825-P Modular Protection System for motors

Specification Guide

1.0 General

1.01 The motor protection relay shall have a current operating range of 0.5 and 5000 amperes.
1.02 The motor protection relay shall provide current measurement-based protection functions with optional voltage measurement-based and temperature measurement-based functions.
1.03 Current measurement shall be performed by a separate three-phase current converter module that provides electrical isolation between the primary measurement circuit and the motor protection relay.
1.04 The three-phase current converter modules shall be capable of direct connection and mounting to contactors in low voltage applications.
1.05 In medium and high voltage applications the converter module shall be wired in series with secondary windings from primary current transformers with a secondary current rating of 1 or 5 amperes.
1.06 A dedicated Trip relay with Form C contacts shall be provided for use in the motor starter control circuit.
1.07 A minimum of two auxiliary relay outputs with Form A contacts shall be provided that are assignable in function.
1.08 All relay contacts shall be rated B300.
1.09 All relays shall be programmable for Failsafe or Non-failsafe operation.
1.10 The motor protection relay shall provide a minimum of two digital inputs that are configurable for function.
1.11 Terminal connections and monitoring circuitry for connection of a zero sequence (core balance) current transformer for ground fault detection shall be included in the standard design of the motor protection relay.
1.12 A fiber optic port shall be provided for optional connection to an RTD temperature monitoring scanner module.
1.13 The motor protection relay shall provide, as standard, terminations and monitoring circuitry for connection of motor winding embedded positive temperature coefficient (PTC) thermistor sensors.
1.14 The motor protection relay shall have a wide power supply operating range of 85 to 264V AC, 50/60 Hz or 85 to 275V DC.
1.15 The front panel operator interface shall consist of a two-line, sixteen character backlit LCD with ▲, ▼, ◄, ► navigation keys.
1.16 A Test/Reset button shall be provided on the front panel of the motor protection relay for the dual purpose of testing relay trip operation or resetting a trip.
1.17 LED indicators shall provide status indication that the motor protection relay is enabled and whether a trip or warning event is active.
1.18 Trip and warning events shall identify cause on the LCD.
1.19 The motor protection relay shall be equipped with an EIA-232 serial communications port at the front panel with a female DB9 connector. This port shall facilitate relay monitoring, programming and flash memory upgrades.
1.20 There shall be three levels of access to relay information and settings. Two of the three will require a user specified password to gain access.

Publication 825-TD001A-EN-P, May 2003

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1.21 The relay shall continue to provide a high level of motor protection in the event of saturation of primary current transformers when used.
1.22 Accessory option cards shall include
- Three-phase voltage input card
- I/O expansion card
- Network communications card

1.23 The three-phase voltage input card shall provide terminations for V_A, V_B, V_C and V_N.
1.24 The three-phase voltage input card shall be rated to 300V AC.
1.25 The three-phase voltage input card shall accept input from potential transformers in wye, delta or open delta configurations.
1.26 The optional I/O expansion input card shall provide three additional configurable inputs, four B300 rated relay outputs with Form A contacts, and one configurable 4-20mA isolated analog output.
1.27 The RTD scanner module shall be equipped with 12 RTD input channels.
1.28 The RTD scanner module shall be compatible with the commonly used types, with each channel individually settable for use with 10 ohm copper, 100 ohm nickel, 120 ohm nickel or 100 ohm platinum.
1.29 The RTD scanner module shall mount separately from the motor protection relay to allow installation in near proximity to the motor to minimize wiring.
1.30 The RTD scanner module shall interface with the motor protection relay through a fiber optic connection for minimized noise interference.
1.31 The RTD module shall be connected to a 120/240V AC, 50/60Hz supply.

2.0 Construction

2.01 The motor protection relay shall be modular in construction such that the protection and functionality provided can be configurable/expandable through the addition of field installable and pluggable accessory option cards or modules.
2.02 The dimensions of the motor protection relay shall not exceed 144mm (5.67 in.) height x 192mm (7.56 in.) width x 146.3mm (5.76 in.) mounted depth regardless of the number of option cards installed.
2.03 The motor protection relay shall be rated for Type 12 (IP65) when installed in an appropriate enclosure.
2.04 Wiring terminals shall provide IP20 finger protection.
2.05 Wiring terminal connectors shall be pluggable.
2.06 Terminal markings shall comply with CENELEC and EN 50012.
2.07 The motor protection relay and accessories shall be rated for an operating environment of -20 to +60°C (-4 to +140°F).
2.08 The motor protection relay shall be capable of operating in an environment with a relative humidity range of 0 to 95%, non-condensing.
2.09 The motor protection relay shall be able to withstand a shock of 30G (per IEC 68-2-27).
2.10 The motor protection relay shall be able to operate without disruption for vibration levels up to 3G (per IEC 68-2-6).
2.11 The motor protection relay shall be able to operate without de-rating to an elevation of 2000m.
2.12 The motor protection relay shall be rated for application in Pollution Degree 3 environments.

