

FORM 4C MICROPROCESSOR-BASED RECLOSER CONTROL TECHNICAL SPECIFICATIONS

INTRODUCTION:

This specification describes the features of the Kyle Form 4C electronic control which shall provide the intelligence to supervise an attached recloser. The control shall be operable with all present Kyle electronically controlled reclosers now utilizing the Form 3, Form 3A, Form 4 and Form 4A controls.

STANDARDS

The reclosers covered by this specification has been designed and tested in accordance with the following standards as applicable:

ANSI/IEEE C37.60-1981. American National Standards Requirements for Overhead, Padmounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for Alternating Current Systems.

C37.61-1973 ANSI 321-1973 IEEE. IEEE Guideline for the Application, Operation and Maintenance of Automatic Circuit Reclosers.

C37.90.1978 ANSI/IEEE. American National Standard Guide for Surge Withstand Capability (SWC) Tests.

IEC-68-2-30. International Electromechanical Commission Standard for Basic Environmental Testing Procedures - Damp Heat, Steady State.

C37.90.2 ANSI. IEEE-Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference.

KYLE SPEC 574. Surge Withstand Capability Testing of Electronic Controls.

FEATURES

The control shall be cable-connected to the recloser and can be located remotely from the recloser. The control shall be housed in a weatherproof cabinet with a door that can be padlocked. The door shall use a three point latching system connected to the cabinet.

The operating temperature range of the control shall be 40°C to +65°C, ambient.

Primary energy for control operation shall be supplied from an external 50 Hertz or 60 Hertz 120 Vac or 240 Vac (two-wire or three-wire) source, provided by the user. A sealed, lead-acid battery shall be provided for backup control operation in event of loss of the primary supply. The battery shall be capable of operating the control for a minimum of 48 hours after loss of the primary supply. After this time, if the primary supply has not been restored the control shall shut down automatically. There shall be local indication and contacts for remote alarm to indicate loss of operating power.

The control shall include a battery test panel which includes switches and a meter display used for checking the condition of the control's 24 Vdc lead acid battery and the battery charging circuit. The test panel shall also include battery test terminals for external battery testing.

A manual control switch shall be located on the front panel of the control to allow manual trip and lockout and manual close of the recloser. This feature shall also allow "cold load" pickup.

Toggle switches shall be provided on the front panel of the control to control the status of the following features:

- ◇ Ground Trip Normal/Block feature
- ◇ Normal/Non-Reclose feature
- ◇ Supervisory On/Off feature
- ◇ Normal/Alternate Minimum Trip feature

The control shall have LCD indicators located on the front panel to provide local indication of the following conditions:

- ◇ Recloser Open
- ◇ Recloser Closed
- ◇ Control Lockout
- ◇ Current Above Minimum Trip
- ◇ Ground Trip Blocked
- ◇ Non-Reclosing Active
- ◇ Malfunction (to indicate the following):
 - Failure to close from a remote signal
 - Low battery voltage
 - Power down in less than programmed time
 - Failure to close from the manual switch
 - Internal diagnostics alarm
- ◇ Accessory Operation
- ◇ Check Battery
- ◇ AC Supply

Control programming and interrogation shall be accomplished by means of a keyboard with 24 keys, with no external devices required.

The control software shall have three customer-programmable security code level, to limit access to control programming to different levels of authorized personnel. The security code shall be a four digit number. The security levels shall be interrogated and changed from security level 3.

The control shall have a total of at least 41 separate time-current curves available for customer selection. Each TCC shall be available for phase trip or ground fault trip timing, for either the first or second timing functions.

The control shall have the ability to permit modification, via the keyboard, of any of the time-current curves using the following modifications:

TCC Multiplier: Shifts the TCC up or down in time by a selected multiplier. The multiplier can be selected from 0.10 to 2.0 times the selected TCC, in multiplier increments of 0.01.

Constant Time Adder: Adds a constant time value to the selected TCC. The time adder can be selected from 0.01 to 0.20 seconds, in increments of 0.01 seconds.

Minimum Response Time: Provides fixed minimum response time, from 1 to 42 cycles (60Hz base) in increments of 1 cycle.

The control shall have a Sequence Coordination feature which allows a source-side recloser to step through its "fast" curve without tripping. The sequence coordination feature provides complete trip coordination with a downline recloser.

The control shall be equipped with a Recloser Interrupting Duty Monitor. The Duty Monitor will measure, calculate, store and display the interrupting duty on each phase of the attached recloser. Per Appendix B of ANSI C37.61-1973, the recloser duty shall be calculated on the basis of number of interruptions $\times 1^{1.5}$.

The control shall include the following operational data that can be displayed on the control keyboard liquid crystal display:

- ◇ Phase and ground fault target indication and counters
- ◇ Recloser operations counter
- ◇ Sequence position feature that indicates the position of the control during the trip operations
- ◇ All protection settings
- ◇ Event Recorder
- ◇ Duty Cycle Monitor

The control shall include a Close-Retry feature to interrupt the closing signal to the recloser when closing power is lost. The close signal will be issued at a programmed interval until closing power is restored. The duration of time the feature is active can be programmed via the keyboard.

The control shall include a High Current Trip feature to provide tripping of the recloser with a choice of time delays (1 through 9 cycles) for both phase and ground when fault currents are above a multiple (2 to 30 multiplier in increments of 1) of the minimum trip. The active shot number (1,2,3, or 4) for the lockout shall be programmable.

The control shall include a Sensitive Ground Fault Trip feature that will provide tripping of the recloser after a programmable, definite time for ground (zero sequence) currents below normal ground minimum trip currents. The feature will have its own operations to lockout counter and will be available in both normal ground minimum trip and alternate ground minimum trip settings.

