shall provide configurable 20 soft pushbuttons that are controlled from the front panel of the relay.

### The relay shall provide 10 programmable home pages.

## Monitoring & Diagnostics

### The relay shall provide a Motor Health Report retrievable via the communication ports that provides a snapshot of the motor operating and diagnostic information. The Report shall include information pertaining to Device, Status, Trip Summary, Motor Operating History, Motor Starting Learned Data, Motor Start Records, and Motor Stopping/Tripping. In addition, the relay shall provide a minimum of six motor start records with a sampling rate of 100 ms and a record length of 60 seconds.

### The relay shall provide advanced motor diagnostics for detection of Broken Rotor bar faults based on coherent demodulation utilizing voltage and current.

### The relay shall provide advanced motor diagnostics for detection of Stator turn to turn faults.

### The relay shall provide advanced motor diagnostics for detection of Roller bearing faults

### The relay shall provide advanced motor diagnostics for detection of Mechanical faults related to Foundation Looseness, Eccentricity & Misalignment.

### The relay shall provide Breaker Health Monitoring features including: Breaker close and breaker open times, Trip/Close circuit monitoring, Spring charging time, Per-phase arcing current, and Trip counters.

### The relay shall provide information on the power factor of the protected device (55).

### The relay shall provide up to 64 digital channels and up to 16 analog channels of oscillography at a sampling rate of 128 samples per cycle.

### The relay shall provide configurable Event Records - with a record of the last 1024 events, time tagged with a resolution of 1mS.

### The relay shall store all its recorded data in non-volatile memory.

### The relay shall provide a separate data logger function which shall record a maximum of 16 Analog channels with a settable sampling rate of 1 cycle, 1 second, 30 seconds, 1 minute, 15 minutes, 30 minutes or 1 hour including a trigger source of sample, min, max, mean.

### The current metering accuracy shall be

### at ≤ 2 × CT: +/- 0.5% of 2 × CT for 50/60 Hz nominal freq.

### +/- 1.0% of 2 × CT for variable frequency (for sinusoidal waveforms)

### at > 2 × CT: +/- 1.0% of 20 × CT for 50/60 Hz nominal freq.

### +/- 3.0% of 12 × CT or less for variable frequency (for sinusoidal waveforms).

### The voltage metering accuracy shall be +/- 2.5% of full scale for ≤ 200 V at 20 to 39 Hz,

### ±1% of full scale for 12 to 240 V at > 40 Hz.

## Hardware

### The protection relay shall provide analog input systems that can reproduce up to 40 times CT rating RMS symmetrical. The relay shall execute protection related main algorithms at 8 times per power system cycle.

### The relay shall have conformal coated electronic board assemblies for harsh environment deployment.

### Microprocessor based protective relays shall employ IPC (Institute for Interconnecting and Packaging Electronic Circuits) Class 3 printed circuit boards (PCB) i.e. IPC Class 610-3.

### The relay shall have a scan rate of 128 samples per power system cycle for digital inputs and provide less than 1 millisecond time stamp resolution for state changes.

### The relay shall provide an Operating temperature range of -40° to +60°C and be tested per IEC 60068 for 16-hour operation between -40° and +85°C.

### The relay shall provide 1A / 5A / CBCT 50:0.025 ground input

### The relay shall support at a minimum 4 Digital Outputs and 6 Digital Inputs.

### The relay contacts should be rated for a minimum of 10A continuous.

### The relay shall support 4 dcmA outputs

### The relay shall support 4 dcmA inputs

### The relay shall provide support for up to 12 RTD inputs for temperature-based protection, an ability to detect open and shorted RTDs, and configurable voting using 2 or 3 RTDs. In addition, the relay shall support 100 Ohm Nickel, 120 Ohm Nickel, 100 Ohm Platinum or 10 Ohm Copper RTDs.

## Security

### The relay shall provide an option for RBAC (Role based access control) with three roles such as Observer for accessing operational data, Operator for start-stop of the motor, and Administrator for configuring the relay.

### The relay shall provide an option for password complexity.

### The relay shall provide an option for local device level authentication and for remote server authentication using RADIUS.

### The relay shall provide optional support for SYSLOG to publish security related events.

### The relay shall support secure file transfer protocol (SFTP).

### Security Setting Reports must include the following events with time stamp.

#### Failed Authentication

#### User lock out

#### Setting changes

#### Login

#### Logout

#### RADIUS server unreachable

#### Clear Event/Transient/Fault records

### The relay shall provide SSH tunneling connection.

## Service and Support

### Warranty: The relay shall include a ten-year warranty for all material and workmanship defects.