3.0 Protection Functions

The motor protection relay shall incorporate the following protection function capabilities:

Current Elements

3.01 Thermal overload (49/51)
- The thermal overload computational algorithm shall employ a three-body model that gives individual consideration to the rotor and stator as well as threshold.
- FLA (*Ie*) setting range of 0.5 to 5000A
- Service factor setting range of 1.01 to 1.50
- Locked rotor current setting range of 250 to 1200% *Ie*
- Locked rotor time setting range of 1.0 to 600.0 seconds
- Reset mode adjustable for manual or automatic reset
- Reset level setting range of 10 to 99% TCU
- Warning level setting range of 50 to 99% TCU
- Thermal start inhibit setting range of 1 to 99 % TCU
- Customization settings for cooling time and running state time constants
- Enable setting for RTD biasing of thermal model
- Adjustment settings for second speed ratings

3.02 Current Imbalance / phase loss (46)
- Trip setting range of 5 to 80%
- Trip delay setting range of 0 to 240 seconds
- Warning setting range of 5 to 80%
- Warning delay setting of 0 to 240 seconds

3.03 Ground fault – residual method (50G)
- Trip setting range of 10 to 100% *Ie*
- Trip delay setting range of 0.00 to 5.00 seconds
- Warning setting range of 10 to 100% *Ie*
- Warning delay setting of 0.0 to 120.0 seconds

3.04 Ground fault – zero sequence method (50N)
- Trip setting range of 0.01 to 25.0A
- Trip delay setting range of 0.00 to 5.00 seconds
- Warning setting range of 0.01 to 25.0A
- Warning delay setting of 0.0 to 120.0 seconds

3.05 Undercurrent – load loss (37)
- Trip setting range of 10 to 100% *Ie*
- Trip delay setting range of 0.0 to 120.0 seconds
- Warning setting range of 10 to 100% *Ie*
- Warning delay setting of 0.0 to 120.0 seconds

3.06 Overcurrent – load jam (48)
- Trip setting range of 100 to 600% *Ie*
- Trip delay setting range of 0.0 to 120.0 seconds

- Warning setting range of 100 to 600% *Ie*
- Warning delay setting of 0.0 to 120.0 seconds

3.07 Short circuit (50P)
- Trip setting range of 400 to 1200% *Ie*
- Trip delay setting range of 0.00 to 5.00 seconds
- Warning setting range of 400 to 1200% *Ie*
- Warning delay setting of 0.00 to 5.00 seconds

3.08 Phase Reversal (47) – current based
- Setting to enable/disable function
- A trip shall occur 0.5 second after three-phase current is sensed and phase rotation determined

3.09 Under/overfrequency (81) – current based
- Trip setting range of 45 to 55 or 55 to 65 Hz
- Trip delay setting range of 0 to 240 seconds
- Warning setting range of 45 to 55 or 55 to 65 Hz
- Warning delay setting of 0 to 240 seconds

Voltage Elements

3.10 Undervoltage (27)
- Trip setting range of 60 to 100% *Vnom*
- Trip delay setting range of 0.0 to 120.0 seconds
- Warning setting range of 60 to 100% *Vnom*
- Warning delay setting of 0.0 to 120.0 seconds

3.11 Overvoltage (59)
- Trip setting range of 100 to 120% *Vnom*
- Trip delay setting range of 0.0 to 120.0 seconds
- Warning setting range of 100 to 120% *Vnom*
- Warning delay setting of 0.0 to 120.0 seconds

3.12 Phase Reversal (47) – voltage based
- Setting to enable/disable function
- A trip shall occur 0.5 second after application of three-phase voltage and phase rotation determined

3.13 Under/overfrequency (81) – voltage based
- Settings shall be the same as the current based elements

Power Elements

3.14 Underpower (37)
- Trip setting range of 1 to 25,000 kW
- Trip delay setting range of 0 to 240 seconds
- Warning setting range of 1 to 25,000 kW
- Warning delay setting of 0 to 240 second

3.15 Power Factor (55)
- Lead and lag trip setting ranges of 0.05 to 0.99
- Trip delay setting range of 0 to 240 seconds
- Lead and lag warning setting ranges of 0.05 to 0.99
- Warning delay setting of 0 to 240 seconds

3.16 Reactive Power
- Negative and positive trip setting ranges of 1 to 25,000 kVAR
- Trip delay setting range of 0 to 240 seconds
- Negative and positive warning setting ranges of 1 to 25,000 kVAR
- Warning delay setting of 0 to 240 seconds

Temperature Elements

3.17 PTC Thermistor (49)
- Reset mode adjustable for manual or automatic reset

3.18 Stator (49), Bearing (38), Ambient and Other RTD (1 - 12)
- Each channel shall be individually settable for location (winding, bearing, ambient or other)
- Each channel shall be individually settable for type (CU10, NI100, NI120, PT100)
- Trip setting range of 0 to 250° C
- Warning setting range of 0 to 250° C
- Winding and bearing trip voting
- Enable setting for RTD temperature biasing

Motor Starting Elements

3.19 Start Inhibit – starts/hour (66)
- Setting range of 1 to 15 starts/hour
- Setting range for minimum time between starts of 1 to 150 minutes

3.20 Emergency Start
- The motor protection relay shall have provisions to perform an emergency override of a thermal trip through contact closure to an assigned input.