The control shall include a Load Profile Monitor which records and displays the RMS current value for each phase and ground at 15 minute intervals for data stored for the most recent 24 hour period.

The control shall be equipped with an Event Recorder feature which shall record and store the 50 most recent events in non-volatile memory. The event recorder shall include information on the time and date of the event occurrence, the event type and the circuit currents on all three phases and ground (this includes the fault current for an overcurrent trip event). The events recorded shall include the following:

- ◇ Overcurrent trip
- ◇ Reset
- ◇ Close by manual control switch
- ◇ Close by supervisory control
- ◇ Lockout by manual control switch
- ◇ Lockout by remote signal
- ◇ Lockout by supervisory signal
- ◇ Supervisory trip
- ◇ Loss of ac voltage
- ◇ Restoration of ac voltage
- ◇ Sequence coordination operation
- ◇ Close-Retry Lockout
- ◇ Sensitive Ground/Earth Fault Trip

The control shall have an Ampere Demand Metering Feature, which measures and displays the following current values for three phases and ground current:

- ◇ Instantaneous phase currents
- ◇ Integrated phase current values, with a programmable integration interval of 5 or 15 minutes
- ◇ Peak integrated demand values
- ◇ Ground unbalance values (instantaneous, integrated and peak demand)

The demand metering integration interval shall be programmable at the control to be 1 or 5 minutes.

The control shall be capable of supervisory operation and interrogation via a momentary or a maintained signal mode, which shall be programmable by the user. The following standard and optional remote and supervisory operations shall be operated with 12Vdc to 125Vdc or 120Vac to 240Vac supply voltage.

Standard Features:

- ◇ Remote Trip and Lockout
- ◇ Supervisory Trip and Lockout
- ◇ Supervisory Close
- ◇ Control Malfunction Indicator
- ◇ Control Power Status Indicator
- ◇ Recloser Status Indicator (OPEN-CLOSED)
- ◇ Supervisory Switch Status Indicator

Optional Features:

- ◇ Supervisory Trip
- ◇ Supervisory Non-Reclosing
- ◇ Supervisory Ground Trip Block
- ◇ Supervisory Alternate Minimum Trip
- ◇ Control Lockout Status Indicator
- ◇ Non-Reclose Function Status Indicator
- ◇ Ground Trip Block Function Status Indicator
- ◇ Remote Fault Target Indicator
- ◇ Alternate Minimum Trip Status Indicator
- ◇ Customizable I/O
- ◇ Load Tap Change Disable Indicator

The control shall include the capability to communicate digitally with the following devices and communication systems:

Temporary Connection

A 9-pin Data Port, located on the control front panel, shall provide the capability for temporary connection with a Data Reader or personal computer.

A Data Reader (hand-held) can be used for data acquisition from the control. The Data Reader is also compatible with the Cooper Power Systems CL-4C Regulator Control and Meter-Pac controls.

A personal computer (PC) can be connected to the control temporarily via the front panel Data Port and used for data acquisition from the control and also for sending new settings to the control.

Permanent Connection

A digital Communications accessory board shall be available to provide the capability for full-time digital communications, SCADA, or data acquisition. Connections from the digital communications board can be made to either to an RTU or a modem via a fiber optic cable supplied by the user.

Communications Software

A public domain communications protocol shall be provided, with the necessary error bit and error message checking to ensure secure and reliable communications.

A software program that runs on an IBM PC (or compatible computer) shall be provided for use with a direct communication link with the control. This can be accomplished via either a personal computer connected to the Data Port, or through a modem to the digital communications accessory board.

Testing

The control shall be capable of being tested by a portable test set, capable of testing all control functions with or without connections to a recloser. The test set shall be the same as used for testing Form 3, Form 3A, Form 4, and Form 4A controls.

The control shall have ability to accomplish the following functions, including local, supervisory I/O and digital communications for each function. Local indication and verification shall be included with each function:

Live-Line (Hot Line Tag) Application:

A live-line application shall disable and interrupt the close circuit. The recloser shall trip on TCC1, with no reclosing operation permitted.

The live-line application shall be activated by a momentary or maintained SCADA command, a serial command, or locally via a front panel switch.

The live-line application shall provide local indication and contacts for remote indication when the control is placed into the Hot Line Tag mode from wither the front panel or supervisory control.

The Hot Line Tag accessory shall be activated by a customer-supplied voltage signal and shall be active as long as the customer-supplied voltage is present.

Switch Mode functionality

In the Switch Mode, the Form 4C recloser control shall become a switch control providing indication of overcurrent conditions without issuing an overcurrent trip signal.

The Switch Mode accessory shall be a non-tripping, fault indication state initiated from the front panel as well as serial or discrete SCADA.

Switch Mode shall be activated remotely by a customer-supplied voltage signal and shall be active as long as customer-supplied voltage is present.

Momentary Elimination (Trip on TCC2) function

A momentary elimination accessory shall minimize the amount of momentary outages on a distribution system by allowing an immediate change in the configuration as necessary. All trip operations shall occur on TCC2 timing curve. The number of operations shall be based on the number of trip operations programmed on TCC2. Local indication shall be included on the front panel.

The momentary elimination function shall not take precedence over the live-line (Hot Line Tag) application.

Trip On TCC2 shall be activated remotely by a customer-supplied voltage signal and shall be active as long as customer-supplied voltage is present.

Sensitive Ground/Earth Fault Disable

Sensitive Ground/Earth Fault Disable shall provide the capability to separate the activation of sensitive ground/earth fault from normal ground/earth sensing.

Sensitive Ground/Earth Fault Disable shall be activated remotely by a customer-supplied voltage signal and shall be active as long as customer-supplied voltage is present.

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