Guide form Specifications

GE Multilin 845 Transformer Protection Relay

# Transformer Protection Relay

Protection, monitoring and metering shall be supplied in one integrated digital relay package for application to power transformers 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 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 protection relay shall provide protection for 2 or 3 winding transformers.

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

#### Dual slope, dual breakpoint Transformer differential protection (87T) which includes:

##### Inrush inhibit options: 2nd harmonic “Per Phase”, “Average”, “2-out-of-3”, “1-out-of-3”

##### Overexcitation inhibit: 5th harmonic

##### External fault security algorithm

###### Current directional check for improved security during external faults with severe CT saturation

###### CT saturation detection

#### Instantaneous Phase Differential

#### Transformer Overload

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

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

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

#### Negative Sequence Time Overcurrent (51\_2)

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

#### Restricted Ground Fault (87REF/RGF)

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

#### Auxiliary Overvoltage and Auxiliary Undervoltage (59X, 27X)

#### Neutral Overvoltage (59N)

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

#### Directional Power (32)

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

#### Frequency Rate of Change (81 ROC)

#### Synchrocheck (25)

### 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 provide the following control functions.

#### 4 Shot Auto Reclose (79)

#### VT Fuse failure (VTFF)

#### CT Supervision

#### Breaker Failure

#### Pole Discordance (52)

#### Manual Close Blocking

#### Firmware configured Main-Tie-Main Bus Transfer logic

#### Undervoltage Restoration (Reactive Power)

#### Undervoltage Restoration

#### Underfrequency Restoration

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

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

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

### The relay shall have a frequency tracking function.

### The maximum magnitude compensation factor should be at least 20.

### The relay shall support detection of On-Load Tap Changer status ~~input~~ based on Ohms, mA or BCD inputs.

### The relay shall have the option to support Tap Changer on either winding. The relay shall be able to automatically compensate the percent differential protection, due to transformation ratio change caused by Tap Changer

### The relay shall have the ability to compensate phase angles and zero sequence.

### The relay shall be able to detect the status of the protected transformer based on the following:

#### Breaker Status

#### Voltage

#### Current supervision

### The relay shall have 6 switchable setting groups for dynamic reconfiguration of the protection elements due to 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 provide temperature or other parameter monitoring (using dcmA Analog Input).

## Programmable Logic

### The relays shall support 1024 lines of user defined logic to build control schemes supporting logic gates, timers, nonvolatile latches.

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

### The relay configuration tool shall have an 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 Ed 2 MMS, HSR, DNP 3.0, IEC 60870-5-104, IEC 60870-5-103, OPC-UA

### The relay shall have the ability to configure both protection and IEC61850 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 IRIG-B, IEEE 1588 and SNTP(2) with the ability to configure priority for the time sources Relays shall provide two fiber optic Ethernet ports with two modes of operation – fail over mode or independent mode.

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

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

### The relay shall have an option for Wi-Fi (IEEE 802.11 b/g/n) connectivity to configure settings and retrieve operational records.

### The 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 IEC 61850-6 standard based Configured IED Description (CID in XML) format file only.

### There shall be only one single relay setting (i.e. CID based XML format) file which can be directly uploaded into the device. No intermediate conversion is allowed for any proprietary setting file formats which require managing multiple settings files for just one relay.

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

## Front-Panel Visualization

### The user interface 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, 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 the following reports related to Dissolved Gas Analysis (DGA) by polling data from DGA devices.

#### Dissolved Gas Analysis

#### Learned Data Records

#### Energization Records

#### Digital Fault Records

#### Transformer Models

#### DGA Models

#### Historical Maximum record

#### Transformer Health report

#### DGA Historical Trend

### Monitoring, Metering and Digital Fault Recording: The relay shall provide the following functions for transformer monitoring.

#### Winding Hot Spot

#### Aging Acceleration Factor

#### Transformer Loss of Life

#### Harmonic Derating

#### Tap Changer Failure

### 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 record its exposure to temperature, humidity and surge. In addition, a report shall be retrievable via the communication ports on the minimum/maximum average of those recorded values. The relay shall provide Environmental awareness statistics that trends temperature, humidity and surge pulses.

### 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 a fault report with an option for the fault locator.

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

### The relay shall store all its recorded data in nonvolatile 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 +/- 0.25% of the reading for up to 2 times rated secondary current and at +/- 1% for above.

### The voltage metering accuracy shall be at +/- 0.5% of the reading from 15 to 208V.

### The power metering accuracy shall be at +/- 1% of the reading.

### The frequency metering accuracy shall be typically at 1 millihertz accuracy level.

## Hardware

### The protection relay shall provide analog input systems that can reproduce up to 46 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 draw-out construction to facilitate testing, maintenance and interchange flexibility.

### The relay shall provide a field swappable (i.e. removable) power supply module.

### 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°C to + 60°C and tested to per IEC60068 for 16-hour operation between -40°C and +85°C.

### The relay shall support at a minimum 15 Digital Outputs and 21 Digital Inputs.

### The relay shall provide inbuilt Trip Coil and Close Coil supervision.

### The Digital Inputs should be capable of accepting wet or dry input signals. In case the external wetting voltage is used, the Voltage Threshold shall be software selectable for 24V, 48V, 125V and 250V DC sources.

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

### The relay shall support 7 dcmA output + 4 dcmA input + 1 RTD.

### The relay shall provide support for up to 12 RTDs.

### The relay shall have integrated arc flash protection with support for up to 4 Arc flash sensors.

## 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 executing control commands 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 Lockout

#### 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.