3.21 Acceleration time monitoring
- Setting range of 1 to 240 seconds

3.22 Speed switch monitoring (14)
- Setting range of 1 to 240 seconds

3.23 Anti-backspin timer
- Setting range of 1 to 60 minutes

3.24 Reduced Voltage Starting (19)
- Implemented by the use of the two standard programmable timers

3.25 Two speed or reversing motor control
- Implemented by the use of the two standard programmable timers

Other Elements

3.26 Remote Trip

- The motor protection relay shall have provisions for tripping from an external device (e.g. vibration switch) through contact closure to an assigned input.

4.0 Metering Functions

The motor protection relay shall offer the following metering functions:

4.01 Individual phase currents in amperes (± 2% accuracy)
4.02 Average current in amperes (± 2% accuracy)
4.03 Average motor load as a percentage of the motor full load ampere rating (± 2% accuracy)
4.04 Percent current imbalance or asymmetry (± 2% accuracy)
4.05 Residual ground fault current in amperes (± 2% accuracy)
4.06 Zero sequence (core balance) ground fault current in amperes (± 2% accuracy)
4.07 Phase-to-phase voltage measurements (± 2% accuracy)
4.08 Three-phase average phase-to-phase voltage measurements (± 2% accuracy)
4.09 Phase-to-neutral voltage measurements (± 2% accuracy)
4.10 Three-phase average phase-to-neutral voltage measurements (± 2% accuracy)
4.11 Percent voltage imbalance or asymmetry (± 2% accuracy)
4.12 Real three-phase power expressed in kW (± 5% accuracy)
4.13 Reactive three-phase power expressed in kVAR (± 5% accuracy)
4.14 Apparent three-phase power expressed in kVA (± 5% accuracy)
4.15 Power factor (± 2% accuracy)
4.16 Frequency (± 0.1 Hz of reading)
4.17 Individual RTD temperature measurements in °C (± 2°C accuracy)
4.18 The default display mode shall automatically scroll through the instantaneous current and voltage metered values in addition to the following user selections: ground current, current imbalance, frequency, percent thermal capacity used, voltage imbalance, power, RTD temperature.

5.0 Control Functions

5.01 The motor protection relay shall have provisions to reset a trip through contact closure to an assigned input.
5.02 The motor protection relay shall incorporate control capability for star (wye)-delta motor applications. The motor protection relay shall switch the contactor arrangement on the basis of the motor operating current falling below 110% of motor rated current on acceleration to full speed. A setting shall be provided that allows for programming of a maximum star contactor configuration time.
5.03 The motor protection relay shall provide two on-delay and two off-delay timers for control purposes. The timers shall have an adjustable range of 0 to 240 seconds.

5.04 The motor protection relay shall allow for disabling of user-selected protection functions by contact closure to a digital input.
5.05 The isolated analog output signal shall be selectable for output of one of the following: maximum phase current, average current, percent load, percent thermal capacity utilized, maximum winding temperature, maximum bearing temperature, kW power, or power factor.
5.06 Load control settings shall allow control of the motor protection relay auxiliary relays on the basis of motor operating current, percent thermal capacity used or kW power.

6.0 Communications

6.01 Network communications shall be accomplished through installation of a single communications option card into an expansion slot in the motor protection relay. Communication options shall include:
- Modbus
- DeviceNet.

6.02 The DeviceNet communications card must support DeviceLogix component technology.

7.0 Statistical Data

The motor protection relay shall provide the following statistical values related to motor operation.

7.01 Percent thermal capacity utilized (%TCU)
7.02 Time to trip
7.03 Time to start
7.04 Elapsed time of operation
7.05 Running time
7.06 Stopped time
7.07 Percent time running
7.08 Number of start cycles
7.09 Number of emergency start operations
7.10 Number of starts available
7.11 Time and date of last reset action

8.0 Diagnostic Historical Data

The motor protection relay shall store diagnostic data related to the 14 most recent trip events. The data provided shall include:

8.01 Time and date of event
8.02 Trip identification
8.03 Phase current magnitude and angle values at time of trip
8.04 Ground fault current magnitude and angle values at time of trip
8.05 Phase voltage magnitude and angle values at time of trip

9.0 Standards

The motor protection relay shall be designed for compliance to the following standards:

9.01 EN 60947-4-1

Publication 825-TD001A-EN-P, May 2003

9.02 EN 60947-5-1
9.03 UL508
9.04 UL1053
9.05 CSA C22.2 No. 14

10.0 Manufacturers

Approved manufacturers for motor protection relays include:

10.01 Allen-Bradley 825-P Modular Protection System

Publication 825-TD001A-EN-P, May 2003

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